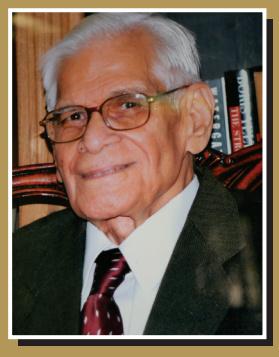
प्रगति प्रतिवेदन
Progress Report

Volume 3: Agronomy, Soil Science & Plant Physiology



Padma Shri Dr SVS Shastri
(1928 - 2019)
"Father of AICRIP"

अखिल भारतीय समन्वित चावल सुधार परियोजना
All India Co-ordinated Rice Improvement Project

2018





भाकृअनुप
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Volume 3

CROP PRODUCTION

AGRONOMY, SOIL SCIENCE

and

PLANT PHYSIOLOGY

ALL INDIA CO-ORDINATED RICE IMPROVEMENT PROGRAMME (AICRIP)

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PREFACE

The Indian Institute of Rice Research - IIRR (formerly Directorate of Rice Research – DRR) through All India Coordinated Rice Improvement Project (AICRIP) coordinates multi-disciplinary and multi-location evaluation of improved cultures, crop management practices, protection technologies and their popularization through FLD's (frontline demonstrations) across diverse ecosystem to identify situation specific technologies for enhancing and stabilizing rice production in the country for the past five decades. As the nodal agency, IIRR has been facilitating joint planning and exchange of experimental material and preparing reports. Over 500 scientists from 44 funded AICRIP centres and about 100 voluntary centres representing various State Agricultural Universities, State Departments of Agriculture, private companies and ICAR Institutions participate in this collective effort.

This volume contains the results of AICRP experiments conducted by agronomists, Soil scientists and Physiologists at different locations during *rabi* 2017-18 and *kharif* 2018 for understanding the response of rice crop to management practices, resource conservation and climatic variations for developing efficient crop and resource management technologies that maximize the productivity and ensure high profitability to double the farmers income on sustainable basis. Agronomists conducted 210 experiments at 44 locations consisting of evaluation of promising cultivars were (36 cultures) belonging to 12 groups *viz.,* early hill (irrigated), medium hill (irrigated), early (DS), medium, late, medium slender, rainfed shallow low land, alkaline, inland saline, coastal saline, aerobic and biofortified trials in transplanted situation, for their response to integrated nutrient management at 50,100 and 150% Recommended dose of fertilizer(RDF). In addition, seven trials on cultural management, two trials on weed management, two trials on rice based cropping systems and five collaborative trials (Soil science, Entomology, Plant pathology and Plant Breeding) were also conducted to develop cost effective technologies in different rice and rice based cropping systems.

The Coordinated Program of Soil Science consists of 7 experiments conducted at 17 locations (total 36 trials) during *rabi* 2017-18 and *kharif* 2018 covered issues related to sustaining productivity of soil and crop systems based on long term fertilizer trials, soil quality and productivity assessment for bridging the gap in farmers' fields, germplasm screening and nutrient management in sodic and acid soils, validation of Computer based nutrient management trial, Nutrient expert in farmers' fields and collaborative trials with Agronomy and Entomology in nutrient management and bio-intensive pest management under organic farming.

In this year 2018, Plant Physiologists conducted 6 trials at 14 locations on influence on silicon solubilisers on stress tolerance at 11 locations, high temperature tolerance at 7 locations and multiple abiotic stress tolerance at 9 locations low light stress at 7 locations, Radiation and Nitrogen use efficiency at 9 locations and rain-fed upland screening trial at 5 locations. The total number of entries tested under different trials was 113.

I congratulate and compliment the Cooperating Scientists, technical staff and Principal Investigators of the program in the Crop Production Section for their excellent effort in conducting the trials, monitoring, data collection and compilation, analysis and in preparation of this voluminous report.

02/04/19

(S.R. VOLETI)
Director

AGRONOMY

4. AGRONOMY

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4. AGRONOMY

SUMMARY

This volume contains the results of AICRP experiments conducted by Agronomists, Soil scientists and Physiologists at different locations during *rabi* 2017-18 and *kharif* 2018 for understanding the response of rice crop to management practices, resource conservation and climatic variations for developing efficient crop and resource management technologies that maximize the productivity and ensure high profitability to double the farmers income on sustainable basis. Agronomists conducted 210 experiments at 44 locations consisting of evaluation of promising cultivars (36 cultures) belonging to 12 groups *viz.*, early hill (irrigated), medium hill (irrigated), early (DS), medium, late, medium slender, rainfed shallow low land, alkaline, inland saline, coastal saline, aerobic and biofortified trials in transplanted situation, for their response to integrated nutrient management at 50,100 and 150% Recommended dose of fertilizer(RDF). In addition, seven trials on cultural management, two trials each on weed management, and rice based cropping systems and five collaborative trials (Soil science, Entomology, Plant pathology and Plant Breeding) were also conducted to develop cost effective technologies in rice and rice based cropping systems.

4.1. NUTRIENT MANAGEMENT TRAILS (NMT)

Development of high yielding and improved varieties and hybrids is one of the major components of rice production technology. In rice growing regions, nutrient management is most important yield limiting factor for enhancing production. Adaptation of cultivars with high Nutrient use efficiency in two different planting situations (wet and dry) is a potential strategy in optimizing nutrient requirement, lowering cost of cultivation and reducing environmental pollution. Optimization of nutrient use not only enhances grain yield through better nutrient use efficiency but also reduces the cost of cultivation. In order to find out the production potential of promising cultivars and their response to varying levels of nutrients and to identify the optimum dose, and the effect on late planted rice situations, Nutrient management trials (NMTs) were constituted and conducted during kharif 2018. A total of 36 AVT-2 entries belonging to 12 categories were evaluated at various locations under different levels of nutrients, i.e., 100 and 150 % of recommended dose of nutrients along with standard and local cultivars.

Nutrient response trials on selected AVT-2 rice cultures under high and low input management

4.1(a) NMT EH (Irrigated)

Five cultivars (IET 25819, Shalimar Rice 3, Vivekdhan 86, VL Dhan 86 and local check) were evaluated at four locations **(Almora, Khudwani, Malan and Upper Shillong)** under two different recommended doses of fertiliser (50% and 100% RFD). Application of 100% RFD recorded higher yield

at **Almora**, **Khudwani**, **Malan** and **Upper Shillong** (3.88, 5.43, 4.68 and 2.78 t/ha). Higher nutrient response was also recorded with 100% RDF application. Average yield of the locations with different varieties ranged from 3.66 to 4.07 t/ha in **Almora**, 4.02 to 5.38 t/ha in **Khudwani**, 3.69 to 4.19 t/ha in **Malan** and 1.93 to 2.74 t/ha in **Upper Shillong**. Popular variety like VL Dhan 86, Vivek Dhan-86, Shalimar rice 3& 4 were found to be promising.

4.1(b) NMT MH (Irrigated)

Different cultivars were evaluated at five locations **(Almora, Khudwani, Malan, Upper Shillong and Wangbal)** under two recommended fertilizer dose (50 and 100% RFD) under medium hill conditions. Application of 100% RFD recorded significantly higher yield at Khudwani (4.75 t/ha), recorded significantly higher yield at Khudwani (4.75 t/ha), Malan (4.49 t/ha) and **Wangbal** (3.53 t/ha). Nutrient response (kg grain / kg N) was higher at 100% RDF. IET 25830 and popular varieties like VL Dhan 65, Vivek Dhan 62, and Shalimar rice 1 were found to be promising.

4.1(c) NMT Early (Direct Seeded)

The trial conducted at five locations (**Ghagraghat, Jagdalpur, Mandya, Ranchi and Rewa** under two recommended doses of fertiliser (50% and 100% RDF) with 6 AVT-2 entries and standard, popular and local varieties. Mean over the locations, the performance of IET-25121 (3.63 t/ha) followed by IET 26353 (3.47 t/ha), Sahbhagidhan (3.20 t/ha) and Govind (3.14 t/ha) was better over other entries, popular varieties local check. The application of 100% NPK recorded higher yield was found to be promising and also exhibited higher nutrient recovery. IET-25121, IET 26356, Sahbhagidhan and Govind were found to be promising.

4.1(d) NMT IME (Transplanted)

Promising cultivars of medium duration were evaluated for their response to nutrients on grain yield at fifteen different locations viz., **Aduthurai, Chinsura, Chiplima, Dhangain, Faizabad, Gangavathi, Karjat, Kanpur, Kota, Mandya, Navsari, Nawagam, Pantnagar, Pattambi, Puducherry and Varanasi** under two different doses of fertiliser (100% and 150% RDF). In this trial, nutrient management with 150% RDF recorded 6.09% higher yield over 100% RDF and also exhibited higher nutrient recovery. Entries like IET 25746 (5.62 t/ha), IET 25764 (5.54 t/ha) and IET 26079 (5.30 t/ha) performed better and recorded recorded higher mean grain yield over the locations.

4.1(e) NMT IM (Transplanted)

AVT-2 entries (IET-26027, IET-25997 and IET-25785) of medium duration were evaluated for their response to nutrients and grain yield from ten different locations viz., **Aduthurai, Chinsurah, Chiplima, Coimbatore, Dhangain, Faizabad, Jagdalpur, Karjat, Kaul, Nagina and Titabar** under two different levels of nutrient input (100% and 150% RDF).

Application of 150% RDF recorded higher grain yields and also exhibited higher nutrient recovery at all the locations. IET 26027, IET 25997, IET 25785 were found to be promising and recorded higher mean grain yield and nutrient response. Significant interaction for grain yield was noted with application of 150% RDF with IET 25997 at Chiplima and Karjat.

4.1(f) NMT Late

AVT- 2 entry (IET 25269) was evaluated for its response to nutrients on grain yield at nine different locations i.e., **Aduthurai, Chinsura, Chiplima, Dhangain, Karjat, Mandya, Maruteru, Nagina, Pusa and Rajendranagar** under two different fertiliser levels (100% and 150% RDF). The application of 150% RDF had higher grain yields at **Karjat** (4.77 t/ha), **Nagina** (4.57 t/ha), **Pusa** (3.98 t/ha), **Maruteru** (5.99t/ha) and **Dhangain** (5.02 t/ha) and also exhibited higher nutrient recovery. IET 25269 was found to be promising in terms of grain yield at most of the locations.

4.1(g) NMT Medium Slender

Four entries (IET 26263, IET 25795, IET 25793 and IET 26241) of medium slender group were evaluated for their response to levels of nutrients on grain yield at six different locations i.e., **Chakdah, Dhangain, Karjat, Kaul, Mandya, Nagina, Raipur and Maruteru** under two levels of RDF (100% and 150% RDF) Application of 150% RDF recorded higher grain yields at **Karjat** (5.57 t/ha), **Kaul** (6.08 t/ha), **Mandya** (7.30 t/ha), **Nagina** (6.23 t/ha), Raipur (7.12 t/ha), **Maruteru** (6.25 t/ha) and **Dhangain** (7.12 t/ha). Higher nutrient response was also recorded with 150% RDF application. Average over the locations, higher mean grain yield of 6.05 t/ha was recorded with 150% RDF and was 5.6% higher than yield obtained with 100% RDF. Grain yield differences among the tested varieties were found significant at all the locations. Entries like IET 26263, IET 25795 and IET 25793 were found to be promising.

4.1(h) NMT RSL

AVT-2 entry (IET 25856) was evaluated for its response to levels nutrients on grain yield at two locations i.e. **Faizabad, Pusa** and **Dhangin** under two levels of RDF (100% and 150% RDF). In this trial, Application of 150% RDF recorded higher grain yields at **Faizabad** (3.86 t/ha) **Pusa** (3.40 t/ha) and **Dhangain** (5.93 t/ha) and also exhibited higher nutrient recovery. Application of 150% recorded 7.7%, 21.7% and 9.9% higher grain yield at **Faizabad, Pusa** and **Dhangain**, respectively over 100% RDF Significantly higher mean maximum grain yield was recorded by IET 25856 at **Faizabad** (4.22 t/ha) **Pusa** (3.25 t/ha) and **Dhangain** (6.09 t/ha)

4.1(i) NMT AL and ISTVT

Saline tolerant culture (IET 22836) was evaluated for its response to different levels of nutrients on grain yield at three different locations i.e. **Kanpur, Lucknow and Navsari** under two recommended

doses of fertiliser (100% and 150% RDF). Application of 150% RDF recorded higher grain yields at **Kanpur** (2.99 t/ha), **Lucknow** (2.53 t/ha) and **Navsari** (3.29 t/ha) and nutrient response. Application of 150% RDF with IET 22836 was found to exhibit significant interaction at **Navsari**. IET 22836 was found to be promising entry and recorded higher grain yield.

4.1(j) NMT CSTVT

Different cultures were evaluated in comparison with standard varieties at **Navsari** under two recommended level of input (100 and 150% RDF). Application of 150% RDF recorded higher yield of 4.09 t/ha but the yield increase was not significant and was comparable to followed by 100 % RDF which recorded yield of 3.58 t/ha. Nutrient response (kg grain/kg Nutrients) was higher at 150% RDF (6.83). IET 25059 (4.31 t/ha) was found to be promising over other varieties with higher nutrient response.

4.1(k) NMT Aerobic

Seven AVT-2 entries (IET 25618, IET26198, IET 26157, IET 26171, IET 26194, IET 26170 and IET 26168) were evaluated at for their response to two fertilizer levels (100% and 150% RDF on grain yield at nine locations viz. **Hazaribagh, Jagdalpur, Kaul, Kota, Ludhiana, Nawagam, Pantnagar, Raipur and Vadgaon**. Application of 150% RDF recorded higher yield at **Kota** (5.69 t/ha), **Nawagam** (2.61 t/ha) and **Vadgaon** (6.67 t/ha). 100 % RDF realised higher grain yield at **Jagdalpur** (2.50 t/ha). 150% RDF recorded higher nutrient response. IET 26198 recorded higher yield at **Hazaribagh** (2.1 t/ha), **Jagdalpur** (2.88 t/ha) and **Pantnagar** (4.48 t/ha). IET 26168 was found to be promising with higher grain yield across the locations.

4.1 (l) NMT Biofortified

Two AVT-2 entries (IET 26383 and IET-26374) were evaluated for their response to different levels of nutrients (100% and 150% RDF) on grain yield from eight different locations viz., **Coimbatore, Kaul, Maruteru**, **Pantnagar, Raipur, Rajendranagar, Rewa and Varanasi.** Application of 150% RDF recorded significantly higher grain yields at **Pantnagar** (3.03 t/ha), **Raipur** (5.72 t/ha) and **Rewa** (5.27 t/ha) with higher nutrient response. Mean over the locations, IET 26383 (5.27 t/ha) performed better and was followed by IET 26375 (4.94 t/ha) with 7.0% higher yield increase. IET 26383 and IET 26375 were found to be promising and recorded higher mean grain.

4.2.2. CULTURAL MANAGEMENT TRIALS

YIELD ENHANCING TRIALS (YET)

4.2.1. Nutrient and Weed management for higher productivity in different rice establishment methods

Rice crop suffers more from weed competition unlike other cereal crops. Weed infestation and weed competition are more in direct seeded rice as compared to transplanted rice and SRI because the land is exposed till the initial seedling establishment in direct seeded rice. Crop establishment and weed management techniques are critical in rice farming. So, present investigation to study the weed infestation and nutrient removal by weeds in different crop establishment methods of rice, their influence on productivity of rice and nutrient uptake by rice was taken up. A trial was conducted i) to identify the optimum and cost effective nutrient management practices in different crop establishment methods and ii) to assess the agronomic efficiency, plant and soil nutrient status under different nutrient management practices in different crop establishment methods. The experiment was conducted during *kharif* 2018 in split-plot design with four replications. Treatments consisting of five crop establishment methods {Mechanical Transplanting method (All the principles as per the SRI); M_2: Direct seeding (Use of Drum seeder/ dibbling of sprouted seed at 25 x25 cm) fb SRI principles (saturation method of water management,weeding with cono-weeder and fertilizer management); M_3: Normal Transplanting (20 x15 cm with flooding water management,3-4 seedlings transplanted at 25-30 days old seedlings); M_4: SRI; M_5: Aerobic rice and M_6: Semi dry rice} were assessed for their productivity performance at 17 locations (**Aduthurai, Chatha, Coimbatore, Gangavathi, Ghaghraghat, Kota, Ludhiana, Mandya, Nagina, Navasari, Pantnagar, Puducherry, Pusa, Ranchi, Rewa, Sabour and Varanasi**). Overall mean grain yield across the locations revealed that mechanical transplanting resulted in the highest grain yield (5.63 t/ha) followed by manual transplanting (5.21 t/ha) and SRI (5.06 t/ha). **Mechanical transplanting performed very well at Gangavathi, Ludhiana, Puducherry and Pusa, may be promoted among farmers**.

4.2.1(R). Evaluation of different nutrient management practices for enhancement of the productivity in different rice establishments methods

Application of 100% recommended dose of fertilizer in *rabi* rice resulted in the highest grain yield (4.5 t/ha) than of no fertilizer treated plots (2.93 t/ha). In terms of system productivity nutrient management in *kharif* and *rabi* season played a major role in enhancing the grain yield of rice. So, 150% RDF in kharif season followed by 100% RDF in rabi season found to be best combination irrespective of crop establishment methods.

4.2.2. Water management for enhancing water use efficiency and weed control efficiency in different rice establishment methods

To evaluate the suitable and promising irrigation management practices in different crop establishment methods a trial was formulated and conducted at 8 locations (**Chatha, Gangavathi, Mandya, Pantnagar, Pusa, Puducherry, ARI Rajendranagar and Varanasi**). Split plot design was adopted with 3 main plots of irrigation management {I_1: Flooding throughout crop growth (3 + / - 2 cm), I_2: Saturation maintenance upto PI and (3 + / - 2 cm) after PI and I_3: Alternate wetting and drying (irrigation at 5 -7 days interval with 5 cm/ha of water (5 cm irrigation at 3 DADPW) up to PI and (3 + / - 2 cm) after PI} and 6 subplots of crop establishment methods {T_1: Mechanical

Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice), T_2: Direct wet seeding on puddled soil (Use of Drum seeder/ dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice, T_3: Normal hand transplanting (20 x15 cm with flooding water management, 3-4 seedlings transplanted at 25-30 days old seedlings), T_4: Aerobic rice T_5: Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice and T_6: Optional- Location specific} and replicated thrice. Over all mean grain yield across all the centres revealed that alternate wetting and drying resulted the highest grain yield (5.13 t/ha) among irrigation management treatments. Similarly, among crop establishment methods mechanical transplanting resulted the highest grain yield (5.79 t/ha). Cost of cultivation under flooding was higher across all the locations varied from Rs. 33443/- at Varanasi to Rs. 45850/- at Mandya. **There was a saving of Rs 3800/- per hectare at Mandya under alternate wetting and drying over flooding. Similarly, input water also saved in the tune of 70 cm/ha**.

4.2.2(R). Evaluation of different irrigation management practices for their water saving potential and enhancement of the productivity and profitability in different rice establishments methods

At **Puducherry,** among irrigation management practices, alternate wetting and drying method (AWD) recorded the highest grain yield (6.88 t/ha). Among establishment methods the highest grain yield (6.17 t/ha) was recorded under mechanical transplanting on puddle soil. Total water input was the highest in flodding through out crop growth treated plots (1475 mm/ha), which were 100 and 200 mm higher than saturation maintenance upto PI and after PI and alternate wetting and drying treated plots, respectively. Among crop establishment methods, the lowest water input was recorded in direct broadcast of dry seeds on well prepared unpuddled soil treatments (1396 mm/ha). The cost of cultivation was same (Rs. 42213/ha) under all three irrigation management treatments.

4.2.3. Enhancing the productivity of direct seeded rice with iron coating under different rice ecologies

The field trial was initiated to study effect of Fe-coating on growth and yield parameters of rice.The trial was laid out in split plot design at 5 locations (**ICAR-IIRR,Coimbatore, Chiplima, Karjat and Raipur**) with 4 date of sowingswith one week interval as main plotsand 5establishment methods(T_1- Iron coated seed, seed rate 25 kg/ha, broadcasting in 1-2mm water level condition (Direct sowing) T_2- Iron coated seed, seed rate 25 kg/ha, broadcasting in wet Condition (Direct sowing) T_3 – Un-coated seed, seed rate 25 kg/ha, broadcasting in 1-2mm water level condition (Direct sowing) T_4 – Un-coated seed, seed rate 25 kg/ha, broadcasting in wet condition (Direct sowing) T_5 – Normal transplanting 21-25 days after sowingas subplots in 3 replications. Over all mean grain yield across all the 5 locations revealed that 1st date of sowing was the best time of sowing for all the locations resulting the highest yield of rice (4.18 t/ha) followed by 2nd(4.29 t/ha), 3rd (4.01 t/ha) and 4th (3.4 t/ha) date of sowing. Iron coated treatments

performed better than without coated treatments. Iron coated seed with seed rate of 25 kg/ha and broadcasted in 1-2 mm water level condition (direct sowing) recorded higher grain yield (4.18 t/ha) than 3.44 t/ha under uncoated seeds. **There is an increase of 11% grain yield due to iron coating of seeds**.

4.2.4. Management practices for enhancing grainyield with green manure and nutrient management in rainfed upland rice

The present investigation was taken up to study the effect of phosphorus and green manure on productivity of rice at 4 locations (**Malan, Pattambi, Pusaand Ranchi**). Experiment was laid out in factorial RBD design {M_1: Rice alone, M_2: Rice + GM (Sunhemp/Dhaincha/Green leaf manuring) and 5 subplots of phosphorus treatment (S_1: 0 kg P_2O_5/ha, S_2: 20 kg P_2O_5/ha, S_3: 40 kg P_2O_5/ha, S_4: Optional and S_5: Farmers practice. Mean grain yield of all the locations revealed that Rice + GM resulted in the highest grain yield (3.83 t/ha). Among phosphorus treatments, 40 kg P_2O_5/ha along with recommended N and K_2O recorded the highest grain yield (4.03 t/ha). **There is an increase of 19.2% and 6.9% in grain yield due to application of 40 kg P_2O_5/ha over without and 20 kg P_2O_5/ha application of phosphorus, respectively**.

4.2.5. Evaluation of promising cultivars for late planting and management for higher productivity

Evaluation of cultivars for late planting identified promising cultivars NLR 40024, Indira Aerobic-1, CR Dhan 201at **Mandya**, cultivars US 314, IET 24117, MTU 1010 and IR 64 at **Rewa** and Indira Baranni Dhan – 1 and IET 24904 at **Maruteru**. Under late planting higher dose of fertilizer (125% of RDF) and closer spacing gave significantly higher grain yield.

4.2.6.(R) Yield maximization of rice through Site Specific Nutrient Management

In clay loam acidic soils of **Puducherry** the trial was conducted at research farm. SSNM based on Nutrient Expert treatment resulted the highest grain yield (6.8 t/ha) of CGZR-1 followed by RFD treated plots (6.5 t/ha). The higher no. of panicles/m^2 (367), test weight (23 g), filled grains/panicle (352) were observed under the same treatment.

4.2.7.(R) Development of technology for enhancing the productivity of organic rice

First year of the experimentation in *kharif* season revealed that there is 11 % and 5.4% reduction in grain yield due to adoption of organic nutrient management compared to 100% RDF through inorganic sources and INM practices, respectively. Similar trend was followed in *rabi* season also. System productivity of rice-wheat and rice-cowpea systems revealed that organic fertilizer management resulted 13.9 and 11.7% less system yield compared to that of INM and 100% RDF through inorganic fertilizers.

4.2.8. Enhancing the productivity of New Plant Types under best management practices

4.2.9. Enhancement of Nitrogen Use Efficiency in irrigated rice

4.2.10. Enhancement of Phosphorous Use Efficiency in irrigated rice

As these trials are collaborative trials, for detailed information kindly refer the Volume - I Progress Report- 2018, Varietal Improvement, ICAR-Indian Institute of Rice Research.

4.3. WEED MANAGEMENT TRIAL

4.3.1 Integrated Pest Management – (Collaborative trial with Entomology and Pathology)

IPM special trial was conducted with an aim to manage pests (including insects, diseases and weeds) in a holistic way in farmers' fields involving them in a participatory way and allowing them to select IPM practices from a basket of options available. During *Kharif* 2018, the trial was conducted at 11 locations viz. **Chatha, Chinsurah, Gangavathi, Malan, Mandya, Nagina, Navsari, Puducherry, Raipur, Titabar and Vadagaon.** The data and results of weed parameters during critical period of crop weed competition and grain yields showed that across the locations, weeds, insect pests, and disease incidence was low in IPM plots. Weed population and weed biomass recorded at all the locations were considerably reduced by two to five times in IPM implemented plots compared to farmers practice, resulted in significantly higher grain yields.

4.3.2 Evaluation of Bio efficiency of Thiobencarb in wet direct sown rice:

With the objective of evaluating the bio efficiency of thiobencarb at different doses in wet direct sown rice in comparison to the promising pre and post emergence herbicides at different locations viz**., Indian Institute of Rice Research- Hyderabad, Malan, Puducherry** and **Raipur**, the experiments conducted during *kharif* 2018, revealed that, the systemic post emergence herbicide thiobencarb @ 5 l/ha applied at 20 days after sowing was found superior, resulting in higher weed control efficiency; higher grain yields; and the performance was comparable to hand weeding twice, standard post emergence herbicide bispyribacsodium @ 300 ml/ha.

4.4. RICE BASED CROPPING SYSTEMS

CONSERVATION AGRICULTURE / SYSTEM BASED MANAGEMENT (CA/SM)

4.4.1 Conversation Agriculture/system base management practices in rice and rice based cropping systems (crop diversification) to utilise the resources and enhancing the profitability and productivity

Conservation Agriculture (CA) systems are developed for the intensive rice-based cropping systems that one be evaluated in different rice-based cropping systems. In general, Rice-based cropping systems are characterised by key edaphic influence of puddling soil for transplanting which destroys the soil structure through intensive tillage and removal or burning of crop residue before sowing of next crop that limits the recycling of organic matter of soils. To

address this issue the trial on conservation agriculture system management practices in rice and rice based cropping system are conducted at 4 location viz. **Aduthurai**, **Karjat, Titabar** and **Vadgoan**. Main plot treatments comprises of three crop establishment methods (M1 – Transplanting, M2 – Wet seeding (line sowing under puddle condition) and M3: Aerobic rice – Dry rice cultivation). The sub plot treatment consists of 3 different residue/straw management (S1 – No residue, S2 – 15 cm height of rice straw retention and S3 – 30 cm height of rice straw retention). Among the crop establishment methods, transplanting method gave better yields at most of the locations due to reduced weed competation.

4.4.2 Enhancing productivity of rice-pulse system under different crop establishment methods

This trial was initiated with a view to evaluate system productivity of rice crop establishment under different cropping systems to realize the production potential of alternate systems of crop establishment under different sequences was conducted at five locations viz. **Chinsurah, Ghaghraghat, Kanpur, Ragolu** and **Titabar**. The results revealed that higher average higher system productivity (9.05 t/ha) was recorded under rice-cowpea system at **Mandya**. Weed population was low under transplanting method but the average cost of cultivation was higher. Wet seeding was promising at **Ragolu** and **Chinsurah**. Pre-kharif pulse increases grain yield significantly over rice-rice system at most of the locations.

NUTRIENT MANAGEMENT TRIALS



4.1. NUTRIENT MANAGEMENT TRIALS (NMTs)

Agronomists conducted 210 experiments at 44 locations consisting of evaluation of promising cultivars were (36 cultures) belonging to 12 groups *viz.*, early hill (irrigated), medium hill (irrigated), early (DS), medium, late, medium slender, rainfed shallow low land, alkaline, inland saline, coastal saline, aerobic and biofortified trials in transplanted situation, for their response to integrated nutrient management at 50,100 and 150% Recommended dose of fertilizer(RDF). In addition, seven trials on cultural management, two trials on weed management, two trials on rice based cropping systems and five collaborative trials (Soil science, Entomology, Plant pathology and Plant Breeding) were also conducted to develop cost effective technologies in different rice and rice based cropping systems.

Nutrient response trials on selected AVT-2 rice cultures under high and low input management

4.1(a) NMT Early hill EH (Irrigated)

Five cultivars (IET 25819, Shalimar Rice 3, Vivekdhan 86, VL Dhan 86 and local check) were evaluated at four locations **(Almora, Khudwani, Malan and Upper Shillong)** under two different recommended doses of fertiliser (50% and 100% RFD). The data received from four locations are summarized and presented in **Table 4.1(a)**.

Different doses of fertiliser exhibited varying differences in grain yield and yield attributes at all the four locations. Application of 100% RFD recorded higher yield at **Almora**, **Khudwani**, **Malan** and **Upper Shillong** (3.88, 5.43, 4.68 and 2.78 t/ha) and was found significantly superior to 50% RFD at **Almora** and **Khudwani**, wheras at **Malan** and **Upper Shillong** the yield difference was not significant. respectively. Interaction effects of N doses and varieties was non-significant at all locations. Averaged across the locations, Nutrient response (kg grain / kg N) was higher at 100% RFD compared to 50% RFD.

Average yield of the locations with different varieties ranged from 3.66 to 4.07 t/ha in **Almora**, 4.02 to 5.38 t/ha in **Khudwani**, 3.69 to 4.19 t/ha in Malan and 1.93 to 2.74 t/ha **in Upper Shillong**. Grain yield of varieties differed significantly at all locations with different doses of RFD. Among the varieties tested, local check (VL Dhan 85) and Vivekdhan 86 (3.66 t/ha & 3.64 t/ha) at **Almora** was found promising over other varieties. At **Khudwani**, local check (Shalimar rice 4) recorded higher yield (5.38 t/ha) followed by Shalimar rice 3 (5.03 t/ha). At **Malan**, Vivekdhan 86 was found to be promising (4.93 t/ha), whereas **Upper Shillong**, VL dhan 86 (2.80 t/ha) was superior and was closely followed by Shalimar rice 3 (2.74 t/ha). Mean over the four locations, Vivek dhan 86 was found promising over other tested varieties.

In this trial, nutrient management with 100% RFD was found to be promising and also exhibited higher nutrient recovery at all the locations. Popular variety like VL Dhan 86, Vivek Dhan-86, Shalimar rice 3& 4 were found to be promising.

Table-4.1(a): Summary of data on grain yield and ancillary character of selected NMT- early hill (irrigated) cultures grown under transplanted conditions at graded levels of recommended nutrient(NPK) doses, kharif 2018.

Fertilizer-levels	Varieties	ALMORA							KHUDWANI					
		Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Panicle Weight (g)	Test Wt(g)	Days for 50% flowering	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)	Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Panicle Weight (g)	Test Wt(g)	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)
F1 - 50% RFD	V1	3.98	*2*	244	3.07	25.3	86		3.28	*10*	273	2.02	26.09	
	V2	-		-	-	-	-		4.22	*7*	322	3.01	28.25	
	V3	3.57	*5*	260	2.77	28.07	92		3.62	*9*	302	2.7	25.8	
	V4	-		-	-	-	-		3.96	*8*	368	2.75	25.7	
	V5	3.54	*6*	241	2.7	24.53	90		4.68	*6*	324	3.13	29.87	
F2 - 100% RFD	V1	4.15	*1*	287	3.5	26.37	86	1.70	4.75	*5*	285	2.29	25.68	14.00
	V2	-		-	-	-	-		5.84	*2*	372	3.43	27.94	15.43
	V3	3.71	*4*	294	3.47	28.37	92	1.40	5.13	*4*	289	3.07	26.66	14.38
	V4	-		-	-	-	-		5.33	*3*	310	3.13	25.59	13.05
	V5	3.77	*3*	262	3.07	25.5	90	2.30	6.08	*1*	397	3.56	29.97	13.33
N at same V		NS		NS	NS	NS	NS		NS		NS	NS	NS	
V at same N		NS		NS	NS	NS	NS		NS		NS	NS	NS	
Means of N levels:														
F1		3.70	*2*	249	2.85	25.97	89		3.95	*2*	318	2.72	27.14	
F2		3.88	*1*	281	3.35	26.75	89	1.80	5.43	*1*	331	3.10	27.17	14.04
C.D.(0.05)		0.15		28.0	0.38	NS	NS		0.95		8.85	NS	NS	
C.V.(%)		1.89		5.2	6.05	1.76	1.21		12.96		1.74	11.66	6.53	
Mean of varieties:														
V1		4.07	*1*	266	3.29	25.84	86	1.70	4.02	*5*	279	2.16	25.89	14.00
V2		-		-	-	-	-		5.03	*2*	347	3.22	28.10	15.43
V3		3.64	*3*	277	3.12	28.22	92	1.40	4.38	*4*	295	2.89	26.23	14.38
V4		-		-	-	-	-		4.65	*3*	339	2.94	25.65	13.05
V5		3.66	*2*	252	2.89	25.02	90	2.30	5.38	*1*	361	3.35	29.92	13.33
C.D.(0.05)		0.22		18.01	NS	1.02	2.25		0.84		40.45	0.21	1.00	
C.V.(%)		4.35		5.11	8.92	2.9	1.9		14.62		10.19	5.93	3.00	
Expt. Mean		**3.79**		**265**	**3.10**	**26.36**	**89**		**4.69**		**324**	**2.91**	**27.16**	
Soil type		-							Sandy clay loam					
pH		7.21							6.80					
Fertilizer levels (kg/ha)														
F1		50:30:20							60:30:15					
F2		100:60:40							120:60:30					
Varieties														
V1		IET 25819							IET 25819					
V2		-							Shalimar Rice-3					
V3		Vivekdhan-86							Vivekdhan-86					
V4		-							VL Dhan 86					
V5		Local Check (VL Dhan-85)							Local Check-Shalimar Rice-4					
Available NPK in Soil		296: 13.2:186							-					

Table 4.1(a) (Contd…)

Fertilizer-levels	Varieties	MALAN							UPPER SHILLONG					Over All Mean	*Rank*
		Grain Yield (t/ha)	*Rank*	Panicle/ m² (No.)	Panicle Wt (g)	Test Wt(g)	Days for 50% flowering	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)	Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Test Wt(g)	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)		
F1 - 50% RFD	V1	3.37	*6*	147	2.77	26.83	88		1.52	*8*	200	2.03		3.04	*10*
	V2	-		-	-	-	-		2.87	*3*	221	2.97		3.55	*7*
	V3	4.52	*3*	160	4.23	27.14	86							3.90	*6*
	V4	-		-	-	-	-		2.20	*6*	247	3.47		3.08	*9*
	V5	3.68	*5*	133	3.43	26.77	90		1.63	*7*	250	4.27		3.38	*8*
F2 - 100% RFD	V1	4.00	*4*	162	2.93	26.21	89	7.41	2.90	*2*	225	2.87	17.25	3.95	*5*
	V2	-		-	-	-	-		2.60	*4*	212	3.30	-3.38	4.22	*3*
	V3	5.33	*1*	190	4.50	27.06	85	9.53						4.72	*1*
	V4	-		-	-	-	-		3.40	*1*	254	4.27	15.00	4.37	*2*
	V5	4.70	*2*	188	3.53	27.08	87	12.00	2.23	*5*	272	4.57	7.50	4.20	*4*
N at same V		NS		NS	NS	NS	NS		NS		NS	0.25			
V at same N		NS		NS	NS	NS	NS		NS		NS	0.57			
Means of N levels:															
F1		3.86	*2*	147	3.48	26.91	85		2.06	*2*	230	3.19		3.29	*2*
F2		4.68	*1*	180	3.65	26.78	86	9.65	2.78	*1*	241	3.75	9.09	4.30	*1*
C.D.(0.05)		NS		NS	NS	NS	NS		NS		NS	NS			
C.V.(%)		13.23		12.68	4.02	2.24	0.93		24.18		2.74	11.73			
Mean of varieties:															
V1		3.69	*3*	154	2.85	26.52	88.67	7.41	2.21	*3*	213	2.45	17.25	3.30	*5*
V2		-		-	-	-	-		2.74	*2*	217	3.14	-3.38	3.88	*2*
V3		4.93	*1*	175	4.37	27.10	85.33	9.53						4.65	*1*
V4		-		-	-	-	-		2.80	*1*	251	3.87	15.00	3.72	*4*
V5		4.19	*2*	161	3.48	26.93	87.00	12.00	1.93	*4*	261	4.42	7.50	3.83	*3*
C.D.(0.05)		0.30		NS	0.23	NS	1.63		NS		11.84	0.17			
C.V.(%)		5.27		9.68	4.95	2.30	1.40		24.15		4.00	3.99			
Expt. Mean		**4.27**		**163**	**3.57**	**26.85**	**87**		**2.42**		**235**	**3.47**			
Soil type		Silty Clay Loam							-						
pH		5.70							-						
Fertilizer levels (kg/ha)															
F1		45:20:20							30:30:20						
F2		90:40:40							60:60:40						
Varieties															
V1		IET 25819							IET 25819						
V2		-							Shalimar Rice-3						
V3		Vivekdhan-86							-						
V4		-							VL Dhan 86						
V5		Local Check-HPR 1068							Local Check-Lynter						
Available NPK in Soil (kg/ha)		468:43:239							NA:6.72:246						

4.1(b) NMT medium hill MH (Irrigated)

Different cultivars were evaluated in comparison with popular varieties, latest released varieties and optional varieties at five locations **(Almora, Khudwani, Malan, Upper Shillong and Wangbal)** under two recommended fertilizer dose (50 and 100% RFD) under medium hill conditions. The data received from four locations are summarized and presented in **Table 4.1(b)**.

Application of 100% RFD gave significantly higher grain yield at all the locations except **Almora** and **Upper Shillong** indicating better response of cultivars to higher nitrogen application. Application of 100% RFD recorded significantly higher yield at **Khudwani** (4.75 t/ha), recorded significantly higher yield at **Khudwani** (4.75 t/ha), **Malan** (4.49 t/ha) and **Wangbal** (3.53 t/ha). Interaction effects of varieties and N levels were not significant at all the locations except **Wangbal**. Nutrient response (kg grain / kg N) was higher at 100 % RDF as compared to 50% RFD at all the locations.

Grain yield differences among cultivars were significant at all the locations Average yield of the locations ranged from 3.97 to 4.47 t/ha at **Almora**, 3.69 to 4.80 t/ha in **Khudwani**, 3.88 to 4.87 t/ha in **Malan**, 2.09 to 2.73 t/ha in **Upper Shillong** and 2.55 to 3.53 t/ha in **Wangbal**. Grain yield of varieties differed significantly at all locations with different doses of RFD. Among the varieties tested, IET 25830 and VL Dhan 61 (4.47 and 4.04 t/ha) at **Almora** was found promising over other varieties. At **Khudwani**, Shalimar rice 1 (4.80 t/ha) recorded higher yield. Vivek Dhan 62 was found to be promising at Malan (4.53 t/ha) and **Upper Shillong** (2.73 t/ha), whereas at **Wangbal** VL Dhan 65 (3.53 t/ha) was recorded to be significantly superior to other varieties.

In this trial, integrated agronomic management with 100% RFD was found to be promising and also exhibited higher nutrient recovery. Popular varieties like VL Dhan 65, Vivek Dhan 62, and Shalimar rice 1 were found to be promising.

Table-4.1(b): Summary of data on grain yield and ancillary character of selected NMT- medium hill (irrigated) cultures grown under tranpslanted conditions at graded levels of recommended nutrient(NPK) doses, kharif 2018.

Fertilizer-levels	Varieties	ALMORA							KHUDWANI				
		Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Panicle Weight (g)	Test Wt(g)	Days for 50% flowering	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)	Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Test Wt(g)	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)
	V1	4.44	*2*	285	3.18	24.75	88		3.01	*8*	239	27.65	
F1 - 50%	V2	3.87	*8*	257	3.07	24.38	88		3.27	*7*	323	22.61	
RFD	V3	3.91	*7*	276	2.93	24.46	91		3.65	*6*	302	23.40	
	V4	3.99	*6*	281	3.04	24.97	90		4.45	*4*	332	27.45	
	V1	4.49	*1*	306	3.41	24.92	87	0.50	4.36	*5*	319	28.34	12.86
F2 - 100%	V2	4.06	*4*	288	3.12	24.40	88	1.90	4.65	*3*	378	23.30	13.14
RFD	V3	4.05	*5*	286	2.86	24.55	85	1.40	4.85	*2*	371	24.39	11.43
	V4	4.08	*3*	268	3.02	24.16	91	0.90	5.15	*1*	394	27.84	6.67
N at same V		NS		NS	NS	NS	NS		NS		NS	0.07	
V at same N		NS		NS	NS	NS	NS		NS		NS	0.07	
Means of N levels:													
F1		4.05	*2*	275	3.06	24.64	89		3.60	*2*	299	25.28	
F2		4.17	*1*	287	3.10	24.51	88	1.18	4.75	*1*	366	25.97	11.02
C.D.(0.05)		NS		NS	NS	NS	NS		0.08		NS	0.03	
C.V.(%)		1.84		5.69	4.93	5.30	3.39		1.08		12.87	0.07	
Mean of varieties:													
V1		4.47	*1*	295	3.30	24.84	88	0.50	3.69	*4*	279	28.00	12.86
V2		3.97	*4*	273	3.10	24.39	88	1.90	3.96	*3*	350	22.96	13.14
V3		3.98	*3*	281	2.90	24.51	88	1.40	4.25	*2*	336	23.90	11.43
V4		4.04	*2*	275	3.03	24.57	91	0.90	4.80	*1*	363	27.65	6.67
C.D.(0.05)		0.11		15.24	0.27	NS	NS		0.32		55.89	0.05	
C.V.(%)		2.10		4.31	6.88	3.29	2.77		6.17		13.37	0.16	
Expt. Mean		**4.11**		**281**	**3.08**	**24.57**	**89**		**4.17**		**332**	**25.62**	
Soil type		-							Sandy clay loam				
pH		7.30							6.90				
Fertilizer levels (kg/ha)													
F1		50:30:20							60:30:15				
F2		100:60:40							120:60:30				
Varieties													
V1		IET 25830							IET 25830				
V2		Vivekdhan-62							Vivekdhan-62				
V3		V L Dhan-65							V L Dhan-65				
V4		Local check - VL Dhan-61							Local check - Shalimar Rice 1				
Available NPK in Soil		305:14.1:211							-				

Table 4.1(b) (Contd…)

Fertilizer-levels	Varieties	MALAN							UPPER SHILLONG				
		Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Panicle Weight (g)	Test Wt(g)	Days for 50% flowering	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)	Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Panicle Weight (g)	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)
F1 - 50% RFD	V1	3.95	*7*	215	1.90	25.63	91		2.10	*6*	253	3.00	
	V2	4.23	*4*	167	2.60	25.34	90		2.83	*2*	250	4.50	
	V3	4.76	*3*	208	2.53	24.32	92		2.00	*8*	252	3.47	
	V4	3.78	*8*	195	2.07	25.23	86		2.87	*1*	317	3.03	
F2 - 100% RFD	V1	4.15	*5*	225	2.07	26.68	89	2.35	2.10	*6*	260	2.40	0.00
	V2	4.83	*2*	192	2.80	25.41	91	7.06	2.63	*3*	246	3.97	-2.50
	V3	4.98	*1*	212	2.90	24.56	92	2.59	2.17	*5*	254	2.80	2.13
	V4	3.98	*6*	207	2.23	25.07	86	2.35	2.37	*4*	299	3.47	-6.25
N at same V		NS		NS	NS	NS	1.03		NS		9.07	NS	
V at same N		NS		NS	NS	NS	1.55		NS		8.62	NS	
Means of N levels:													
F1		4.18	*2*	196	2.28	25.13	85		2.45	*1*	268	3.50	
F2		4.49	*1*	209	2.50	25.43	86	3.59	2.32	*2*	265	3.16	-1.66
C.D.(0.05)		0.15		NS	0.16	NS	NS		NS		NS	NS	
C.V.(%)		1.98		5.72	3.92	2.80	1.04		11.90		0.96	8.58	
Mean of varieties:													
V1		4.05	*3*	220	1.99	26.16	89.00	2.35	2.10	*3*	256	2.70	0.00
V2		4.53	*2*	179	2.70	25.38	91.00	7.06	2.73	*1*	248	4.24	-2.50
V3		4.87	*1*	210	2.72	24.44	92.33	2.59	2.09	*4*	253	3.14	2.13
V4		3.88	*4*	201	2.15	25.15	86.00	2.35	2.62	*2*	308	3.25	-6.25
C.D.(0.05)		0.35		11.17	0.16	0.78	0.73		0.39		6.41	0.42	
C.V.(%)		6.34		4.38	5.22	2.45	0.64		13.11		1.92	9.96	
Expt. Mean		**4.33**		**203**	**2.39**	**25.28**	**90**		**2.38**		**266**	**3.33**	
Soil type		Silty Clay Loam							-				
pH		5.60							-				
Fertilizer levels (kg/ha)													
F1		45:20:20							30:30:20				
F2		90:40:40							60:60:40				
Varieties													
V1		IET 25830							IET 25830				
V2		Vivekdhan-62							Vivekdhan-62				
V3		V L Dhan-65							V L Dhan-65				
V4		Local check - HPR 2143							Local check - Pnah mawsyntai				
Available NPK in Soil (kg/ha)		-							NA:6.72:246				

Table 4.1(b) (Contd…)

Fertilizer-levels	Varieties	WANGBAL							Over All Mean	*Rank*
		Grain Yield (t/ha)	*Rank*	Panicle/m² (No.)	Panicle Weight (g)	Test Wt(g)	Days for 50% flowering	Nutrient res. (kg grain/kg Nutrient) (Base level 50% RDF)		
F1 - 50% RFD	V1	2.00	*8*	275	7.50	24.00	100		3.10	*8*
	V2	2.70	*7*	257	7.07	24.25	102		3.38	*7*
	V3	3.36	*4*	348	7.03	25.00	95		3.54	*6*
	V4	2.80	*6*	296	4.03	24.53	91		3.58	*5*
F2 - 100% RFD	V1	3.09	*5*	238	8.20	24.10	102	12.11	3.64	*4*
	V2	3.67	*2*	355	8.13	24.30	71	10.78	3.97	*1*
	V3	3.69	*1*	332	5.03	25.00	96	3.67	3.95	*2*
	V4	3.67	*2*	336	5.50	24.90	90	9.67	3.85	*3*
N at same V		0.13		19.59	0.28	NS	NS			
V at same N		0.18		26.86	0.38	NS	NS			
Means of N levels:										
F1		2.72	*2*	294	6.41	24.45	85		3.40	*2*
F2		3.53	*1*	315	6.72	24.58	86	9.06	3.85	*1*
C.D.(0.05)		0.19		NS	NS	NS	NS			
C.V.(%)		3.38		4.99	3.16	0.67	22.24			
Mean of varieties:										
V1		2.55	*4*	257	7.85	24.05	101.67	12.11	3.37	*4*
V2		3.19	*3*	306	7.60	24.28	70.80	10.78	3.67	*3*
V3		3.53	*1*	340	6.03	25.00	95.67	3.67	3.74	*1*
V4		3.24	*2*	316	4.77	24.72	90.00	9.67	3.71	*2*
C.D.(0.05)		0.09		13.85	0.20	0.21	NS			
C.V.(%)		2.37		3.61	2.43	0.67	23.11			
Expt. Mean		**3.12**		**305**	**6.56**	**24.51**	**90**			
Soil type		Silty Clay Loam								
pH		5.60								
Fertilizer levels (kg/ha)										
F1		30:20:20								
F2		60:40:40								
Varieties										
V1		IET 25830								
V2		Vivekdhan-62								
V3		V L Dhan-65								
V4		Local check - Punshi								
Available NPK in Soil (kg/ha)		-								

4.1(c) NMT Early (Direct seeded)

Different AVT-2 entries (IET 26348, IET 26365, IET 25103 (R), IET 26356, IET 26337 and IET 25121) were evaluated for their response to input level of nutrients on grain yield in comparison to standard varieties i.e. Sahbhagidhan, Vandana, Govind, NDR-97, Varalu, CR Dhan 201 and local checks at five locations **viz. Ghagraghat (120:60:40), Jagdalpur (80:50:30), Mandya (100:50:50), Ranchi (60:30:20) and Rewa (80:50:40).** The experiments were arranged in a split plot design at all the locations**.** The treatments were two levels of input (50% and 100% RDF) as main plot and varieties were assigned to sub plots. The data received from these locations are summarized and presented in **Table 4.1(c)**.

Different doses of RDF (50% and 100%) exhibited significant differences in grain yield at all the locations except **Jagdalpur** and **Mandya**. Grain yield increased with increasing level of input from 50% to 100% RFD. Application of 100% NPK recorded higher yield at **Ghagraghat** (1.74 t/ha), **Mandya** (4.10 t/ha), **Ranchi** (3.14 t/ha) and **Rewa** (4.89 t/ha). Nutrient response (kg grain / kg nutrient) was higher at 100 % RDF at **Ghagraghat** (1.48), **Mandya** (5.03), **Ranchi** (5.61) and **Rewa** (3.05) compared to 50% NPK. Negative nutrient response (kg grain /kg NPK) at 100% NPK was recorded at **Jagdalpur** (-0.20).

Grain yield differences among the tested genotypes were significant at all the locations. Significant mean maximum yield was recorded by IET-26356 at **Jagdalpur** (2.04 t/ha. IET 25121 at **Mandya** (4.86 t/ha), IET 25103 at **Ranchi** (3.21 t/ha) and **Rewa** (4.49 t/ha), IET 26337 had recorded higher yield at **Ghagraghat** (1.77 t/ha). Mean over the locations, the performance of IET-25121 (3.63 t/ha) followed by IET 26356 (3.47 t/ha), Sahbhagidhan (3.20 t/ha) and Govind (3.14 t/ha) was better over other entries and local check. Interaction effects of nutrient levels x cultivars on grain yield was non-significant at all locations.

In this trial, medium input of nutrients (100% RDF) was found to be promising with 11.8% higher grain yield and also exhibited higher nutrient recovery. IET-25121, IET 26356 recorded higher grain yield of 3.63 and 3.47 t/ha, respectively were the promising entries.

Table 4.1(c): Summary of data on grain yield and ancillary characters of selected NMT Early (DS) cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	GHAGHRAGHAT					JAGDALPUR					MANDYA						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Test weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Test weight (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
F1: Low input (50% NPK)	V1	1.34	17	95	1.92		1.46	16	306	16.32		3.45	23	304	3.18	21.03	101	
	V2	1.61	12	102	1.95		1.61	12	557	25.15		4.19	9	371	2.84	31.41	81	
	V3	1.58	13	100	1.80		1.19	17	481	19.75		3.67	19	263	2.78	20.11	83	
	V4	-		-	-		2.08	1	573	23.49		4.49	6	293	3.39	25.99	87	
	V5	1.71	9	108	2.00		0.37	25	86	22.91		3.50	21	282	3.08	28.45	59	
	V6	-		-	-		1.75	7	370	25.88		4.65	3	314	3.33	28.74	84	
	V7	1.72	8	106	2.13		1.68	10	256	25.01		4.19	9	249	3.03	30.78	78	
	V8	1.74	7	113	2.20		0.56	23	87	23.95		3.13	25	232	2.66	27.99	67	
	V9	-		-	-		1.18	18	317	24.87		3.95	13	241	2.72	29.66	82	
	V10	1.31	18	97	1.75		1.13	19	432	22.37		3.09	26	318	2.46	34.27	81	
	V11	-		-	-		1.69	9	367	19.57		3.77	17	265	3.67	24.43	88	
	V12	1.39	16	89	1.90		1.48	14	363	25.14		4.14	11	301	2.95	34.61	82	
	V13	1.82	4	117	2.27		1.88	4	387	22.09		3.82	15	222	3.08	27.79	83	
F2: Medium input (100% NPK)	V1	1.67	11	98	1.94	3.00	1.51	13	357	16.37	0.63	3.78	16	263	2.58	20.22	101	6.60
	V2	1.78	6	107	1.98	1.55	1.79	6	528	24.79	2.25	4.74	2	371	2.87	32.14	81	11.00
	V3	1.71	9	103	1.87	1.18	0.94	22	421	18.13	-3.13	4.05	12	356	2.49	24.83	84	7.60
	V4	-		-	-		1.99	3	532	23.99	-1.13	4.61	4	341	2.98	27.36	88	2.40
	V5	1.83	3	115	2.05	1.09	0.32	26	73	21.68	-0.63	3.58	20	223	3.15	28.58	59	1.60
	V6	-		-	-		1.81	5	339	23.56	0.75	5.07	1	337	3.91	29.44	85	8.40
	V7	1.79	5	112	2.21	0.64	1.73	8	365	25.34	0.63	4.29	7	336	2.87	30.21	78	2.00
	V8	1.96	2	119	2.30	2.00	0.46	24	100	23.3	-1.25	3.68	18	240	2.84	28.79	68	11.00
	V9	-		-	-		1.12	20	312	25.59	-0.75	4.26	8	254	3.27	30.61	82	6.20
	V10	1.44	15	101	1.79	1.18	0.99	21	436	22.94	-1.75	3.24	24	385	2.77	29.88	81	3.00
	V11	-		-	-		1.47	15	352	19.79	-2.75	3.95	13	266	3.32	24.72	87	3.60
	V12	1.51	14	97	1.93	1.09	1.65	11	407	25.04	2.13	4.59	5	300	3	30.27	83	9.00
	V13	2.00	1	124	2.40	1.64	2.07	2	352	22.73	2.38	3.47	22	259	3.3	28.18	83	-7.00
Interaction																		
F at same V		NS		NS	NS		NS		NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		NS	NS		NS		NS	NS		NS		NS	NS	NS	NS	
F1		1.58	2	103	1.99		1.39	1	353	22.81		3.85	2	281	3.01	28.10	81	
F2		1.74	1	109	2.05	1.48	1.37	2	352	22.56	-0.20	4.10	1	302	3.03	28.09	81	5.03
C.D.(0.05)		0.04		NS	NS		NS		NS	NS		NS		17.96	NS	NS	NS	
C.V.(%)		1.84		6.53	3.11		19.96		14.89	2.38		10.78		6.32	10.33	14.13	2.34	

Table 4.1(c): Contd.

N-levels	Varieties	GHAGHRAGHAT					JAGDALPUR					MANDYA						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Test weight (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
Mean of varieties:																		
	V1	1.51	7	97	1.93	3.00	1.49	8	332	16.35	0.63	3.62	10	283	2.88	20.63	101	6.60
	V2	1.70	5	105	1.97	1.55	1.70	5	543	24.97	2.25	4.47	3	371	2.86	31.78	81	11.00
	V3	1.65	6	102	1.84	1.18	1.07	10	451	18.94	-3.13	3.86	8	309	2.64	22.47	84	7.60
	V4	-		-	-		2.04	1	552	23.74	-1.13	4.55	2	317	3.19	26.68	87	2.40
	V5	1.77	3	112	2.03	1.09	0.35	13	79	22.30	-0.63	3.54	11	253	3.12	28.52	59	1.60
	V6	-		-	-		1.78	3	355	24.72	0.75	4.86	1	325	3.62	29.09	84	8.40
	V7	1.76	4	109	2.17	0.64	1.71	4	311	25.18	0.63	4.24	5	292	2.95	30.50	78	2.00
	V8	1.85	2	116	2.25	2.00	0.51	12	94	23.63	-1.25	3.41	12	236	2.75	28.39	67	11.00
	V9	-		-	-		1.15	9	315	25.23	-0.75	4.11	6	248	3.00	30.14	82	6.20
	V10	1.38	9	99	1.77	1.18	1.06	11	434	22.66	-1.75	3.17	13	351	2.62	32.08	81	3.00
	V11	-		-	-		1.58	6	360	19.68	-2.75	3.86	7	265	3.50	24.58	88	3.60
	V12	1.45	8	93	1.92	1.09	1.57	7	385	25.09	2.13	4.37	4	300	2.98	32.44	82	9.00
	V13	1.91	1	121	2.34	1.64	1.98	2	369	22.41	2.38	3.65	9	241	3.19	27.99	83	-7.00
	C.D.(0.05)	0.15		7.15	0.09		0.28		86.11	1.72		0.79		41.01	0.51	2.11	1.03	
	C.V. (%)	7.50		5.79	3.87		17.28		21.18	6.57		17.29		12.17	14.50	6.50	1.10	
	Expt. Mean	**1.66**		**106**	**2.02**		**1.38**		**352**	**22.68**		**3.98**		**292**	**3.02**	**28.10**	**81**	
	Soil type	Sandy Loam					-					Sandy loam						
	pH	7.50					-					6.99						
N - levels (kg/ha)																		
	F1	60:30:20					40:25:15					50:50:50						
	F2	120:60:40					80:50:30					100:50:50						
	Recommended N:P:K (kg/ha)	120:60:40					80:50:30					100:50:50						
Varieties																		
	V1	IET 26348					IET 26348					IET 26348						
	V2	IET- 26365					IET- 26365					IET- 26365						
	V3	IET- 25103(R)					IET- 25103(R)					IET- 25103(R)						
	V4	-					IET - 26356					IET - 26356						
	V5	IET - 26337					IET - 26337					IET - 26337						
	V6	-					IET – 25121(R)					IET - 25121 (R)						
	V7	Sahbhagi dhan					Sahbhagi dhan					Sahbhagi dhan						
	V8	Vandana					Vandana					Vandana						
	V9	-					Govind					Govind						
	V10	NDR-97					NDR-97					NDR-97						
	V11	-					Varalu					Varalu						
	V12	CR- Dhan-201					CR- Dhan-201					CR- Dhan-201						
	V13	Local Check - NDR 359					Local Check-Samleswari					Local Check-Rasi						
Available N:P:K of soil (kg/ha)		200:24:236					-					341:105:271						

Table 4.1(c): Contd.

N-levels	Varieties	RANCHI						REWA						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle Weight (g)	Test weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle Weight (g)	Test weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)		
F1	V1	2.78	20	147	2.67	63		3.80	19	286	2.80	24.77		2.57	22
	V2	2.67	24	140	2.63	61		3.83	17	282	2.73	24.47		2.78	17
	V3	3.01	12	157	2.95	68		4.00	13	297	2.87	24.90		2.69	21
	V4	2.92	15	153	2.72	68		3.53	23	291	2.80	24.47		3.26	6
	V5	2.75	21	143	2.65	63		3.47	24	294	2.73	24.90		2.36	26
	V6	3.22	4	192	2.97	65		3.97	16	294	2.67	24.60		3.40	3
	V7	2.82	19	151	2.69	80		3.80	19	281	2.70	24.60		2.84	14
	V8	2.57	26	138	2.52	59		4.00	13	294	2.77	24.30		2.40	25
	V9	2.86	17	155	2.70	70		4.00	13	286	2.73	23.43		3.00	11
	V10	2.75	21	146	2.65	61		3.83	17	285	2.60	24.27		2.42	24
	V11	2.62	25	144	2.63	58		3.80	19	282	2.73	24.60		2.97	12
	V12	3.15	7	186	3.02	66		-		-	-	-		2.54	23
	V13	2.68	23	154	2.64	63		3.73	22	287	2.83	23.80		2.79	16
F2	V1	3.05	11	165	2.99	67	4.91	4.77	10	308	3.27	24.30	11.41	2.96	13
	V2	2.96	13	156	2.65	64	5.27	4.90	6	307	3.13	24.47	12.59	3.23	7
	V3	3.40	3	183	2.96	70	7.09	4.97	4	302	3.33	24.90	11.41	3.01	10
	V4	3.10	8	172	2.75	69	3.27	5.03	2	308	3.20	24.30	17.65	3.68	2
	V5	2.95	14	165	2.68	67	3.64	4.87	7	306	3.50	25.20	16.47	2.71	20
	V6	3.45	2	217	3.10	68	4.18	5.10	1	308	3.10	24.83	13.29	3.86	1
	V7	3.09	10	171	2.73	84	4.91	4.83	8	310	3.60	24.30	12.12	3.15	8
	V8	2.86	17	159	2.56	61	5.27	4.93	5	312	3.37	24.47	10.94	2.78	18
	V9	3.18	5	170	2.72	74	5.82	5.03	2	312	3.63	24.90	12.12	3.40	4
	V10	3.18	5	164	2.70	63	7.82	4.80	9	307	3.37	24.30	11.41	2.73	19
	V11	3.10	8	161	2.66	60	8.73	4.73	11	306	3.67	24.60	10.94	3.31	5
	V12	3.57	1	212	3.10	69		-		-	-	-		2.83	15
	V13	2.92	15	165	2.67	66		4.70	12	311	3.17	24.60	11.41	3.03	9
Interaction															
F at same V		NS		NS	NS	1.03		NS		NS	NS	NS			
V at same F		NS		NS	NS	1.34		NS		NS	NS	NS			
F1		2.83	2	154	2.73	65.08		3.81	2	288	2.75	24.43		2.69	2
F2		3.14	1	174	2.79	67.87	5.61	4.89	1	308	3.36	24.60	12.65	3.05	1
C.D.(0.05)		0.19		4.95	NS	1.17		0.22		3.76	0.25	NS			
C.V.(%)		6.69		3.1	2.49	1.8		4.90		1.24	7.92	1.54			

Table 4.1(c): Contd.

N-levels	Varieties	RANCHI						REWA						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Test weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Weight (g)	Test weight (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)		
Mean of varieties:															
	V1	2.92	8	156	2.83	65.00	4.91	4.29	8	297	3.04	24.54	11.41	2.76	9
	V2	2.82	11	148	2.64	62.34	5.27	4.37	5	295	2.93	24.47	12.59	3.01	5
	V3	3.21	3	170	2.96	68.84	7.09	4.49	3	300	3.10	24.90	11.41	2.85	8
	V4	3.01	5	163	2.74	68.50	3.27	4.28	9	299	3.00	24.39	17.65	3.47	2
	V5	2.85	10	154	2.67	65.00	3.64	4.17	12	300	3.12	25.05	16.47	2.54	13
	V6	3.34	2	205	3.04	66.50	4.18	4.54	1	301	2.89	24.72	13.29	3.63	1
	V7	2.96	7	161	2.71	82.33	4.91	4.32	6	296	3.15	24.45	12.12	2.99	6
	V8	2.72	13	149	2.54	60.17	5.27	4.47	4	303	3.07	24.39	10.94	2.59	11
	V9	3.02	4	163	2.71	71.84	5.82	4.52	2	299	3.18	24.17	12.12	3.20	3
	V10	2.97	6	155	2.68	62.17	7.82	4.32	6	296	2.99	24.29	11.41	2.58	12
	V11	2.86	9	153	2.65	59.17	8.73	4.27	10	294	3.20	24.60	10.94	3.14	4
	V12	3.36	1	199	3.06	67.83	0.00	-		-	-	-		2.69	10
	V13	2.80	12	160	2.66	64.50	0.00	4.22	11	299	3.00	24.20	11.41	2.91	7
	C.D.(0.05)	0.33		16.8	0.12	0.73		0.23		NS	NS	NS			
	C.V. (%)	9.65		8.87	3.79	0.94		4.52		1.91	6.23	4.22			
	Expt. Mean	**2.99**		**164**	**2.76**	**66.47**		**4.35**		**298**	**3.05**	**25**		2.87	
	Soil type	Sandy Loam						Clay							
	pH	7.70						-							
N - levels (kg/ha)															
	F1	30:15:10						40:25:20							
	F2	60:30:20						80:50:40							
	Recommended N:P:K (kg/ha)	60:30:20						80:50:40							
Varieties															
	V1	IET 26348						IET 26348							
	V2	IET- 26365						IET- 26365							
	V3	IET- 25103(R)						IET- 25103(R)							
	V4	IET - 26356						IET - 26356							
	V5	IET - 26337						IET - 26337							
	V6	IET - 25121 ®						IET - 25121 ®							
	V7	Sahbhagi dhan						Sahbhagi dhan							
	V8	Vandana						Vandana							
	V9	Govind						Govind							
	V10	NDR-97						NDR-97							
	V11	Varalu						Varalu							
	V12	CR- Dhan-201						-							
	V13	Local Check-BVD 110						Local Check-IR 64							
	Available N:P:K of soil (kg/ha)	-						294:20.6:471							

4.1(d) NMT IME (Transplanted)

AVT-2 IM cultures (IET 25746, IET 25764, IET 26079, IET 25749, IET 26125, IET 24931 and IET 25330) were evaluated at fifteen locations *viz.*, **Aduthurai (150:60:60), Chinsura (80:40:40), Chiplima (80:40:40), Faizabad (120:60:40), Gangavathi (150:75:75), Karjat (150:50:50), Kanpur (120:60:60), Kota (120:60:40), Mandya (100:50:50), Navsari (100:30:50), Nawagam (100:25:0), Pantnagar (120:60:40), Pattambi (90:45:45), Puducherry (120:40:40), Varanasi (120:60:40)** and **Dhangain (120:60:40)** in comparison to high yielding standard checks (PR 113, Lalat, Karjat 7, MTU 1010, HC-US 312 and local check) under two recommended dose of fertiliser (100% and 150% RDF). The details and data received from these locations are summarized and presented in **Table 4.1(d)**.

Application of different nutrient levels significantly influenced the grain yield at all the locations and the maximum increase in grain yield was observed with 150% RDF. At **Chinsurah, Chiplima, Gangavathi, Kota, Mandya, Navsari, Nawagam** and **Dhangain** application of higher dose i.e. 150% RDF did not result in significant yield increase. Application of 150% RDF recorded significantly higher grain yields at **Aduthurai** (5.32 t/ha), **Faizabad** (5.10 t/ha), **Karjat** (5.69 t/ha), **Kanpur** (4.12 t/ha), **Pantnagar** (5.11 t/ha), **Pattambi** (5.36 t/ha), **Puducherry** (6.11 t/ha) and **Varanasi** (4.34 t/ha). Nutrient response (kg grain/kg nutrient was found to be higher with the application of 150% RDF at **Aduthurai** (4.31), **Chinsurah** (2.19), **Chiplima** (1.66), **Faizabad** (8.71), **Gangavathi** (1.14), **Karjat** (3.27), **Kanpur** (4.26), **Kota** (1.55), **Mandya** (3.00), **Navsari** (2.50), **Nawagam** (2.00), **Pantnagar** (3.99), **Pattambi** (3.03), **Puducherry** (1.94), **Varanasi** (5.68) and **Dhangain** (8.97).

Grain yield differences among the tested varieties were found to be significant at all the locations. Highest grain yield was recorded by IET 24931 at **Aduthurai** (5.87 t/ha), **Gangavathi** (10.07 t/ha), **Karjat** (6.22 t/ha), **Kanpur** (4.21 t/ha) and **Kota** (8.09 t/ha). Among the AVT-2 entries, IET25764 (4.85 t/ha) and IET 26079 (4.90 t/ha) performed at **Chinsurah** and **Dhangain**, IET 25764 at **Faizabad** (5.43 t/ha) and **Karjat** (6.42 t/ha). IET 25749 recorded higher grain yield at **Kota** (8.64 t/ha), **Mandya** (8.39 t/ha), and **Puducherry** (6.80 t/ha). Higher grain yield at **Navsari** (4.77 t/ha), **Pantnagar** (5.64 t/ha) and **Varanasi** (4.64 t/ha) was noted with IET 25746. At **Nawagam**, IET 26125 (5.23 t/ha) followed by IET 26079 (5.14 t/ha) produced higher grain yield. Mean over the locations performance, IET 25746 (5.62 t/ha) followed by IET 25764 (5.54 t/ha) and IET 26079 (5.30 t/ha) recorded higher yields. Interaction effects among RDF x varieties was found to be non-significant at all the locations except at **Chiplima, Faizabad** and **Varanasi** where significant interaction was noted. Significant interaction for grain yield was seen with application of 150% RDF with IET 26079 at **Chiplima**, IET 25746 and IET 25764 at **Faizabad** and IET 25746 at **Varanasi**.

In this trial, mean over the locations nutrient management with 150% RDF recorded 6.09% higher yield over 100% RDF. IET 25746 (5.62 t/ha), IET 25764 (5.54 t/ha) and IET 26079 (5.30 t/ha) performed better and recorded higher mean grain yield over the locations.

Table 4.1(d): Summary of data on grain yield and ancillary characters of selected NMT Medium (Transplanted) cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	ADUTHURAI							CHINSURAH				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	5.17	15	390	2.53	22.48	88.33		3.96	14	337	4.26	
	V2	4.43	25	388	2.87	23.01	87.33		4.67	7	396	4.82	
	V3	4.77	21	387	2.48	21.82	86.00		4.74	5	403	4.94	
	V4	4.30	26	330	2.46	22.96	99.00		3.91	15	333	3.88	
	V5	4.67	24	392	2.40	20.77	86.67		3.29	19	280	3.07	
	V6	5.77	2	457	3.11	21.33	92.00		3.72	16	316	3.68	
	V7	5.43	7	418	2.92	21.53	86.67		4.04	13	343	4.22	
	V8	-		-	-	-	-		-		-	-	
	V9	4.87	19	387	2.67	24.51	87.00		-		-	-	
	V10	5.27	8	312	2.25	23.97	85.00		4.74	5	403	4.74	
	V11	5.10	16	368	2.35	20.84	82.67		-		-	-	
	V12	5.23	12	325	2.30	22.01	85.67		-		-	-	
	V13	5.20	14	333	2.43	18.20	90.33		5.15	2	437	5.39	
	V14	4.73	22	338	2.24	16.17	77.33		3.68	17	313	3.83	
F2	V1	5.67	4	397	2.60	22.58	90.67	6.67	4.36	9	371	3.74	5.00
	V2	4.80	20	394	3.02	23.34	90.33	4.93	5.03	4	428	5.35	4.50
	V3	5.07	17	400	2.53	21.97	90.00	4.00	5.06	3	430	5.39	4.00
	V4	4.73	22	339	2.49	23.04	102.33	5.73	4.23	11	360	4.29	4.00
	V5	5.00	18	388	2.47	20.87	89.67	4.40	2.95	20	251	3.13	-4.25
	V6	5.97	1	467	3.18	21.48	94.67	2.67	4.17	12	354	4.05	5.63
	V7	5.73	3	428	3.03	21.67	89.67	4.00	4.62	8	392	5.40	7.25
	V8	-		-	-	-	-		-		-	-	
	V9	5.23	12	397	2.73	24.68	90.67	4.80	-		-	-	
	V10	5.27	8	317	2.29	24.01	87.67	0.00	4.36	9	370	4.63	-4.75
	V11	5.27	8	379	2.45	20.94	85.67	2.27	-		-	-	
	V12	5.27	8	339	2.43	22.21	87.67	0.53	-		-	-	
	V13	5.63	5	342	2.49	18.37	93.67	5.73	5.19	1	442	5.38	0.50
	V14	5.50	6	351	2.30	16.50	80.67	10.27	3.68	17	313	3.88	0.00
Interaction													
F at same V		NS		NS	NS	0.05	NS		NS		NS	NS	
V at same F		NS		NS	NS	0.06	NS		NS		NS	NS	
F1		5.00	2	371	2.54	21.51	87		4.19	2	356	4.28	
F2		5.32	1	380	2.62	21.67	90	4.31	4.37	1	371	4.52	2.19
C.D.(0.05)		0.18		8.00	0.09	0.03	1.24		NS		NS	0.24	
C.V.(%)		3.49		1.85	3.05	0.14	1.21		7.88		7.78	4.84	

Table 4.1(d): Contd.

F-levels	Varieties	ADUTHURAI							CHINSURAH				
		Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle Wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle Wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
Mean of varieties:													
	V1	5.42	3	394	2.57	22.53	90	6.67	4.16	6	354	4.00	5.00
	V2	4.62	12	391	2.95	23.18	89	4.93	4.85	3	412	5.09	4.50
	V3	4.92	10	393	2.51	21.90	88	4.00	4.90	2	417	5.17	4.00
	V4	4.52	13	335	2.48	23.00	101	5.73	4.07	7	346	4.09	4.00
	V5	4.84	11	390	2.44	20.82	88	4.40	3.12	10	266	3.10	-4.25
	V6	5.87	1	462	3.15	21.41	93	2.67	3.95	8	335	3.87	5.63
	V7	5.58	2	423	2.98	21.60	88	4.00	4.33	5	367	4.81	7.25
	V8	-		-	-	-	-		-		-	-	
	V9	5.05	9	392	2.70	24.60	89	4.80	-		-	-	
	V10	5.27	5	315	2.27	23.99	86	0.00	4.55	4	387	4.69	-4.75
	V11	5.19	7	374	2.40	20.89	84	2.27	-		-	-	
	V12	5.25	6	332	2.37	22.11	87	0.53	-		-	-	
	V13	5.42	4	338	2.46	18.29	92	5.73	5.17	1	439	5.39	0.50
	V14	5.12	8	344	2.27	16.34	79	10.27	3.68	9	313	3.86	0.00
C.D.(0.05)		0.30		NS	0.08	0.47	1.19		0.61		51.74	0.51	
C.V. (%)		8.63		4.50	3.79	2.42	1.60		12.22		12.20	9.88	
Expt. Mean		**5.16**		**375**	**2.58**	**22**	**89**		**4.28**		**364**	**4.40**	
Soil type		Clay							Clay loam				
pH		7.20							7.20				
N - levels (kg/ha)													
F1		150:60:60							80:40:40				
F2		225:60:60							120:60:60				
Recommended N:P:K (kg/ha)		150:60:60							80:40:40				
Varieties													
V1		IET 25746							IET 25746				
V2		IET 25764							IET 25764				
V3		IET 26079							IET 26079				
V4		IET 25749							IET 25749				
V5		IET 26125							IET 26125				
V6		IET 24931							IET 24931				
V7		IET 25330							IET 25330				
V8		-							-				
V9		PR 113							-				
V10		Lalat							Lalat				
V11		Karjat 7							-				
V12		MTU 1010							-				
V13		HC- US 312							HC- US 312				
V14		Local Check - ADT 43							Local Check				
Available N:P:K of soil (kg/ha)		28.5:72.5:132							458:95:295				

Table 4.1(d): Contd.

F-levels	Varieties	CHIPLIMA							FAIZABAD				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle Wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	3.03	22	157	3.99	24.75	98		4.71	13	280	3.28	
	V2	3.30	19	130	4.22	24.83	106		5.02	8	266	3.15	
	V3	3.49	12	205	3.92	26.98	100		4.48	15	277	3.29	
	V4	3.39	17	141	4.28	28.03	96		4.21	19	270	3.28	
	V5	3.54	10	200	3.50	26.50	98		4.86	12	272	3.33	
	V6	3.32	18	122	4.45	26.43	103		4.12	20	265	3.09	
	V7	3.60	8	204	3.82	24.95	103		3.09	26	270	3.22	
	V8	-		-	-	-	-		-		-	-	
	V9	2.51	24	151	4.16	30.15	103		3.59	25	277	3.11	
	V10	2.94	23	142	3.37	28.48	99		4.02	21	267	3.19	
	V11	3.11	21	178	2.96	22.50	95		3.92	22	276	3.10	
	V12	3.72	6	208	3.16	26.85	96		3.75	24	276	3.21	
	V13	3.58	9	187	3.99	24.13	96		3.79	23	271	3.30	
	V14	3.48	14	190	3.48	28.03	105		4.28	16	275	3.25	
F2	V1	3.78	4	163	4.17	23.00	99	9.38	5.90	1	317	3.42	10.82
	V2	3.81	3	178	4.44	27.70	105	6.38	5.83	2	320	3.20	7.36
	V3	3.94	1	219	4.16	28.35	100	5.63	5.09	7	283	3.40	5.55
	V4	3.49	12	148	4.40	26.11	97	1.25	5.47	4	278	3.33	11.45
	V5	3.73	5	206	3.74	26.40	98	2.38	5.73	3	283	3.40	7.91
	V6	3.68	7	128	3.72	25.70	104	4.50	5.17	5	278	3.22	9.55
	V7	3.50	11	210	4.13	25.83	103	-1.25	5.01	9	282	3.40	17.45
	V8	-		-	-	-	-		-		-	-	
	V9	2.51	24	157	4.09	29.08	104	0.00	4.91	10	283	3.32	12.00
	V10	3.27	20	148	3.50	27.93	101	4.13	5.17	5	278	3.28	10.45
	V11	2.36	26	184	3.34	25.23	95	-9.38	4.25	17	278	3.40	3.00
	V12	3.82	2	214	3.70	27.96	97	1.25	4.61	14	275	3.25	7.82
	V13	3.40	16	194	4.15	23.83	97	-2.25	4.25	17	275	3.28	4.18
	V14	3.45	15	197	3.81	28.28	106	-0.37	4.90	11	277	3.32	5.64
Interaction													
F at same V		0.44		NS	NS	NS	NS		0.48		13.77	NS	
V at same F		0.49		NS	NS	NS	NS		0.47		14.45	NS	
F1		3.31	2	170	3.79	26.35	100		4.14	2	273	3.22	
F2		3.44	1	180	3.95	26.57	101	1.66	5.10	1	285	3.32	8.71
C.D.(0.05)		NS		NS	0.12	NS	NS		0.13		7.48	0.06	
C.V.(%)		9.69		18.93	3.18	1.50	1.04		2.95		2.75	1.96	

Table 4.1(d): Contd.

F-levels	Varieties	CHIPLIMA							FAIZABAD				
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:													
	V1	3.41	10	160	4.08	23.88	99	9.38	5.31	2	299	3.35	10.82
	V2	3.56	4	154	4.33	26.27	106	6.38	5.43	1	293	3.18	7.36
	V3	3.72	2	212	4.04	27.67	100	5.63	4.79	5	280	3.35	5.55
	V4	3.44	9	145	4.34	27.07	97	1.25	4.84	4	274	3.31	11.45
	V5	3.64	3	203	3.62	26.45	98	2.38	5.30	3	278	3.37	7.91
	V6	3.50	6	125	4.09	26.07	104	4.50	4.65	6	272	3.16	9.55
	V7	3.55	5	207	3.98	25.39	103	-1.25	4.05	12	276	3.31	17.45
	V8	-		-	-	-	-		-		-	-	
	V9	2.51	13	154	4.13	29.62	104	0.00	4.25	9	280	3.22	12.00
	V10	3.11	11	145	3.44	28.21	100	4.13	4.60	7	273	3.24	10.45
	V11	2.74	12	181	3.15	23.87	95	-9.38	4.09	11	277	3.25	3.00
	V12	3.77	1	211	3.43	27.41	97	1.25	4.18	10	275	3.23	7.82
	V13	3.49	7	191	4.07	23.98	97	-2.25	4.02	13	273	3.29	4.18
	V14	3.47	8	194	3.65	28.16	106	-0.37	4.59	8	276	3.29	5.64
C.D.(0.05)		0.31		27.20	0.40	1.45	1.24		0.34		9.74	0.09	
C.V. (%)		7.92		13.42	9.05	4.74	1.07		6.31		3.02	2.41	
Expt. Mean		**3.38**		**175**	**3.87**	**26**	**100**		**4.62**		**279**	**3.27**	
Soil type		Sandy loam							Sandy Loam				
pH		6.55							7.60				
N - levels (kg/ha)													
F1		80:40:40							120:60:40				
F2		120:60:60							180:90:60				
Recommended N:P:K (kg/ha)		80:40:40							120:60:40				
Varieties													
	V1	IET 25746							IET 25746				
	V2	IET 25764							IET 25764				
	V3	IET 26079							IET 26079				
	V4	IET 25749							IET 25749				
	V5	IET 26125							IET 26125				
	V6	IET 24931							IET 24931				
	V7	IET 25330							IET 25330				
	V8	-							-				
	V9	PR 113							PR 113				
	V10	Lalat							Lalat				
	V11	Karjat 7							Karjat 7				
	V12	MTU 1010							MTU 1010				
	V13	HC- US 312							HC- US 312				
	V14	Local Check - Mandakini							Local Check - NDR 2065				
Available N:P:K of soil (kg/ha)		153.8:30.4:135.7							200:24:234				

Table 4.1(d): Contd.

F-levels	Varieties	GANGAVATHI							KARJAT						
		Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	9.71	4	307	5.31	26.59	100		5.56	12	363	4.30	27.45	98	
	V2	8.83	8	318	4.34	25.50	101		6.20	3	405	5.36	26.19	101	
	V3	8.51	12	344	4.17	25.57	92		5.22	16	341	3.79	24.25	101	
	V4	8.92	7	300	4.74	23.53	101		5.36	15	350	4.00	23.74	112	
	V5	8.36	16	308	3.08	23.45	89		5.52	13	360	4.23	24.62	100	
	V6	9.89	3	314	4.45	24.56	100		6.01	5	392	5.02	23.79	109	
	V7	8.41	15	341	3.68	21.79	100		4.80	21	314	3.20	22.20	108	
	V8	-		-	-	-	-		-		-	-	-	-	
	V9	7.06	21	325	3.93	29.92	104		5.21	17	340	3.77	29.36	104	
	V10	6.63	23	331	3.07	24.58	94		5.06	19	330	3.56	25.39	101	
	V11	5.57	26	316	2.28	21.18	89		4.38	23	285	2.66	28.48	100	
	V12	6.72	22	387	3.01	25.42	89		4.33	24	283	2.61	28.48	105	
	V13	8.63	11	337	4.22	20.83	100		5.73	9	374	4.56	23.35	111	
	V14	8.21	17	374	2.97	15.26	103		-		-	-	-	-	
F2	V1	10.22	2	304	4.71	27.50	100	3.40	5.92	6	386	4.80	28.62	100	2.88
	V2	9.40	5	336	4.50	25.60	101	3.80	6.63	1	433	6.03	26.26	102	3.44
	V3	9.29	6	325	4.68	25.08	96	5.20	5.64	10	368	4.37	24.63	100	3.36
	V4	8.70	10	308	4.92	24.03	104	-1.47	5.76	8	376	4.56	23.26	112	3.20
	V5	8.42	14	341	3.02	24.46	94	0.40	5.89	7	385	4.76	24.63	102	2.96
	V6	10.25	1	284	5.30	22.68	100	2.40	6.43	2	419	5.67	23.42	112	3.36
	V7	8.44	13	337	3.74	21.64	100	0.20	5.21	17	340	3.73	24.16	110	3.28
	V8	-		-	-	-	-		-		-	-	-	-	
	V9	7.34	19	327	3.75	28.61	104	1.87	5.63	11	367	4.34	30.18	106	3.36
	V10	5.96	24	332	2.86	25.63	94	-4.47	5.46	14	356	4.08	26.21	104	3.20
	V11	5.81	25	344	2.54	21.62	91	1.60	4.75	22	310	3.09	25.26	98	2.96
	V12	7.25	20	294	2.90	26.22	89	3.53	4.82	20	314	3.18	24.80	105	3.92
	V13	8.81	9	349	4.64	20.63	100	1.20	6.14	4	401	5.17	23.13	108	3.28
	V14	7.79	18	391	3.15	15.04	104	-2.80	-		-	-	-	-	
Interaction															
F at same V		NS		32.70	NS	NS	NS		NS		NS	NS	0.30	NS	
V at same F		NS		32.34	NS	NS	NS		NS		NS	NS	0.29	NS	
F1		8.11	2	331	3.79	23.71	97		5.28	2	345	3.92	25.61	104	
F2		8.28	1	329	3.90	23.75	98	1.14	5.69	1	371	4.48	25.38	105	3.27
C.D.(0.05)		NS		NS	NS	NS	NS		0.01		0.72	0.01	0.07	NS	
C.V.(%)		5.53		3.06	9.52	4.33	1.71		0.14		0.20	0.34	0.28	1.53	

Table 4.1(d): Contd.

F-levels	Varieties	GANGAVATHI							KARJAT						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:															
	V1	9.97	2	306	5.01	27.05	100	3.40	5.74	4	375	4.55	28.04	99	2.88
	V2	9.12	3	327	4.42	25.55	101	3.80	6.42	1	419	5.70	26.23	101	3.44
	V3	8.90	4	334	4.43	25.33	94	5.20	5.43	7	354	4.08	24.44	101	3.36
	V4	8.81	5	304	4.83	23.78	103	-1.47	5.56	6	363	4.28	23.50	112	3.20
	V5	8.39	8	324	3.05	23.96	92	0.40	5.71	5	373	4.50	24.63	101	2.96
	V6	10.07	1	299	4.88	23.62	100	2.40	6.22	2	406	5.35	23.61	111	3.36
	V7	8.43	7	339	3.71	21.72	100	0.20	5.01	10	327	3.47	23.18	109	3.28
	V8	-		-	-	-	-		-		-	-	-	-	
	V9	7.20	10	326	3.84	29.27	104	1.87	5.42	8	354	4.06	29.77	105	3.36
	V10	6.30	12	331	2.97	25.11	94	-4.47	5.26	9	343	3.82	25.80	103	3.20
	V11	5.69	13	330	2.41	21.40	90	1.60	4.57	12	298	2.88	26.87	99	2.96
	V12	6.99	11	340	2.96	25.82	89	3.53	4.58	11	299	2.90	26.64	105	3.92
	V13	8.72	6	343	4.43	20.73	100	1.20	5.94	3	387	4.87	23.24	110	3.28
	V14	8.00	9	382	3.06	15.15	103	-2.80	-		-	-	-	-	
C.D.(0.05)		0.48		23.12	0.37	1.12	2.05		0.14		8.92	0.21	0.21	2.91	
C.V. (%)		5.09		6.07	8.31	4.09	1.82		2.16		2.16	4.38	0.73	2.41	
Expt. Mean		**8.20**		**330**	**3.84**	**24**	**98**		**5.49**		**358**	**4.20**	**25.49**	**105**	
Soil type		Sandy loam							Sandy loam						
pH		8.30							7.95						
N - levels (kg/ha)															
F1		150:75:75							150:50:50						
F2		225:112.5:112.5							225:75:75						
Recommended N:P:K (kg/ha)		150:75:75:20							150:50:50						
Varieties															
	V1	IET 25746							IET 25746						
	V2	IET 25764							IET 25764						
	V3	IET 26079							IET 26079						
	V4	IET 25749							IET 25749						
	V5	IET 26125							IET 26125						
	V6	IET24731							IET24731						
	V7	IET 25330(R)							IET 25330(R)						
	V8	-							-						
	V9	PR 113							PR 113						
	V10	Lalat							Lalat						
	V11	Karjat 7							Karjat 7						
	V12	MTU 1010							MTU 1010						
	V13	HC- US 312							HC- US 312						
	V14	Local Check(GVT-Sona)							-						
Available N:P:K of soil (kg/ha)		-							-						

Table 4.1(d): Contd.

F-levels	Varieties	KANPUR					KOTA				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	3.56	22	278	2.27		7.08	10	311	5.23	
	V2	3.61	21	284	2.28		7.20	9	317	5.27	
	V3	3.73	16	286	2.18		6.64	14	294	5.00	
	V4	3.69	17	285	2.27		8.59	2	370	6.05	
	V5	3.78	15	283	2.24		6.35	16	286	4.85	
	V6	3.81	14	297	2.26		7.96	4	351	5.74	
	V7	3.69	17	281	2.15		7.53	6	334	5.43	
	V8	-		-	-		5.29	19	230	3.62	
	V9	3.41	25	278	2.12		-		-	-	
	V10	3.50	24	282	2.12		-		-	-	
	V11	3.33	26	274	2.02		5.40	18	245	4.12	
	V12	3.64	20	282	2.14		-		-	-	
	V13	3.52	23	286	2.14		6.82	13	303	5.11	
	V14	3.69		292	2.15		-		-	-	
F2	V1	4.00	9	294	2.39	3.67	7.24	8	316	5.30	1.45
	V2	4.07	7	299	2.44	3.83	7.40	7	325	5.41	1.82
	V3	4.11	5	304	2.41	3.17	6.88	12	301	5.10	2.18
	V4	4.25	4	302	2.41	4.67	8.68	1	378	5.90	0.82
	V5	4.42	2	299	2.40	5.33	6.58	15	297	5.05	2.09
	V6	4.60	1	306	2.32	6.58	8.22	3	357	5.80	2.36
	V7	4.33	3	291	2.28	5.33	7.77	5	343	5.63	2.18
	V8	-		-	-		5.08	20	235	3.60	-1.91
	V9	3.95	10	288	2.26	4.50	-		-	-	
	V10	4.06	8	289	2.23	4.67	-		-	-	
	V11	3.84	13	283	2.20	4.25	5.63	17	251	4.18	2.09
	V12	3.95	10	288	2.24	2.58	-		-	-	
	V13	3.94	12	291	2.28	3.50	7.08	10	310	5.21	2.36
	V14	4.08	6	299	2.35	3.25	-		-	-	
Interaction											
F at same V		NS		NS	NS		NS		NS	NS	
V at same F		NS		NS	NS		NS		NS	NS	
F1		3.61	2	284	2.18		6.89	2	304	5.04	
F2		4.12	1	295	2.32	4.26	7.06	1	311	5.12	1.55
C.D.(0.05)		0.02		0.57	0.09		NS		NS	NS	
C.V.(%)		0.55		0.20	4.10		5.25		5.79	6.83	

Table 4.1(d): Contd.

F-levels	Varieties	KANPUR					KOTA				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:											
	V1	3.78	9	286	2.33	3.67	7.16	5	314	5.27	1.45
	V2	3.84	7	292	2.36	3.83	7.30	4	321	5.34	1.82
	V3	3.92	5	295	2.30	3.17	6.76	7	298	5.05	2.18
	V4	3.97	4	293	2.34	4.67	8.64	1	374	5.98	0.82
	V5	4.10	2	291	2.32	5.33	6.47	8	292	4.95	2.09
	V6	4.21	1	302	2.29	6.58	8.09	2	354	5.77	2.36
	V7	4.01	3	286	2.22	5.33	7.65	3	339	5.53	2.18
	V8	-		-	-		5.19	10	233	3.61	-1.91
	V9	3.68	12	283	2.19	4.50	-		-	-	
	V10	3.78	10	286	2.18	4.67	-		-	-	
	V11	3.59	13	279	2.11	4.25	5.52	9	248	4.15	2.09
	V12	3.80	8	285	2.19	2.58	-		-	-	
	V13	3.73	11	289	2.21	3.50	6.95	6	307	5.16	2.36
	V14	3.89	6	296	2.25	3.25	-		-	-	
C.D.(0.05)		0.18		5.24	0.10		0.54		20.81	0.31	
C.V. (%)		3.97		1.57	3.81		6.67		5.80	5.29	
Expt. Mean		**3.87**		**289**	**2.25**		**6.97**		**308**	**5.08**	
Soil type		Sandy loam					Clay loam				
pH		7.95					8.14				
N - levels (kg/ha)											
F1		120:60:60					120:60:40				
F2		180:90:90					180:90:60				
Recommended N:P:K (kg/ha)		120:60:60					120:60:40				
Varieties											
V1		IET 25746					IET 25746				
V2		IET 25764					IET 25764				
V3		IET 26079					IET 26079				
V4		IET 25749					IET 25749				
V5		IET 26125					IET 26125				
V6		IET24731					IET24731				
V7		IET 25330(R)					IET 25330				
V8		-					IR 64				
V9		PR 113					-				
V10		Lalat					-				
V11		Karjat 7					Karjat 7				
V12		MTU 1010					-				
V13		HC- US 312					HC- US 312				
V14		Local Check- Pant 12					-				
Available N:P:K of soil (kg/ha)		204:18:182					320:62:525				

Table 4.1(d): Contd.

F-levels	Varieties	MANDYA							NAVSARI						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	7.87	4	357	6.23	28.47	109		4.47	4	99	2.12	22.63	102	
	V2	7.09	8	326	6.31	25.53	108		4.30	7	114	1.77	25.54	103	
	V3	7.3	7	364	6.12	26.70	95		3.56	20	93	2.45	21.68	103	
	V4	8.01	3	340	6.36	23.71	109		4.04	11	97	1.64	21.47	101	
	V5	5.62	20	343	4.88	25.89	92		3.66	18	106	1.56	22.38	85	
	V6	6.91	10	399	6.40	25.19	99		4.40	5	107	2.25	21.34	94	
	V7	7.36	6	361	5.62	22.35	101		4.21	8	90	2.55	19.70	84	
	V8	3.82	26	364	3.65	29.62	96		-		-	-	-	-	
	V9	6.35	17	361	5.20	34.30	113		2.97	24	102	2.15	27.24	103	
	V10	4.03	25	333	4.74	28.29	98		3.21	22	112	2.18	21.91	91	
	V11	4.57	23	319	4.29	22.77	96		2.93	25	125	1.39	21.66	95	
	V12	6.21	18	427	4.82	27.45	96		2.80	26	100	1.46	23.18	94	
	V13	6.63	14	319	5.65	22.44	102		4.02	12	105	1.51	19.36	102	
	V14	3.56	28	354	2.86	17.07	92		4.11	9	106	2.35	29.30	91	
F2	V1	8.12	2	371	6.26	28.35	109	2.50	5.07	1	96	2.58	20.11	99	6.67
	V2	7.08	9	333	6.28	26.31	108	-0.10	4.89	2	127	2.22	25.00	103	6.56
	V3	7.39	5	375	5.97	25.65	95	0.90	3.59	19	95	2.28	23.02	103	0.33
	V4	8.76	1	354	6.04	24.19	109	7.50	3.76	15	101	3.02	23.77	102	-3.11
	V5	5.85	19	354	5.20	26.45	92	2.30	3.72	16	123	1.95	21.24	80	0.67
	V6	6.9	11	375	6.66	25.09	99	-0.10	4.53	3	130	2.34	22.77	101	1.44
	V7	6.77	12	410	5.50	25.73	101	-5.90	3.77	14	107	2.15	20.34	95	-4.89
	V8	4.84	22	371	3.65	29.43	96	10.20	-		-	-	-	-	
	V9	6.59	15	364	5.48	32.22	112	2.40	3.01	23	106	2.03	27.52	102	0.44
	V10	4.4	24	336	4.86	27.59	98	3.70	3.69	17	93	2.21	26.93	95	5.33
	V11	4.93	21	382	3.97	26.77	96	3.60	3.35	21	101	1.47	20.98	87	4.67
	V12	6.53	16	441	4.62	27.68	96	3.20	3.82	13	103	1.68	24.36	87	11.33
	V13	6.64	13	347	5.33	22.96	102	0.10	4.34	6	105	2.33	20.69	101	3.56
	V14	3.68	27	378	3.60	22.64	92	1.20	4.06	10	125	2.31	28.20	91	-0.56
Interaction															
F at same V		NS		NS	NS	NS	NS		NS		16.78	0.45	NS	NS	
V at same F		NS		NS	NS	NS	NS		NS		16.65	0.54	NS	NS	
F1		6.10	2	355	5.22	25.70	100		3.74	2	104	1.95	22.88	96	
F2		6.32	1	371	5.24	26.50	100	3.00	3.97	1	108	2.20	23.46	96	2.50
C.D.(0.05)		NS		NS	NS	NS	NS		NS		NS	NS	NS	NS	
C.V.(%)		5.13		10.45	11.25	12.53	0.38		19.99		5.19	19.84	4.58	5.25	

Table 4.1(d): Contd.

F-levels	Varieties	MANDYA							NAVSARI						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:															
	V1	8.00	2	364	6.25	28.41	109	2.50	4.77	1	97	2.35	21.37	101	6.67
	V2	7.09	4	329	6.30	25.92	108	-0.10	4.60	2	120	2.00	25.27	103	6.56
	V3	7.35	3	369	6.05	26.18	95	0.90	3.58	9	94	2.37	22.35	103	0.33
	V4	8.39	1	347	6.20	23.95	109	7.50	3.90	7	99	2.33	22.62	102	-3.11
	V5	5.74	10	348	5.04	26.17	92	2.30	3.69	8	114	1.76	21.81	83	0.67
	V6	6.91	6	387	6.53	25.14	99	-0.10	4.47	3	118	2.30	22.06	97	1.44
	V7	7.07	5	385	5.56	24.04	101	-5.90	3.99	6	98	2.35	20.02	90	-4.89
	V8	4.33	12	368	3.65	29.53	96	10.20	-		-	-	-	-	
	V9	6.47	8	362	5.34	33.26	113	2.40	2.99	13	104	2.09	27.38	102	0.44
	V10	4.22	13	334	4.80	27.94	98	3.70	3.45	10	103	2.20	24.42	93	5.33
	V11	4.75	11	350	4.13	24.77	96	3.60	3.14	12	113	1.43	21.32	91	4.67
	V12	6.37	9	434	4.72	27.57	96	3.20	3.31	11	101	1.57	23.77	91	11.33
	V13	6.64	7	333	5.49	22.70	102	0.10	4.18	4	105	1.92	20.03	102	3.56
	V14	3.62	14	366	3.23	19.86	92	1.20	4.09	5	116	2.33	28.75	91	-0.56
C.D.(0.05)		1.14		51.97	0.62	2.93	0.93		0.57		11.86	0.32	1.75	7.75	
C.V. (%)		15.96		12.42	10.19	9.74	0.80		12.74		9.66	13.34	6.54	6.99	
Expt. Mean		**6.21**		**363**	**5.23**	**26.10**	**100**		**3.86**		**106**	**2.08**	**23.17**	**96**	
Soil type		Red Sandy Loam							Clay						
pH		7.02							7.92						
N - levels (kg/ha)															
F1		100:50:50							100:30:50						
F2		150:75:75							150:45:75						
Recommended N:P:K (kg/ha)		100:50:50							100:30:50						
Varieties															
V1		IET 25746							IET 25746						
V2		IET 25764							IET 25764						
V3		IET 26079							IET 26079						
V4		IET 25749							IET 25749						
V5		IET 26125							IET 26125						
V6		IET24731							IET 24931						
V7		IET 25330(R)							IET 25330(R)						
V8		IR 64							-						
V9		ZC- PR 113 (N)							ZC- PR 113 (N)						
V10		Lalat (E & NE)							Lalat (E & NE)						
V11		Karjat 7 (W)							Karjat 7 (W)						
V12		MTU 1010 (C & S)							MTU 1010 (C & S)						
V13		HC- US 312							HC- US 312						
V14		Chittimuthyalu							Local Check (GNR-3)						
Available N:P:K of soil (kg/ha)		354:5.87:285							156:148:320						

Table 4.1(d): Contd.

F-levels	Varieties	NAWAGAM							PANTNAGAR						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
F1	V1	3.82	16	207	2.47	25.10	61		5.18	4	198	2.86	26.77	85	
	V2	4.05	13	218	2.60	21.20	61		4.30	15	183	2.76	26.33	84	
	V3	4.48	9	178	3.07	20.60	65		4.47	14	191	2.67	25.17	87	
	V4	4.11	12	219	3.13	21.80	67		4.15	16	184	2.65	25.47	89	
	V5	5.15	4	204	3.13	19.43	61		4.75	11	197	2.75	24.53	86	
	V6	4.98	6	185	2.93	20.97	69		4.65	13	205	2.54	26.37	89	
	V7	3.73	19	203	2.60	17.93	69		-		-	-	-	-	
	V8	3.41		191	3.00	21.03	59		-		-	-	-	-	
	V9	3.65	21	198	2.53	22.33	65		4.93	9	213	2.62	23.30	85	
	V10	3.47	23	189	2.20	18.77	61		-		-	-	-	-	
	V11	2.03	28	194	3.00	18.30	53		-		-	-	-	-	
	V12	4.69	8	160	2.67	21.37	68		-		-	-	-	-	
	V13	3.70	20	201	2.20	17.63	66		-		-	-	-	-	
	V14	4.75	7	216	2.67	24.47	63		4.97	8	205	2.72	26.27	83	
F2	V1	4.22	11	187	2.40	25.13	59	6.40	5.35	2	206	2.94	26.73	83	1.55
	V2	3.91	15	204	2.80	21.53	62	-2.24	5.07	6	207	2.71	26.47	81	7.00
	V3	5.80	1	196	3.27	22.93	66	21.12	4.85	10	229	2.36	25.27	87	3.45
	V4	5.15	4	185	3.00	20.40	68	16.64	4.74	12	224	2.43	25.57	88	5.36
	V5	5.30	2	224	3.33	20.13	61	2.40	5.17	5	236	2.42	24.80	84	3.82
	V6	3.18	26	208	2.53	21.03	69	-28.80	4.98	7	214	2.55	26.40	88	3.00
	V7	3.76	18	209	2.27	16.63	69	0.48	-		-	-	-	-	
	V8	3.82		230	3.33	21.80	60	6.56	-		-	-	-	-	
	V9	3.30	25	211	2.40	27.50	63	-5.60	5.22	3	220	2.72	23.47	90	2.64
	V10	3.94	14	187	2.67	24.23	64	7.52	-		-	-	-	-	
	V11	2.31	27	152	2.87	18.00	54	4.48	-		-	-	-	-	
	V12	4.25	10	237	1.73	21.77	69	-7.04	-		-	-	-	-	
	V13	3.62	22	210	2.20	17.67	68	-1.28	-		-	-	-	-	
	V14	5.21	3	217	3.40	24.90	63	7.36	5.53	1	219	2.86	26.47	84	5.09
Interaction															
F at same V		NS		30.42	0.51	1.17	NS		NS		NS	NS	NS	NS	
V at same F		NS		49.62	0.56	1.47	NS		NS		NS	NS	NS	NS	
F1		4.00	2	197	2.73	20.78	63		4.68	2	197	2.70	25.53	86	
F2		4.13	1	204	2.73	21.69	64	2.00	5.11	1	219	2.62	25.65	86	3.99
C.D.(0.05)		NS		NS	NS	NS	NS		0.32		8.24	NS	NS	NS	
C.V.(%)		17.78		27.49	12.70	6.08	1.46		5.28		3.19	10.14	1.93	4.18	

Table 4.1(d): Contd.

F-levels	Varieties	NAWAGAM							PANTNAGAR						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
Mean of varieties:															
	V1	4.02	7	197	2.44	25.12	60	6.40	5.27	1	202	2.90	26.75	84	1.55
	V2	3.98	8	211	2.70	21.37	62	-2.24	4.69	6	195	2.74	26.40	83	7.00
	V3	5.14	2	187	3.17	21.77	66	21.12	4.66	7	210	2.52	25.22	87	3.45
	V4	4.63	4	202	3.07	21.10	68	16.64	4.45	8	204	2.54	25.52	88	5.36
	V5	5.23	1	214	3.23	19.78	61	2.40	4.96	4	216	2.59	24.67	85	3.82
	V6	4.08	6	196	2.73	21.00	69	-28.80	4.82	5	209	2.55	26.39	89	3.00
	V7	3.75	9	206	2.44	17.28	69	0.48	-		-	-	-	-	
	V8	3.62	12	210	3.17	21.42	59	6.56	-		-	-	-	-	
	V9	3.48	13	204	2.47	24.92	64	-5.60	5.08	3	217	2.67	23.39	88	2.64
	V10	3.71	10	188	2.44	21.50	63	7.52	-		-	-	-	-	
	V11	2.17	14	173	2.94	18.15	54	4.48	-		-	-	-	-	
	V12	4.47	5	199	2.20	21.57	69	-7.04	-		-	-	-	-	
	V13	3.66	11	205	2.20	17.65	67	-1.28	-		-	-	-	-	
	V14	4.98	3	217	3.04	24.69	63	7.36	5.25	2	212	2.79	26.37	84	5.09
C.D.(0.05)		0.71		21.51	0.36	0.83	1.85		0.31		NS	0.22	0.65	2.58	
C.V. (%)		15.19		9.29	11.53	3.38	2.51		5.40		6.44	6.99	2.15	2.54	
Expt. Mean		**4.06**		**201**	**2.73**	**21.24**	**64**		**4.89**		**208**	**2.66**	**26**	**86**	
Soil type		Clay loam							Silt loam						
pH		7.50							7.80						
N - levels (kg/ha)															
F1		100:25:0							120:60:40						
F2		150:37.5:0							180:90:60						
Recommended N:P:K (kg/ha)		100:25:0							120:60:40						
Varieties															
	V1	IET 25746							IET 25746						
	V2	IET 25764							IET 25764						
	V3	IET 26079							IET 26079						
	V4	IET 25749							IET 25749						
	V5	IET 26125							IET 26125						
	V6	IET 24931							IET 24931						
	V7	IET 25330(R)							-						
	V8	IR 64							-						
	V9	PR 113 (N)							PR 113						
	V10	Lalat (E & NE)							-						
	V11	Karjat 7 (W)							-						
	V12	MTU 1010 (C & S)							-						
	V13	HC- US 312							-						
	V14	Local Check (GNR-3)							Local Check - PD 22						
Available N:P:K of soil (kg/ha)		-:211:41							232:21.4:223						

Table 4.1(d): Contd.

F-levels	Varieties	PATTAMBI							PUDUCHERRY					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
F1	V1	5.65	12	224	3.87	29.48	93		6.78	4	372	5.70	25.49	
	V2	6.74	2	240	4.66	26.66	98		6.68	7	365	5.58	24.44	
	V3	4.88	18	245	3.42	23.38	96		5.56	19	277	4.00	24.62	
	V4	5.40	15	203	5.07	23.81	104		6.84	3	374	5.84	24.66	
	V5	5.70	10	292	2.61	24.03	92		5.45	21	287	4.12	24.53	
	V6	6.07	4	239	4.05	23.33	97		6.45	10	350	5.25	23.62	
	V7	6.04	5	272	4.10	21.47	93		5.18	23	258	3.38	23.74	
	V8	-		-	-	-	-		-		-	-	-	
	V9	3.77	23	317	3.83	29.70	99		6.51	9	355	5.39	27.57	
	V10	5.26	16	297	3.28	27.56	96		6.34	13	335	4.90	26.29	
	V11	3.85	22	188	2.77	24.61	86		5.52	20	267	3.68	23.85	
	V12	3.19	26	267	3.03	20.83	102		5.91	15	323	4.47	24.47	
	V13	3.68	24	321	3.72	20.64	110		5.94	14	321	4.45	23.69	
	V14	5.95	7	348	2.77	23.49	104		4.82	26	240	2.90	22.69	
F2	V1	5.68	11	249	3.80	28.49	90	0.33	6.70	6	350	5.49	25.76	-1.33
	V2	7.09	1	254	4.00	25.55	97	3.89	6.96	1	344	5.37	25.74	4.67
	V3	6.24	3	257	3.62	24.21	95	15.11	5.87	16	254	3.87	25.28	5.17
	V4	5.82	9	210	4.23	24.99	102	4.67	6.75	5	363	5.61	25.15	-1.50
	V5	5.64	13	325	3.23	23.87	91	-0.67	5.24	22	268	3.92	24.04	-3.50
	V6	5.89	8	241	4.03	24.15	96	-2.00	6.89	2	329	5.02	24.72	7.33
	V7	5.60	14	271	3.32	21.57	92	-4.89	5.12	24	226	3.28	23.59	-1.00
	V8	-		-	-	-	-		-		-	-	-	
	V9	4.88	18	305	3.89	28.57	98	12.33	6.44	11	335	5.18	26.58	-1.17
	V10	5.21	17	356	2.99	27.74	93	-0.56	6.68	7	308	4.78	26.35	5.67
	V11	4.04	21	355	3.21	23.25	87	2.11	5.78	18	248	3.58	24.41	4.33
	V12	4.20	20	274	3.14	22.60	101	11.22	5.83	17	299	4.37	24.31	-1.33
	V13	3.41	25	295	3.83	20.00	94	-3.00	6.37	12	284	4.35	24.53	7.17
	V14	6.03	6	356	3.04	24.24	106	0.89	4.86	25	208	2.70	23.50	0.67
Interaction														
F at same V		NS		49.05	NS	NS	3.58		NS		NS	NS	NS	
V at same F		NS		60.57	NS	NS	3.92		NS		NS	NS	NS	
F1		5.09	2	265	3.63	24.54	97		6.00	2	317	4.59	24.59	
F2		5.36	1	288	3.56	24.56	95	3.03	6.11	1	293	4.42	24.92	1.94
C.D.(0.05)		0.24		NS	NS	NS	NS		0.05		7.75	0.06	NS	
C.V.(%)		1.28		6.97	15.52	3.41	1.01		0.86		2.60	1.44	13.30	

Table 4.1(d): Contd.

F-levels	Varieties	PATTAMBI							PUDUCHERRY					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
Mean of varieties:														
	V1	5.67	6	236	3.84	28.99	91	0.33	6.74	3	361	5.60	25.63	-1.33
	V2	6.92	1	247	4.33	26.11	97	3.89	6.82	1	354	5.48	25.09	4.67
	V3	5.56	8	251	3.52	23.80	95	15.11	5.72	9	265	3.94	24.95	5.17
	V4	5.61	7	206	4.65	24.40	103	4.67	6.80	2	369	5.73	24.91	-1.50
	V5	5.67	5	308	2.92	23.95	92	-0.67	5.35	11	277	4.02	24.29	-3.50
	V6	5.98	3	240	4.04	23.74	97	-2.00	6.67	4	340	5.14	24.17	7.33
	V7	5.82	4	271	3.71	21.52	92	-4.89	5.15	12	242	3.33	23.67	-1.00
	V8	-		-	-	-	-		-		-	-	-	
	V9	4.33	10	311	3.86	29.14	98	12.33	6.48	6	345	5.29	27.08	-1.17
	V10	5.24	9	326	3.14	27.65	94	-0.56	6.51	5	321	4.84	26.32	5.67
	V11	3.95	11	272	2.99	23.93	86	2.11	5.65	10	258	3.63	24.13	4.33
	V12	3.70	12	270	3.09	21.72	101	11.22	5.87	8	311	4.42	24.39	-1.33
	V13	3.55	13	308	3.78	20.32	102	-3.00	6.16	7	302	4.40	24.11	7.17
	V14	5.99	2	352	2.91	23.87	105	0.89	4.84	13	224	2.80	23.10	0.67
C.D.(0.05)		0.65		34.69	0.71	1.69	2.53		0.31		19.92	0.24	1.35	
C.V. (%)		8.58		8.59	13.48	4.70	1.80		4.43		5.65	4.56	4.71	
Expt. Mean		**5.23**		**277**	**3.60**	**24.55**	**96**		**6.06**		**305**	**4.51**	**24.75**	
Soil type		Red Lateritic							Clay loam					
pH		5.60							6.69					
N - levels (kg/ha)														
F1		90:45:45							120:40:40					
F2		135:67.5:67.5							180:40:40					
Recommended N:P:K (kg/ha)		90:45:45							120:40:40					
Varieties														
V1		IET 25746							IET 25746					
V2		IET 25764							IET 25764					
V3		IET 26079							IET 26079					
V4		IET 25749							IET 25749					
V5		IET 26125							IET 26125					
V6		IET 24931							IET 24931					
V7		IET 25330(R)							IET 25330(R)					
V8		-							-					
V9		PR 113 (N)							PR 113					
V10		Lalat (E & NE)							Lalat					
V11		Karjat 7 (W)							Karjat 7					
V12		MTU 1010 (C & S)							MTU 1010					
V13		HC- US 312							HC- US 312					
V14		Local Check - UMA							Local Check - W.Ponni					
Available N:P:K of soil (kg/ha)		204:20.5:94							280:50:184					

Table 4.1(d): Contd.

F-levels	Varieties	VARANASI						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
F1	V1	5.07	5	222	3.85	26.70	96	
	V2	4.52	9	237	3.37	24.68	98	
	V3	5.07	5	207	3.75	22.98	89	
	V4	4.05	11	213	4.73	21.16	99	
	V5	3.57	15	295	2.59	20.76	84	
	V6	3.35	17	237	3.49	22.08	102	
	V7	3.82	13	229	3.56	19.46	101	
	V8	-		-	-	-	-	
	V9	3.00	22	227	2.75	27.74	95	
	V10	3.25	18	242	2.63	24.60	104	
	V11	2.92	23	285	1.78	19.28	97	
	V12	2.57	24	253	1.71	23.40	85	
	V13	4.75	8	228	3.46	19.12	100	
	V14	-		-	-	-	-	
F2	V1	6.20	1	236	4.47	26.48	95	10.27
	V2	5.17	4	251	3.81	25.50	97	5.91
	V3	4.50	10	233	4.02	23.26	88	-5.18
	V4	5.27	3	228	2.93	21.70	99	11.09
	V5	4.80	7	291	2.77	22.42	84	11.18
	V6	3.37	16	227	2.83	21.72	100	0.18
	V7	3.72	14	243	3.04	20.72	101	-0.91
	V8	-		-	-	-	-	
	V9	3.10	20	242	2.82	23.90	96	0.91
	V10	4.00	12	274	3.30	24.22	104	6.82
	V11	3.17	19	296	2.04	17.30	95	2.27
	V12	3.07	21	239	2.58	23.24	87	4.55
	V13	5.70	2	236	4.27	19.32	100	8.64
	V14	-		-	-	-	-	
Interaction								
F at same V		0.23		14.04	0.89	0.88	NS	
V at same F		0.23		13.91	0.94	0.85	NS	
F1		3.83	2	239	3.14	22.66	96	
F2		4.34	1	250	3.24	22.48	95	4.64
C.D.(0.05)		0.09		4.59	NS	NS	NS	
C.V.(%)		2.19		1.85	16.06	0.86	1.23	

Table 4.1(d): Contd.

F-levels	Varieties	VARANASI						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)
Mean of varieties:								
V1		5.64	1	229	4.16	26.59	95	10.27
V2		4.85	3	244	3.59	25.09	98	5.91
V3		4.79	4	220	3.89	23.12	88	-5.18
V4		4.66	5	220	3.83	21.43	99	11.09
V5		4.19	6	293	2.68	21.59	84	11.18
V6		3.36	9	232	3.16	21.90	101	0.18
V7		3.77	7	236	3.30	20.09	101	-0.91
V8		-		-	-	-	-	
V9		3.05	10	235	2.79	25.82	95	0.91
V10		3.63	8	258	2.97	24.41	104	6.82
V11		3.05	11	291	1.91	18.29	96	2.27
V12		2.82	12	246	2.15	23.32	86	4.55
V13		5.23	2	232	3.87	19.22	100	8.64
V14		-		-	-	-	-	
C.D.(0.05)		0.16		9.93	0.63	0.62	1.48	
C.V. (%)		3.44		3.52	17.09	2.38	1.34	
Expt. Mean		**4.08**		**244**	**3.19**	**22.57**	**96**	
Soil type		Sandy loam						
pH		7.02						
N - levels (kg/ha)								
F1		120:60:40						
F2		180:90:60						
Recommended N:P:K (kg/ha)		120:60:40						
Varieties								
V1		IET 25746						
V2		IET 25764						
V3		IET 26079						
V4		IET 25749						
V5		IET 26125						
V6		IET 24931						
V7		IET 25330(R)						
V8		-						
V9		PR 113 (N)						
V10		Lalat (E & NE)						
V11		Karjat 7 (W)						
V12		MTU 1010 (C & S)						
V13		HC- US 312						
V14		-						
Available N:P:K of soil (kg/ha)		216:19.56:201						

Table 4.1(d): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)		
F1	V1	4.67	5	292	7.96	90		5.39	6
	V2	4.33	12	287	6.73	89		5.33	8
	V3	4.42	11	294	6.60	87		5.08	13
	V4	3.97	20	261	5.82	92		5.18	11
	V5	4.03	18	286	5.65	85		4.89	16
	V6	4.1	16	282	5.78	89		5.34	7
	V7	3.63	23	260	3.98	101		4.97	15
	V8	-		-	-	-		4.17	27
	V9	3.87	22	270	5.74	95		4.41	23
	V10	3.47	25	252	4.06	94		4.37	24
	V11	2.67	26	226	3.68	90		3.95	28
	V12	3.97	20	257	4.99	84		4.36	25
	V13	4.03	18	261	4.74	89		5.01	14
	V14	4.13	15	270	5.28	103		4.64	21
F2	V1	5.2	1	339	8.94	90	8.83	5.85	1
	V2	4.72	3	313	7.45	90	6.50	5.74	2
	V3	4.93	2	318	8.32	88	8.50	5.52	5
	V4	4.48	9	316	6.25	92	8.50	5.63	3
	V5	4.63	6	305	7.25	85	10.00	5.19	10
	V6	4.5	8	312	7.39	90	6.67	5.55	4
	V7	4.33	12	294	4.72	102	11.67	5.18	12
	V8	-		-	-	-		4.58	22
	V9	4.52	7	294	6.51	95	10.83	4.76	18
	V10	4.05	17	297	5.03	95	9.67	4.68	20
	V11	3.48	24	267	4.30	90	13.50	4.21	26
	V12	4.32	14	302	5.47	84	5.83	4.75	19
	V13	4.43	10	289	5.26	89	6.67	5.26	9
	V14	4.7	4	289	6.51	103	9.50	4.88	17
Interaction									
F at same V		NS		NS	NS	NS			
V at same F		NS		NS	NS	NS			
F1		3.95	2	269	5.46	91		4.87	2
F2		4.48	1	303	6.42	92	8.97	5.20	1
C.D.(0.05)		0.09		14.45	0.48	NS			
C.V.(%)		2.09		5.19	8.31	0.54			

Table 4.1(d): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)		
Mean of varieties:									
	V1	4.94	1	316	8.45	90	8.83	5.62	1
	V2	4.53	3	300	7.09	89	6.50	5.54	2
	V3	4.68	2	306	7.46	88	8.50	5.30	5
	V4	4.23	8	288	6.04	92	8.50	5.41	4
	V5	4.33	5	296	6.45	85	10.00	5.04	8
	V6	4.30	6	297	6.59	90	6.67	5.45	3
	V7	3.98	11	277	4.35	101	11.67	5.07	7
	V8	-		-	-	-		4.38	13
	V9	4.20	9	282	6.13	95	10.83	4.58	10
	V10	3.76	12	274	4.55	95	9.67	4.53	12
	V11	3.08	13	246	3.99	90	13.50	4.08	14
	V12	4.15	10	279	5.23	84	5.83	4.56	11
	V13	4.23	7	275	5.00	89	6.67	5.14	6
	V14	4.42	4	280	5.90	103	9.50	4.76	9
C.D.(0.05)		0.42		15.46	0.62	0.48			
C.V. (%)		8.73		4.68	9.03	0.45			
Expt. Mean		**4.21**		**286**	**5.94**	**92**		5.03	
Soil type		-							
pH		-							
N - levels (kg/ha)									
F1		120:60:40							
F2		180:60:40							
Recommended N:P:K (kg/ha)		120:60:40							
Varieties									
V1		IET 25746							
V2		IET 25764							
V3		IET 26079							
V4		IET 25749							
V5		IET 26125							
V6		IET 24931							
V7		IET 25330(R)							
V8		-							
V9		PR 113 (N)							
V10		Lalat (E & NE)							
V11		Karjat 7 (W)							
V12		MTU 1010 (C & S)							
V13		HC- US 312							
V14		Local Check - R. Sweta							
Available N:P:K of soil (kg/ha)		-							

4.1(e) NMT IM (Transplanted)

Different AVT-2 entries (IET-26027, IET-25997 and IET-25785) of medium duration were evaluated for their response to nutrients and grain yield from ten different locations viz., **Aduthurai (150:60:60), Chinsurah (120:60:60), Chiplima (80:40:40), Coimbatore (150:60:60), Faizabad (120:60:60), Jagdalpur (100:60:40), Karjat (150:50:50), Kaul (150:60:60), Nagina (120:60:40), Titabar (60:20:40)** and **Dhangain (120:60:40)** under two different levels of nutrient input (100% and 150% RDF). The details and data received from these locations are summarized and presented in Table 4.1 (e).

Application of different nutrient levels significantly influenced the grain yield at all the locations and the maximum increase in grain yield was observed with 150% RDF. Application of 150% RDF recorded higher grain yields at **Aduthurai** (5.39 t/ha), **Chinsurah** (4.78 t/ha), **Chiplima** (3.93 t/ha), **Coimbatore** (5.22 t/ha), **Faizabad** (5.43 t/ha), **Jagdalpur** (6.47 t/ha), **Karjat** (4.94 t/ha), **Kaul** (7.13 t/ha), **Nagina** (4.41 t/ha), **Titabar** (5.12 t/ha) and Dhangain (5.02 t/ha). Higher nutrient response was recorded with 150% RDF at **Aduthurai** (3.73), **Chinsurah** (4.18), **Chiplima** (5.37), **Coimbatore** (2.57), **Faizabad** (8.03), **Jagdalpur** (8.91), **Karjat** (5.12), **Kaul** (0.73), **Nagina** (1.27), **Titabar** (7.46) and **Dhangain** (10.37).

Grain yield differences among the tested varieties were found to be significant at all the locations. Highest grain yield was recorded by IET 26027 at **Aduthurai** (6.15 t/ha), **Faizabad** (6.21 t/ha), **Titabar** (5.46 t/ha) and **Dhangain** (5.61 t/ha). At **Chinsurah**, IET 25997 recorded higher grain yield (5.42 t/ha) and was followed by IET 26027 (4.87 t/ha) and NDR 8002 (4.56 t/ha). At **Chiplima**, IET 25997 (4.12 t/ha) recorded higher grain yield and was followed by NDR 8002 (4.01 t/ha). IET 25785 was superior and had the highest grain yield at **Coimbatore** (5.48 t/ha), **Jagdalpur** (7.07 t/ha), **Kaul** (7.42 t/ha) and **Nagina** (4.57 t/ha).Mean over the locations IET 26027 (5.47 t/ha) performed better and was closely followed by IET 25997 (5.39 t/ha), local check (5.11 t/ha) and IET 25785 (5.12 t/ha). Interaction effects among RDF x varieties was found to be non-significant at all the locations except at **Chiplima** and **Karjat** where significant interaction was noted. Significant interaction for grain yield was noted with application of 150% RDF with IET 25997 at **Chiplima** and **Karjat**.

In this trial, mean over the locations nutrient management with 150% RDF was found to be promising. IET 26027, IET 25997, IET 25785 were found to be promising on overall mean grain yield over the locations.

Table 4.1 (e): Summary of data on grain yield and ancillary characters of selected Irrigated Medium (Transplanted) cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	ADUTHURAI							CHINSURAH				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	6.00	2	399	3.03	25.84	92		4.61	7	427	4.27	
	V2	5.50	6	396	2.92	23.51	88		5.22	2	484	4.84	
	V3	5.17	10	397	2.89	24.70	91		3.83	13	358	3.56	
	V4	5.50	6	378	3.18	29.52	88		3.50	14	324	3.25	
	V5	-		-	-	-	-		-		-	-	
	V6	-		-	-	-	-		4.50	9	414	4.17	
	V7	3.73	14	389	2.59	26.47	85		-		-	-	
	V8	4.47	12	308	2.76	28.33	91		4.00	11	371	3.70	
	V9	-		-	-	-	-		-		-	-	
	V10	5.40	9	382	2.18	25.77	100		4.30	10	402	4.00	
F2	V1	6.30	1	401	3.17	25.98	93	4.00	5.12	3	474	4.74	4.25
	V2	5.67	5	399	3.03	23.66	90	2.27	5.61	1	521	5.21	3.25
	V3	5.50	6	398	2.98	25.64	93	4.40	3.89	12	359	3.60	0.50
	V4	5.73	4	381	3.58	29.64	89	3.07	4.72	5	438	4.38	10.17
	V5	-		-	-	-	-		-		-	-	
	V6	-		-	-	-	-		4.61	7	429	4.28	0.92
	V7	4.00	13	392	2.68	26.53	87	3.60	-		-	-	
	V8	4.73	11	309	2.77	28.41	93	3.47	4.84	4	450	4.49	7.00
	V9	-		-	-	-	-		-		-	-	
	V10	5.80	3	384	2.23	25.84	102	5.33	4.68	6	438	4.34	3.17
Interaction													
F at same V		NS		NS	NS	NS	NS		NS		NS	NS	
V at same F		NS		NS	NS	NS	NS		NS		NS	NS	
F1		5.11	2	378	2.79	26.31	90		4.28	2	397	3.97	
F2		5.39	1	381	2.92	26.53	92	3.73	4.78	1	444	4.43	4.18
C.D.(0.05)		0.11		NS	NS	NS	0.82		0.14		24.37	0.17	
C.V.(%)		1.56		1.74	7.70	1.21	0.68		2.39		4.36	2.98	

Table 4.1 (e): Contd.

F-levels	Varieties	ADUTHURAI							CHINSURAH				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:													
	V1	6.15	1	400	3.10	25.91	93	4.00	4.87	2	450	4.51	4.25
	V2	5.59	4	397	2.98	23.59	89	2.27	5.42	1	503	5.03	3.25
	V3	5.34	5	398	2.94	25.17	92	4.40	3.86	7	358	3.58	0.50
	V4	5.62	2	380	3.38	29.58	89	3.07	4.11	6	381	3.82	10.17
	V5	-		-	-	-	-		-		-	-	
	V6	-		-	-	-	-		4.56	3	422	4.23	0.92
	V7	3.87	7	391	2.64	26.50	86	3.60	-		-	-	
	V8	4.60	6	309	2.77	28.37	92	3.47	4.42	5	411	4.10	7.00
	V9	-		-	-	-	-		-		-	-	
	V10	5.60	3	383	2.21	25.81	101	5.33	4.49	4	420	4.17	3.17
	C.D.(0.05)	0.16		4.47	0.18	0.37	0.71		0.57		54.07	0.53	
	C.V. (%)	2.48		0.99	5.40	1.17	0.65		10.58		10.79	10.62	
	Expt. Mean	**5.25**		**380**	**2.86**	**26**	**91**		**4.53**		**421**	**4.20**	
	Soil type	Clay							Clay Loam				
	pH	7.20							7.05				
N - levels (kg/ha)													
	F1	150:60:60							120:60:60				
	F2	225:60:60							180:90:90				
	Recommended N:P:K (kg/ha)	150:60:60:25							120:60:60				
Varieties													
	V1	IET 26027							IET 26027				
	V2	IET 25997							IET 25997				
	V3	IET 25785							IET 25785				
	V4	NC- NDR 359							NC- NDR 359				
	V5	-							-				
	V6	-							NDR 8002 (E&C)				
	V7	Jaya (NE & S)							-				
	V8	Akshayadhan (W)							Akshayadhan (W)				
	V9	-							-				
	V10	Local Check - ADT 46							Local Check -				
	Available N:P:K of soil (kg/ha)	28.5:72.5:132							485:103:297				

Table 4.1 (e): Contd.

F-levels	Varieties	CHIPLIMA							COIMBATORE					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	3.48	11	179	4.09	25.90	108		5.16	7	349	2.44	24.30	
	V2	4.06	6	192	4.29	26.14	110		5.26	6	352	3.33	19.43	
	V3	3.09	13	223	2.59	20.39	109		5.28	4	363	3.03	24.13	
	V4	3.39	12	161	4.21	20.06	111		4.62	14	322	2.41	16.83	
	V5	-		-	-	-	-		-		-	-	-	
	V6	3.55	8	192	2.70	18.89	111		-		-	-	-	
	V7	3.49	10	197	3.71	23.88	107		5.03	10	319	2.21	24.83	
	V8	2.95	15	148	4.85	18.82	108		4.67	13	315	3.09	23.70	
	V9	-		-	-	-	-		-		-	-	-	
	V10	3.96	7	231	3.19	22.42	109		5.11	9	348	2.60	13.83	
F2	V1	3.53	9	196	4.08	27.13	109	0.62	5.27	5	368	2.49	24.60	1.47
	V2	4.17	4	201	4.47	27.32	111	1.38	5.54	2	376	3.43	19.43	3.73
	V3	3.09	13	242	2.67	20.83	110	0.00	5.67	1	384	3.94	24.60	5.20
	V4	4.38	3	168	4.52	19.67	111	12.38	4.82	12	325	2.29	16.83	2.67
	V5	-		-	-	-	-		-		-	-	-	
	V6	4.47	2	201	3.09	19.21	112	11.50	-		-	-	-	
	V7	4.17	4	213	4.01	23.73	107	8.50	5.12	8	317	2.09	24.57	1.20
	V8	2.79	16	149	4.67	19.47	109	-2.00	4.86	11	327	3.12	24.43	2.53
	V9	-		-	-	-	-		-		-	-	-	
	V10	4.81	1	235	3.82	21.65	109	10.63	5.29	3	374	2.73	14.07	2.40
Interaction														
F at same V		0.41		NS	NS	NS	NS		NS		8.21	0.35	NS	
V at same F		0.41		NS	NS	NS	NS		NS		16.60	0.61	NS	
F1		3.50	2	190	3.70	22.06	109		5.02	2	338	2.73	21.01	
F2		3.93	1	201	3.92	22.38	110	5.37	5.22	1	353	2.87	21.22	2.57
C.D.(0.05)		0.21		8.92	NS	NS	NS		0.04		NS	NS	NS	
C.V.(%)		4.54		3.67	5.25	3.34	2.20		0.57		4.23	18.03	0.76	

Table 4.1 (e): Contd.

F-levels	Varieties	CHIPLIMA							COIMBATORE					
		Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:														
V1		3.51	6	188	4.09	26.52	109	0.62	5.22	3	358	2.47	24.45	1.47
V2		4.12	2	197	4.38	26.73	110	1.38	5.40	2	364	3.38	19.43	3.73
V3		3.09	7	233	2.63	20.61	110	0.00	5.48	1	374	3.49	24.37	5.20
V4		3.89	4	164	4.37	19.87	111	12.38	4.72	7	324	2.35	16.83	2.67
V5		-		-	-	-	-		-		-	-	-	
V6		4.01	3	196	2.90	19.05	112	11.50	-		-	-	-	
V7		3.83	5	205	3.86	23.81	107	8.50	5.08	5	318	2.15	24.70	1.20
V8		2.87	8	148	4.76	19.15	108	-2.00	4.77	6	321	3.11	24.07	2.53
V9		-		-	-	-	-		-		-	-	-	
V10		4.39	1	233	3.51	22.04	109	10.63	5.20	4	361	2.67	13.95	2.40
C.D.(0.05)		0.29		15.88	0.39	1.30	0.89		0.09		5.80	0.25	0.42	
C.V. (%)		6.55		6.87	8.72	4.96	0.69		1.41		1.41	7.52	1.65	
Expt. Mean		**3.71**		**195**	**3.81**	**22**	**109**		**5.12**		**346**	**2.80**	**21.11**	
Soil type		Sandy loam							Clay Loam					
pH		6.55							8.42					
N - levels (kg/ha)														
F1		80:40:40							150:60:60					
F2		120:60:60							225:60:60					
Recommended N:P:K (kg/ha)		80:40:40							150:60:60					
Varieties														
V1		IET 26027							IET 26027					
V2		IET 25997							IET 25997					
V3		IET 25785							IET 25785					
V4		NC- NDR 359							NC- NDR 359					
V5		-							-					
V6		NDR 8002 (E&C)							-					
V7		Jaya(NE&S)							Jaya(NE&S)					
V8		Akshayadhan (W)							Akshayadhan (W)					
V9		-							-					
V10		Local Check - MTU 1001							Local Check - CO R (52)					
Available N:P:K of soil (kg/ha)		154:30:136							154:30:136					

Table 4.1 (e): Contd.

F-levels	Varieties	FAIZABAD						JAGDALPUR				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	5.70	4	275	3.81	128		6.47	8	398	3.90	
	V2	5.04	11	273	3.77	115		6.58	5	452	4.15	
	V3	5.10	8	267	4.10	108		6.53	7	442	4.24	
	V4	5.07	10	266	4.13	115		6.55	6	409	4.19	
	V5	-		-	-	-		-		-	-	
	V6	4.41	13	268	3.30	113		4.08	15	314	3.52	
	V7	3.92	14	237	3.35	110		5.20	12	316	3.72	
	V8	3.92	14	213	3.37	115		5.50	11	321	4.05	
	V9	-		-	-	-		-		-	-	
	V10	5.10	8	265	3.40	108		3.72	16	308	3.52	
F2	V1	6.72	1	300	4.07	131	17.00	7.46	2	437	4.93	9.90
	V2	5.79	3	290	3.70	116	12.50	7.19	4	457	5.26	6.10
	V3	6.31	2	297	4.20	111	20.17	7.60	1	456	5.26	10.70
	V4	5.44	6	277	4.10	117	6.17	7.45	3	427	4.93	9.00
	V5	-		-	-	-		-		-	-	
	V6	5.47	5	273	3.93	115	17.67	5.14	13	317	4.15	10.60
	V7	4.50	12	260	3.50	113	9.67	6.02	10	351	3.90	8.20
	V8	3.84	16	233	3.19	116	-1.33	6.36	9	331	4.15	8.60
	V9	-		-	-	-		-		-	-	
	V10	5.33	7	275	3.53	110	3.83	4.54	14	323	3.79	8.20
Interaction												
F at same V		NS		NS	0.24	0.40		NS		NS	NS	
V at same F		NS		NS	0.25	0.52		NS		NS	NS	
F1		4.78	2	258	3.65	114		5.58	2	370	3.91	
F2		5.43	1	276	3.78	116	8.03	6.47	1	387	4.55	8.91
C.D.(0.05)		NS		NS	0.12	0.47		0.24		NS	0.26	
C.V.(%)		16.10		6.13	2.68	0.33		3.25		4.67	4.86	

Table 4.1 (e): Contd.

F-levels	Varieties	FAIZABAD						JAGDALPUR				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 50% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:												
	V1	6.21	1	288	3.94	129	17.00	6.97	3	417	4.42	9.90
	V2	5.42	3	281	3.74	116	12.50	6.89	4	455	4.71	6.10
	V3	5.71	2	282	4.15	109	20.17	7.07	1	449	4.75	10.70
	V4	5.26	4	272	4.12	116	6.17	7.00	2	418	4.56	9.00
	V5	-		-	-	-		-		-	-	
	V6	4.94	6	271	3.62	114	17.67	4.61	7	316	3.84	10.60
	V7	4.21	7	248	3.43	112	9.67	5.61	6	333	3.81	8.20
	V8	3.88	8	223	3.28	116	-1.33	5.93	5	326	4.10	8.60
	V9	-		-	-	-		-		-	-	
	V10	5.22	5	270	3.47	109	3.83	4.13	8	316	3.66	8.20
	C.D.(0.05)	0.39		8.58	0.17	0.28		0.37		44.03	0.43	
	C.V. (%)	6.43		2.72	3.87	0.21		5.15		9.83	8.67	
	Expt. Mean	**5.10**		**267**	**3.72**	**115**		**6.02**		**379**	**4.23**	
	Soil type	Sandy loam						-				
	pH	7.40						-				
N - levels (kg/ha)												
	F1	120:60:60						100:60:40				
	F2	180:60:60						150:90:60				
	Recommended N:P:K (kg/ha)	120:60:60:25						100:60:40				
Varieties												
	V1	IET 26027						IET 26027				
	V2	IET 25997						IET 25997				
	V3	IET 25785						IET 25785				
	V4	NC- NDR 359						NC- NDR 359				
	V5	-						-				
	V6	NDR 8002 (E&C)						NDR 8002 (E&C)				
	V7	Jaya(NE&S)						Jaya(NE&S)				
	V8	Akshayadhan (W)						Akshayadhan (W)				
	V9	-						-				
	V10	Local Check - NDR 3112-1						Local Check - MTU 1001				
	Available N:P:K of soil (kg/ha)	200:24:234						-				

Table 4.1 (e): Contd.

F-levels	Varieties	KARJAT							KAUL					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	4.75	7	345	3.88	21.79	117		6.75	7	245	3.19	19.90	
	V2	4.85	5	352	4.03	19.94	117		6.54	10	298	2.52	20.47	
	V3	3.97	14	288	2.70	22.62	109		7.39	4	254	3.59	22.20	
	V4	3.82	16	277	2.51	27.93	106		7.22	6	283	3.27	21.90	
	V5	-		-	-	-	-		-		-	-	-	
	V6	3.88	15	282	2.59	15.59	110		-		-	-	-	
	V7	4.22	11	306	3.05	26.45	107		-		-	-	-	
	V8	4.17	13	302	2.98	22.25	106		-		-	-	-	
	V9	-		-	-	-	-		-		-	-	-	
	V10	4.74	8	343	3.85	21.47	106		7.35	5	288	3.13	21.40	
F2	V1	5.39	3	391	4.92	22.45	118	5.12	6.75	7	249	3.17	20.03	0.00
	V2	5.49	1	398	5.10	19.72	118	5.12	6.58	9	300	2.55	20.53	0.36
	V3	4.62	9	335	3.60	23.75	108	5.20	7.44	2	255	3.54	21.93	0.45
	V4	4.19	12	303	2.96	29.04	105	2.96	7.40	3	283	3.28	21.53	1.64
	V5	-		-	-	-	-		-		-	-	-	
	V6	4.49	10	325	3.41	15.64	112	4.88	-		-	-	-	
	V7	5.11	4	370	4.41	26.38	110	7.12	-		-	-	-	
	V8	4.79	6	347	3.88	25.49	110	4.96	-		-	-	-	
	V9	-		-	-	-	-		-		-	-	-	
	V10	5.44	2	394	5.01	21.85	108	5.60	7.48	1	291	3.16	21.10	1.18
Interaction														
F at same V		0.16		11.21	0.25	NS	NS		NS		NS	NS	NS	
V at same F		0.17		12.54	0.28	NS	NS		NS		NS	NS	NS	
F1		4.30	2	312	3.20	22.26	110		7.05	2	274	3.14	21.17	
F2		4.94	1	358	4.16	23.04	111	5.12	7.13	1	276	3.14	21.02	0.73
C.D.(0.05)		0.12		8.79	0.20	NS	NS		NS		NS	NS	NS	
C.V.(%)		2.06		2.11	4.30	4.66	2.57		11.21		12.28	3.52	4.76	

Table 4.1 (e): Contd.

F-levels	Varieties	KARJAT							KAUL					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:														
V1		5.07	3	368	4.40	22.12	118	5.12	6.75	4	247	3.18	19.97	0.00
V2		5.17	1	375	4.57	19.83	117	5.12	6.56	5	299	2.54	20.50	0.36
V3		4.30	6	311	3.15	23.19	108	5.20	7.42	1	255	3.57	22.07	0.45
V4		4.01	8	290	2.74	28.49	105	2.96	7.31	3	283	3.28	21.72	1.64
V5		-		-	-	-	-		-		-	-	-	
V6		4.19	7	303	3.00	15.62	111	4.88	-		-	-	-	
V7		4.67	4	338	3.73	26.42	109	7.12	-		-	-	-	
V8		4.48	5	325	3.43	23.87	108	4.96	-		-	-	-	
V9		-		-	-	-	-		-		-	-	-	
V10		5.09	2	369	4.43	21.66	107	5.60	7.42	1	290	3.15	21.25	1.18
C.D.(0.05)		0.11		7.93	0.17	2.08	2.78		0.57		23.84	0.16	NS	
C.V. (%)		2.02		2.00	4.01	7.76	2.13		6.53		7.09	4.20	7.99	
Expt. Mean		**4.62**		**335**	**3.68**	**22.65**	**110**		**7.09**		**275**	**3.14**	**21.10**	
Soil type		-							Clay Loam					
pH		-							8.10					
N - levels (kg/ha)														
F1		150:50:50							150:60:60					
F2		225:75:75							225:90:90					
Recommended N:P:K (kg/ha)		150:50:50							150:60:60:25					
Varieties														
V1		IET 26027							IET 26027					
V2		IET 25997							IET 25997					
V3		IET 25785							IET 25785					
V4		NC- NDR 359							NC- NDR 359					
V5		-							-					
V6		NDR 8002 (E&C)							-					
V7		Jaya(NE&S)							-					
V8		Akshayadhan (W)							-					
V9		-							-					
V10		Local Check - KJT- 3							Local Check - HKR 127					
Available N:P:K of soil (kg/ha)		154:30:136							-					

Table 4.1 (e): Contd.

F-levels	Varieties	NAGINA							TITABAR					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	4.38	7	272	2.61	23.56	100		5.09	5	249	5.45	112	
	V2	4.45	5	268	2.60	24.21	101		4.77	10	221	4.91	113	
	V3	4.47	4	284	2.77	23.86	104		4.56	13	221	4.06	113	
	V4	4.31	8	234	2.40	22.16	104		-		-	-	-	
	V5	-		-	-	-	-		4.61	12	250	4.73	114	
	V6	-		-	-	-	-		4.77	10	238	4.40	110	
	V7	4.01	11	258	2.16	23.87	100		3.97	16	238	4.39	111	
	V8	4.00	12	265	2.48	24.88	105		4.41	14	224	4.31	113	
	V9	-		-	-	-	-		-		-	-	-	
	V10	-		-	-	-	-		4.89	8	259	4.61	113	
F2	V1	4.61	2	285	2.72	23.61	99	2.09	5.82	1	296	5.49	119	11.23
	V2	4.59	3	280	2.63	24.21	101	1.27	5.27	4	259	5.37	117	7.69
	V3	4.67	1	291	2.77	25.90	104	1.82	4.89	8	250	4.41	114	5.08
	V4	4.39	6	260	2.50	22.22	106	0.73	-		-	-	-	
	V5	-		-	-	-	-		5.30	2	278	5.37	118	10.62
	V6	-		-	-	-	-		5.29	3	247	4.68	112	8.00
	V7	4.12	9	270	2.16	23.21	101	1.00	4.22	15	260	4.58	112	3.85
	V8	4.08	10	255	2.50	24.92	106	0.73	5.07	7	242	4.61	115	10.15
	V9	-		-	-	-	-		-		-	-	-	
	V10	-		-	-	-	-		5.09	5	277	4.91	116	3.08
Interaction														
F at same V		NS		NS	0.02	0.79	NS		NS		NS	NS	1.86	
V at same F		NS		NS	0.03	0.83	NS		NS		NS	NS	2.11	
F1		4.27	2	264	2.50	23.76	102		4.63	2	237	4.61	112	
F2		4.41	1	274	2.55	24.01	103	1.27	5.12	1	264	4.93	115	7.46
C.D.(0.05)		NS		8.68	0.03	NS	NS		0.17		8.23	NS	1.53	
C.V.(%)		3.11		2.25	0.76	1.51	0.28		2.80		2.65	8.65	1.08	

Table 4.1 (e): Contd.

F-levels	Varieties	NAGINA							TITABAR					
		Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:														
V1		4.50	3	279	2.67	23.59	100	2.09	5.46	1	273	5.47	116	11.23
V2		4.52	2	274	2.62	24.21	101	1.27	5.02	3	240	5.14	115	7.69
V3		4.57	1	288	2.77	24.88	104	1.82	4.73	7	236	4.24	113	5.08
V4		4.35	4	247	2.45	22.19	105	0.73	-		-	-	-	
V5		-		-	-	-	-		4.96	5	264	5.05	116	10.62
V6		-		-	-	-	-		5.03	2	243	4.54	111	8.00
V7		4.07	5	264	2.16	23.54	101	1.00	4.10	8	249	4.49	112	3.85
V8		4.04	6	260	2.49	24.90	106	0.73	4.74	6	233	4.46	114	10.15
V9		-		-	-	-	-		-		-	-	-	
V10		-		-	-	-	-		4.99	4	268	4.76	115	3.08
C.D.(0.05)		0.17		16.22	0.02	0.56	1.01		0.37		19.46	0.57	1.31	
C.V. (%)		3.25		5.02	0.52	1.95	0.82		6.43		6.57	10.18	0.97	
Expt. Mean		**4.34**		**269**	**2.53**	**23.88**	**103**		**4.88**		**251**	**4.77**	**114**	
Soil type		-							Silty Clay Loam					
pH		7.10							5.20					
N - levels (kg/ha)														
F1		120:60:40							60:20:40					
F2		180:90:60							90:30:60					
Recommended N:P:K (kg/ha)		120:60:40:25							60:20:40					
Varieties														
V1		IET 26027							IET 26027					
V2		IET 25997							IET 25997					
V3		IET 25785							IET 25785					
V4		NC- NDR 359							-					
V5		-							ZC- Pant Dhan-19 (N)					
V6		-							NDR 8002 (E&C)					
V7		Jaya (NE & S)							Jaya (NE & S)					
V8		Akshayadhan (W)							Akshayadhan (W)					
V9		-							-					
V10		-							Local Check - Numali					
Available N:P:K of soil (kg/ha)		21:18.3:209							510:12:91					

Table 4.1 (e): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	5.33	3	327	6.04	99		5.25	8
	V2	4.92	6	292	5.16	101		5.20	9
	V3	4.58	11	282	4.95	95		4.91	10
	V4	3.96	17	234	3.89	93		4.79	13
	V5	-		-	-	-		4.61	15
	V6	4.08	16	261	3.94	104		4.18	20
	V7	4.25	15	275	4.70	93		4.20	18
	V8	3.75	18	233	3.81	93		4.18	19
	V9	4.46	13	277	4.86	97		4.46	17
	V10	4.29	14	253	4.18	103		4.89	12
F2	V1	5.88	1	357	6.40	99	9.17	5.71	1
	V2	5.38	2	329	5.93	101	7.67	5.57	2
	V3	5.04	5	328	5.92	95	7.67	5.34	3
	V4	4.5	12	302	4.97	93	9.00	5.30	5
	V5	-		-	-	-		5.30	6
	V6	4.75	9	281	5.52	104	11.17	4.89	11
	V7	4.83	8	312	5.15	93	9.67	4.68	14
	V8	4.67	10	274	4.08	94	15.33	4.60	16
	V9	5.25	4	330	5.81	97	13.17	5.25	7
	V10	4.92	6	308	5.54	103	10.50	5.34	4
Interaction									
F at same V		NS		NS	NS	1.86			
V at same F		NS		NS	NS	2.11			
F1		4.40	2	270	4.61	97		4.81	2
F2		5.02	1	313	5.48	98	10.37	5.26	1
C.D.(0.05)		0.35		33.59	0.3	NS			
C.V.(%)		6.26		9.83	5.09	1.01			

Table 4.1 (e): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
Mean of varieties:									
	V1	5.61	1	342	6.22	99	9.17	5.48	1
	V2	5.15	2	311	5.55	101	7.67	5.39	2
	V3	4.81	4	305	5.44	95	7.67	5.12	3
	V4	4.23	8	268	4.43	93	9.00	5.05	5
	V5	-		-	-	-		4.96	6
	V6	4.42	7	271	4.73	104	11.17	4.54	8
	V7	4.54	6	294	4.93	93	9.67	4.44	9
	V8	4.21	9	253	3.95	94	15.33	4.39	10
	V9	4.86	3	304	5.34	97	13.17	4.86	7
	V10	4.61	5	280	4.86	103	10.50	5.11	4
C.D.(0.05)		0.52		28.5	0.53	0.4			
C.V. (%)		9.4		8.37	9.07	0.35			
Expt. Mean		**4.71**		**292**	**5.05**	**97**		5.03	
Soil type		-							
pH		-							
N - levels (kg/ha)									
F1		120:60:40							
F2		180:60:40							
Recommended N:P:K (kg/ha)		120:60:40							
Varieties									
V1		IET 26027							
V2		IET 25997							
V3		IET 25785							
V4		NDR 359							
V5		-							
V6		NDR 8002 (E&C)							
V7		Jaya (NE & S)							
V8		Akshayadhan (W)							
V9		HC- HRI 174							
V10		Local Check - R. Sweta							
Available N:P:K of soil (kg/ha)		-							

4.1(f) NMT Late

AVT-2 entry (IET 25269) was evaluated for its response to levels nutrients on grain yield at nine locations i.e. **Aduthurai (150:60:60), Chinsura (120:60:60), Chiplima (80:40:40), Karjat (150:50:50), Mandya (100:50:50), Nagina (120:60:40, Pusa (120:60:40), Rajendranagar (120:60:40), Maruteru (90:60:60)** and **Dhangain (120:60:40)** under two levels of RDF (100% and 150% RDF). The details and data received from these locations are summarized and presented in Table 4.1(f).

Fertliser levels application significantly influenced the grain yield at **Karjat**, **Nagina** and **Pusa** locations and the maximum increase in grain yield was recorded at all the locations with 150% RDF. Application of 150% RDF had higher grain yields at **Karjat** (4.77 t/ha), **Nagina** (4.57 t/ha), **Pusa** (3.98 t/ha), **Maruteru** (5.99 t/ha) and Dhangain (5.02 t/ha). Higher nutrient response (kg grain/kg nutrient) was with 150% RDF over 100% RDF at **Aduthurai** (2.07), **Chinsurah** (2.41), **Chiplima** (3.80), **Karjat** (5.78), **Mandya** (11.00), **Nagina** (1.48), **Pusa** (12.48), **Rajendranagar** (1.26), **Maruteru** (2.0) and **Dhangain** (11.60)

Grain yield differences among the tested varieties were found to be significant at all the locations. Significantly higher mean maximum grain yield was recorded by IET 25269 at **Aduthurai** (6.32 t/ha), **Chinsurah** (5.40 t/ha), **Chiplima** (5.36 t/ha), Karjat (4.97 t/ha), **Nagina** (5.09 t/ha), **Rajendranagar** (9.59 t/ha), **Maruteru** (6.85 t/ha) and Dangain (5.70 t/ha). Higher grain yield was with the variety Salivahana at **Mandya** (8.54 t/ha) and with Samba Masuri at at **Pusa** (4.01 t/ha). Interaction effects among RDF x varieties was found to be non-significant at all the locations.

In this trial, 150% RDF was found to be promising with 6.5% increased grain yield and also exhibited higher nutrient recovery efficiency. IET 25269 was found to be promising in terms of grain yield at most of the locations.

Table 4.1 (f): Summary of data on grain yield and ancillary characters of selected late cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	ADUTHURAI							CHINSURAH				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	6.23	2	430	3.19	24.50	99		5.21	5	455	4.71	
	V2	3.60	16	407	1.85	16.15	82		4.50	16	394	4.04	
	V3	4.90	9	320	3.12	24.35	98		4.69	13	409	4.23	
	V4	4.53	12	399	1.83	14.09	99		4.96	9	434	4.48	
	V5	4.23	14	396	2.02	19.59	85		5.05	7	441	4.55	
	V6	4.90	9	382	2.99	19.78	107		4.71	12	411	4.24	
	V7	5.47	6	328	2.61	18.83	95		5.17	6	452	4.66	
	V8	5.83	4	414	2.69	23.10	113		4.85	11	424	4.39	
F2	V1	6.40	1	442	3.23	24.61	101	2.27	5.59	3	488	5.05	3.17
	V2	3.67	15	418	1.90	16.19	85	0.93	4.61	14	402	4.17	0.92
	V3	5.10	7	330	3.17	24.44	100	2.67	4.89	10	428	4.40	1.67
	V4	4.73	11	408	1.87	14.18	100	2.67	5.02	8	438	4.54	0.50
	V5	4.47	13	401	2.10	19.72	87	3.20	5.69	1	496	5.14	5.33
	V6	5.03	8	388	3.04	19.86	108	1.73	4.56	15	398	4.12	-1.25
	V7	5.53	5	333	2.66	18.93	96	0.80	5.66	2	494	5.12	4.08
	V8	6.00	3	418	2.73	23.17	115	2.27	5.43	4	474	4.91	4.83
Interaction													
F at same V		NS		NS	NS	NS	0.99		NS		NS	NS	
V at same F		NS		NS	NS	NS	1.00		NS		NS	NS	
F1		4.96	2	385	2.54	20.05	97		4.89	2	427	4.41	
F2		5.12	1	392	2.59	20.14	99	2.07	5.18	1	452	4.68	2.41
C.D.(0.05)		NS		1.12	NS	0.01	0.47		NS		NS	NS	
C.V.(%)		2.50		0.23	2.32	0.03	0.39		10.10		9.70	11.04	

Table 4.1 (f): Contd.

F-levels	Varieties	ADUTHURAI							CHINSURAH				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:													
	V1	6.32	1	436	3.21	24.56	100	2.27	5.40	2	472	4.88	3.17
	V2	3.64	8	413	1.88	16.17	84	0.93	4.56	8	398	4.11	0.92
	V3	5.00	4	325	3.15	24.40	99	2.67	4.79	6	418	4.32	1.67
	V4	4.63	6	404	1.85	14.14	99	2.67	4.99	5	436	4.51	0.50
	V5	4.35	7	398	2.06	19.66	86	3.20	5.37	3	469	4.85	5.33
	V6	4.97	5	385	3.02	19.82	107	1.73	4.64	7	405	4.18	-1.25
	V7	5.50	3	331	2.64	18.88	95	0.80	5.42	1	473	4.89	4.08
	V8	5.92	2	416	2.71	23.14	114	2.27	5.14	4	449	4.65	4.83
C.D.(0.05)		0.14		5.22	0.04	0.08	0.70		0.36		31.05	0.33	
C.V. (%)		2.28		1.14	1.30	0.34	0.60		6.03		5.97	6.21	
Expt. Mean		**5.04**		**388**	**2.56**	**20**	**98**		**5.04**		**440**	**4.55**	
Soil type		Clay							Clay Loam				
pH		7.20							7.12				
N - levels (kg/ha)													
F1		150:60:60							120:60:60				
F2		225:60:60							180:90:90				
Recommended N:P:K (kg/ha)		150:60:60:25							120:60:60				
Varieties													
V1		IET 25269							IET 25269				
V2		NDR 8002							NDR 8002				
V3		Salivahana							Salivahana				
V4		Samba Masuri							Samba Masuri				
V5		Swarna							Swarna				
V6		Ranjeet							Ranjeet				
V7		Pushyami							Pushyami				
V8		Local Check - CR 1009							Local Check -				
Available N:P:K of soil (kg/ha)		28.5:72.5:132							412:88:288				

Table 4.1 (f): Contd.

F-levels	Varieties	CHIPLIMA							KARJAT						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	5.20	3	208	4.54	23.73	115		4.56	6	298	2.91	21.36	120	
	V2	3.99	13	222	4.02	17.90	113		4.12	12	258	2.17	15.37	122	
	V3	4.86	4	253	3.96	22.85	112		3.56	16	265	2.30	22.18	122	
	V4	3.84	15	226	3.66	22.78	111		3.66	15	268	2.35	17.16	126	
	V5	4.11	11	225	3.95	25.73	112		3.70	14	309	3.12	17.24	122	
	V6	4.57	7	203	3.78	25.11	116		4.26	10	322	3.39	16.10	128	
	V7	3.76	16	176	4.14	28.93	116		4.45	7	296	2.86	21.19	124	
	V8	4.42	9	234	4.18	25.78	116		4.08	13	343	3.85	25.05	124	
F2	V1	5.52	2	206	5.09	24.80	116	4.00	5.37	1	389	4.87	21.44	122	6.48
	V2	4.35	10	241	4.24	17.71	115	4.50	4.81	4	349	3.91	15.42	122	5.52
	V3	5.54	1	269	4.16	23.25	112	8.50	4.19	11	304	2.97	22.23	122	5.04
	V4	3.97	14	228	3.72	23.95	111	1.63	4.45	7	323	3.35	17.36	126	6.32
	V5	4.47	8	208	4.39	24.08	115	4.50	4.45	7	323	3.36	16.47	123	6.00
	V6	4.68	5	206	3.97	24.68	118	1.37	4.99	3	362	4.22	16.18	129	5.84
	V7	4.03	12	182	4.89	27.93	117	3.38	5.10	2	370	4.39	21.28	125	5.20
	V8	4.62	6	235	4.18	24.79	117	2.50	4.81	4	349	3.92	25.15	125	5.84
Interaction															
F at same V		NS		NS	NS	NS	NS		NS		15.53	0.33	NS	NS	
V at same F		NS		NS	NS	NS	NS		NS		15.55	0.34	NS	NS	
F1		4.34	2	218	4.03	24.10	114		4.05	2	295	2.87	19.46	124	
F2		4.65	1	222	4.33	23.90	115	3.80	4.77	1	346	3.87	19.44	125	5.78
C.D.(0.05)		NS		NS	0.06	NS	NS		0.07		7.10	0.17	NS	0.36	
C.V.(%)		6.25		3.05	1.15	1.51	0.95		1.36		1.78	4.12	2.24	0.23	

Table 4.1 (f): Contd.

F-levels	Varieties	CHIPLIMA							KARJAT						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:															
V1		5.36	1	207	4.82	24.27	115	4.00	4.97	1	344	3.89	21.40	121	6.48
V2		4.17	6	232	4.13	17.81	114	4.50	4.47	4	303	3.04	15.40	122	5.52
V3		5.20	2	261	4.06	23.05	112	8.50	3.88	8	285	2.64	22.21	122	5.04
V4		3.91	7	227	3.69	23.37	111	1.63	4.06	7	296	2.85	17.26	126	6.32
V5		4.29	5	216	4.17	24.91	113	4.50	4.08	6	316	3.24	16.86	123	6.00
V6		4.63	3	205	3.88	24.90	117	1.37	4.63	3	342	3.81	16.14	129	5.84
V7		3.90	8	179	4.52	28.43	116	3.38	4.78	2	333	3.63	21.24	125	5.20
V8		4.52	4	234	4.18	25.29	116	2.50	4.45	5	346	3.89	25.10	125	5.84
C.D.(0.05)		0.27		25.01	0.40	1.18	1.04		0.15		10.98	0.24	0.51	0.75	
C.V. (%)		5.09		9.61	8.02	4.14	0.77		2.91		2.90	5.93	2.23	0.51	
Expt. Mean		**4.50**		**220**	**4.18**	**24**	**114**		**4.41**		**320**	**3.37**	**19.45**	**124**	
Soil type		Sandy loam							-						
pH		6.55							-						
N - levels (kg/ha)															
F1		80:40:40							150:50:50						
F2		120:60:60							225:75:75						
Recommended N:P:K (kg/ha)		80:40:40							150:50:50						
Varieties															
V1		IET 25269							IET 25269						
V2		NDR 8002							NDR 8002						
V3		Salivahana							Salivahana						
V4		Samba Masuri							Samba Masuri						
V5		Swarna							Swarna						
V6		Ranjeet							Ranjeet						
V7		Pushyami							Pushyami						
V8		Local Check - Pratikshya							Local Check - KJT 10						
Available N:P:K of soil (kg/ha)		154:30:136							-						

Table 4.1 (f): Contd.

F-levels	Varieties	MANDYA							MARUTERU					NAGINA						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	6.26	11	329	4.50	28.78	86		6.74	2	282	3.93		4.96	2	323	3.60	26.69	109	
	V2	6.98	5	367	4.30	19.43	103		5.99	7	266	3.81		-		-	-	-	-	
	V3	7.65	3	351	5.58	28.03	111		4.86	16	237	2.82		4.21	12	291	3.36	26.39	111	
	V4	6.65	9	393	3.79	19.18	113		5.53	13	240	3.01		4.25	10	302	3.48	26.42	111	
	V5	5.04	15	343	3.70	22.14	85		5.83	10	255	3.87		4.25	10	292	3.20	26.36	109	
	V6	6.02	13	384	4.33	21.11	122		5.42	14	238	2.88		4.37	9	290	3.52	26.31	113	
	V7	6.75	7	353	6.18	21.83	109		5.92	9	257	3.64		4.39	7	285	2.95	26.42	110	
	V8	5.93	14	457	3.57	18.57	86		5.97	8	264	3.83								
F2	V1	6.59	10	440	4.34	27.81	86	6.60	6.96	1	287	3.98	2.10	5.21	1	345	3.61	26.70	110	2.27
	V2	6.75	7	414	4.39	20.50	103	-4.60	6.18	4	246	3.95	1.81							
	V3	9.43	1	350	5.75	27.91	111	35.60	5.00	15	211	2.99	1.33	4.38	8	311	3.43	26.40	110	1.55
	V4	6.08	12	411	3.80	18.67	113	-11.40	5.75	11	231	3.37	2.10	4.44	5	314	3.50	26.43	111	1.73
	V5	4.93	16	340	3.97	23.43	85	-2.20	6.11	6	233	3.45	2.67	4.47	4	305	3.21	26.38	110	2.00
	V6	7.03	4	390	4.51	21.49	122	20.20	5.62	12	224	3.21	1.90	4.41	6	321	3.52	26.32	113	0.36
	V7	8.04	2	377	6.02	22.24	109	25.80	6.12	5	235	3.68	1.90	4.50	3	320	2.96	26.44	110	1.00
	V8	6.83	6	433	3.60	18.59	87	18.00	6.20	3	255	3.87	2.19							
Interaction																				
F at same V		NS		NS	NS	NS	NS		NS		NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		NS	NS	NS	NS		NS		NS	NS		NS		NS	NS	NS	NS	
F1		6.41	2	372	4.49	22.38	102		5.78	2	255	3.47		4.41	2	297	3.35	26.43	111	
F2		6.96	1	394	4.55	22.58	102	11.00	5.99	1	240	3.56	2.00	4.57	1	319	3.37	26.45	111	1.48
C.D.(0.05)		NS		NS	NS	NS	NS		0.15		NS	NS		0.11		14.71	NS	NS	NS	
C.V.(%)		14.27		13.53	7.49	7.08	0.99		2.06		6.21	5.81		1.64		3.33	0.63	0.07	0.54	

Table 4.1 (f): Contd.

F-levels	Varieties	MANDYA							MARUTERU					NAGINA						
		Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt(g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:																				
	V1	6.43	5	385	4.42	28.30	86	6.60	6.85	1	285	3.96	2.10	5.09	1	334	3.61	26.70	110	2.27
	V2	6.87	3	390	4.35	19.97	103	-4.60	6.09	2	256	3.88	1.81							
	V3	8.54	1	350	5.67	27.97	111	35.60	4.93	8	224	2.91	1.33	4.30	6	301	3.40	26.40	111	1.55
	V4	6.37	7	402	3.80	18.93	113	-11.40	5.64	6	236	3.19	2.10	4.35	5	308	3.49	26.43	111	1.73
	V5	4.99	8	341	3.84	22.79	85	-2.20	5.97	5	244	3.66	2.67	4.36	4	298	3.21	26.37	110	2.00
	V6	6.53	4	387	4.42	21.30	122	20.20	5.52	7	231	3.05	1.90	4.39	3	306	3.52	26.32	113	0.36
	V7	7.40	2	365	6.10	22.04	109	25.80	6.02	4	246	3.66	1.90	4.45	2	303	2.96	26.43	110	1.00
	V8	6.38	6	445	3.59	18.58	86	18.00	6.09	2	260	3.85	2.19							
C.D.(0.05)		0.99		60.50	0.49	1.63	1.16		0.17		24.72	0.27		0.17		11.87	0.02	0.02	0.91	
C.V. (%)		12.55		13.35	9.17	6.15	0.96		2.42		8.45	6.61		3.24		3.20	0.49	0.05	0.68	
Expt. Mean		**6.69**		**383**	**4.52**	**22.5**	**102**		**5.89**		**248**	**3.52**		**4.49**		**308**	**3.36**	**26.44**	**111**	
Soil type		Red Sandy Loam							-					-						
pH		7.05							7.16					7.70						
N - levels (kg/ha)																				
F1		100:50:50							90:60:60					120:60:40						
F2		150:50:50							135:90:90					180:90:60						
Recommended N:P:K (kg/ha)		100:50:50							90:60:60					120:60:40:25						
Varieties																				
V1		IET 25269							IET 25269					IET 25269						
V2		NDR 8002							NDR 8002					-						
V3		Salivahana							Salivahana					Salivahana						
V4		Samba Masuri							Samba Masuri					Samba Masuri						
V5		Swarna							Swarna					Swarna						
V6		Ranjeet							Ranjeet					Ranjeet						
V7		Pushyami							Pushyami					Pushyami						
V8		Local Check - BPT 5204							Local Check - MTU 1061					-						
Available N:P:K of soil (kg/ha)		350:98:280							151:36:257					21:18:209						

Table 4.1 (f): Contd.

F-levels	Varieties	PUSA				RAJENDRANAGAR						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	2.68	16	259		9.88	1	370	3.80	18.24	111	
	V2	2.72	15	264								
	V3	3.24	13	242		8.47	7	404	3.16	19.70	109	
	V4	3.86	6	242		7.45	13	429	2.77	13.43	106	
	V5	3.56	8	247		7.76	12	424	4.94	16.67	103	
	V6	3.31	12	242		7.81	10	338	2.45	15.47	109	
	V7	3.02	14	253		8.17	8	333	4.11	17.90	109	
	V8	3.48	11	248		8.76	6	253	3.62	20.23	108	
F2	V1	3.56	8	273	14.67	9.29	2	421	2.83	22.23	110	-5.36
	V2	3.52	10	276	13.33							
	V3	4.46	1	257	20.33	9.03	4	416	3.52	21.23	107	5.09
	V4	4.16	3	257	5.00	7.82	9	443	2.48	14.17	107	3.36
	V5	4.25	2	262	11.50	7.40	14	287	2.14	17.63	103	-3.27
	V6	4.08	4	258	12.83	7.79	11	251	3.30	16.77	106	-0.18
	V7	3.83	7	261	13.50	9.17	3	372	3.85	18.03	106	9.09
	V8	4.00	5	263	8.67	8.77	5	343	3.40	19.50	109	0.09
Interaction												
F at same V		NS		NS		NS		NS	0.90	NS	NS	
V at same F		NS		NS		NS		NS	0.92	NS	NS	
F1		3.23	2	250		8.33	2	364	3.55	17.38	108	
F2		3.98	1	263	12.48	8.47	1	362	3.07	18.51	107	1.26
C.D.(0.05)		0.09		NS		NS		NS	NS	NS	NS	
C.V.(%)		2.04		6.51		7.61		12.15	11.75	9.92	1.23	

Table 4.1 (f): Contd.

F-levels	Varieties	PUSA				RAJENDRANAGAR						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:												
	V1	3.12	7	266	14.67	9.59	1	395	3.32	20.24	111	-5.36
	V2	3.12	7	270	13.33							
	V3	3.85	3	249	20.33	8.75	3	410	3.34	20.47	108	5.09
	V4	4.01	1	250	5.00	7.64	6	436	2.63	13.80	107	3.36
	V5	3.91	2	255	11.50	7.58	7	356	3.54	17.15	103	-3.27
	V6	3.70	5	250	12.83	7.80	5	295	2.88	16.12	108	-0.18
	V7	3.43	6	257	13.50	8.67	4	353	3.98	17.97	107	9.09
	V8	3.74	4	256	8.67	8.77	2	298	3.51	19.87	109	0.09
C.D.(0.05)		0.33		NS		0.60		69.19	0.63	1.29	2.79	
C.V. (%)		7.80		5.99		5.97		15.99	16.09	6.02	2.18	
Expt. Mean		**3.61**		**257**		**8.40**		**363**	**3.31**	**17.94**	**107**	
Soil type		Silty Loam				Clay loam						
pH		8.20				7.99						
N - levels (kg/ha)												
F1		120:60:40				120:60:40						
F2		180:60:40				180:90:60						
Recommended N:P:K (kg/ha)		120:60:40				120:60:40						
Varieties												
V1		IET 25269				IET 25269						
V2		NDR 8002				-						
V3		Salivahana				Salivahana						
V4		Samba Masuri				Samba Masuri						
V5		Swarna				Swarna						
V6		Ranjeet				Ranjeet						
V7		Pushyami				Pushyami						
V8		Local Check - Rajendra Mahsuri				Local Check - WGG 44						
Available N:P:K of soil (kg/ha)		-				26:109:689						

Table 4.1 (f): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	5.47	3	335	5.15	106		5.72	3
	V2	3.83	14	298	3.70	104		4.47	16
	V3	3.92	13	308	4.25	109		5.04	11
	V4	4.43	11	316	4.38	110		4.92	12
	V5	5.20	5	338	4.43	107		4.87	14
	V6	3.47	16	292	3.29	110		4.88	13
	V7	4.47	10	326	4.47	109		5.16	9
	V8	3.77	15	302	3.27	110		5.23	6
F2	V1	5.93	1	365	5.73	107	7.67	6.04	1
	V2	4.67	8	339	4.29	104	14.00	4.82	15
	V3	5.00	7	341	5.67	110	18.00	5.70	4
	V4	5.13	6	352	5.10	111	11.67	5.16	10
	V5	5.53	2	365	5.54	108	5.50	5.18	8
	V6	4.07	12	327	3.99	110	10.00	5.23	7
	V7	5.27	4	362	5.26	109	13.33	5.73	2
	V8	4.53	9	334	5.09	110	12.67	5.69	5
Interaction									
F at same V		NS		NS	NS	NS			
V at same F		NS		NS	NS	NS			
F1		4.32	2	314	4.12	108		5.07	2
F2		5.02	1	348	5.08	109	11.60	5.47	1
C.D.(0.05)		NS		20.01	0.4	0.31			
C.V.(%)		15.98		4.86	7.08	0.23			

Table 4.1 (f): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt(g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
Mean of varieties:									
	V1	5.70	1	350	5.44	107	7.67	5.88	1
	V2	4.25	6	319	4.00	104	14.00	4.64	8
	V3	4.46	5	325	4.96	110	18.00	5.37	4
	V4	4.78	4	334	4.74	111	11.67	5.04	6
	V5	5.37	2	352	4.99	108	5.50	5.03	7
	V6	3.77	8	309	3.64	110	10.00	5.06	5
	V7	4.87	3	344	4.87	109	13.33	5.44	3
	V8	4.15	7	318	4.18	110	12.67	5.46	2
C.D.(0.05)		0.47		21.99	0.55	0.55			
C.V. (%)		8.46		5.61	10.03	0.43			
Expt. Mean		**4.67**		**331**	**4.60**	**108**		5.27	
Soil type		-							
pH		-							
N - levels (kg/ha)									
F1		120:60:40							
F2		180:60:40							
Recommended N:P:K (kg/ha)		120:60:40							
Varieties									
V1		IET 25269							
V2		NDR 8002							
V3		Salivahana							
V4		Samba Masuri							
V5		Swarna							
V6		Ranjeet							
V7		Pushyami							
V8		Local Check - R. Mahsuri-1							
Available N:P:K of soil (kg/ha)		-							

4.1(g) NMT MS

Four entries (IET 26263, IET 25795, IET 25793 and IET 26241) of medium slender group were evaluated for their response to levels of nutrients on grain yield at seven different locations i.e., **Chakdah (60:30:30), Karjat (100:50:50), Kaul (150:60:60), Mandya (100:50:50), Nagina (150:60:40), Raipur (120:60:40), Maruteru (90:60:60)** and **Dhangain** (120:60:40) under two levels of RDF (100% and 150% RDF). The details and data received from these locations are summarized and presented in Table 4.1(g).

RDF doses significantly influenced the grain yield at all the locations and the maximum increase in grain yield was observed with 150% RDF at most of the location except at **Chakdah**. Application of 150% RDF recorded higher grain yields at **Karjat** (5.57 t/ha), **Kaul** (6.08 t/ha), **Mandya** (7.30 t/ha), **Nagina** (6.23 t/ha), **Raipur** (7.12 t/ha), **Maruteru** (6.25 t/ha) and **Dhangain** (7.12 t/ha). Average over the locations, higher mean grain yield of 6.05 t/ha was recorded with 150% RDF and was 5.6% higher than yield obtained with 100% RDF. Higher nutrient response was recorded with 150% RDF over 100% RDF at **Karjat** (8.79), **Kaul** (0.11), **Mandya** (8.41), **Nagina** (1.27), **Raipur** (3.68), **Maruteru** (1.56) and **Dhangain** (9.44)

Grain yield differences among the tested varieties were found significant at all the locations. Significantly higher mean maximum grain yield was recorded by IET 26263 at **Chakdah** (5.70 t/ha), **Karjat** (5.64 t/ha), **Maruteru** (6.64 t/ha) and Dhangain (5.69 t/ha). IET 25795 performed better at **Mandya** (8.20 t/ha) and Raipur (7.62 t/ha). IET 25793 (6.97 t/ha) followed by IET 26263 (6.18 t/ha) and IET 25795 (6.13 t/ha) recorded higher grain yield at **Kaul**. The interaction effect between fertiliser levels and varieties was found to be non-significant at all the locations. Mean over the locations, cultivars IET 26263, IET 25795 and IET 25793 were found to be high yielders.

In this trial, application of 150% RDF was found to be promising and also exhibited higher nutrient recovery. Entries like IET 26263, IET 25795 and IET 25793 were found to be promising.

Table 4.1(g): Summary of data on grain yield and ancillary characters of selected NMT MS cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	CHAKDAHA							KARJAT						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	5.75	1	329	4.03	16.16	101		5.29	6	383	4.78	18.23	118	
	V2	4.32	8	277	3.20	15.28	95		4.91	8	356	4.13	16.16	109	
	V3	4.27	9	308	3.75	17.73	94		5.21	7	377	4.63	18.28	111	
	V4	4.47	5	284	4.17	15.28	97		-		-	-	-	-	
	V5	-		-	-	-	-		-		-	-	-	-	
	V6	4.57	3	328	4.06	19.27	98		4.63	11	336	3.67	15.79	110	
	V7	4.02	11	311	4.05	15.41	98		4.28	12	310	3.13	13.12	106	
	V8	-		-	-	-	-		4.88	10	354	4.07	18.66	111	
F2	V1	5.64	2	335	4.03	16.07	99	-1.83	5.98	1	434	6.11	18.30	120	8.63
	V2	4.33	7	292	3.44	15.74	95	0.17	5.63	3	408	5.42	16.21	112	9.00
	V3	4.36	6	311	3.63	18.04	95	1.50	5.84	2	423	5.83	18.31	111	7.88
	V4	4.26	10	294	3.88	16.15	95	-3.50	-		-	-	-	-	
	V5	-		-	-	-	-		-		-	-	-	-	
	V6	4.52	4	325	3.97	18.74	100	-0.83	5.44	5	394	5.04	15.81	112	10.13
	V7	3.67	12	309	4.10	15.67	97	-5.83	4.91	8	355	4.11	13.19	110	7.88
	V8	-		-	-	-	-		5.62	4	408	5.40	18.70	111	9.25
Interaction															
F at same V		NS		NS	NS	NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		NS	NS	NS	NS		NS		NS	NS	NS	NS	
F1		4.57	1	306	3.88	16.52	97		4.87	2	353	4.07	16.71	111	
F2		4.46	2	311	3.84	16.74	97	-1.72	5.57	1	404	5.32	16.75	113	8.79
C.D.(0.05)		NS		NS	NS	NS	NS		0.15		10.69	0.27	NS	NS	
C.V.(%)		3.27		1.17	1.95	8.17	0.3		1.99		1.97	4.04	0.39	1.13	
Mean of varieties:															
V1		5.70	1	332	4.03	16.12	100	-1.83	5.64	1	409	5.45	18.27	119	8.63
V2		4.33	4	285	3.32	15.51	95	0.17	5.27	3	382	4.78	16.19	111	9.00
V3		4.32	5	310	3.69	17.89	95	1.50	5.53	2	400	5.23	18.30	111	7.88
V4		4.37	3	289	4.03	15.72	96	-3.50	-		-	-	-	-	
V5		-		-	-	-	-		-		-	-	-	-	
V6		4.55	2	327	4.02	19.01	99	-0.83	5.04	5	365	4.36	15.80	111	10.13
V7		3.85	6	310	4.08	15.54	98	-5.83	4.60	6	333	3.62	13.16	108	7.88
V8		-		-	-	-	-		5.25	4	381	4.74	18.68	111	9.25
C.D.(0.05)		0.22		15.99	0.25	0.86	3.41		0.1		7.57	0.18	0.07	1.77	
C.V. (%)		3.98		4.3	5.47	4.3	2.92		1.64		1.66	3.24	0.35	1.32	
Expt. Mean		**4.52**		**309**	**3.86**	**16.63**	**97**		**5.22**		**378**	**4.69**	**16.73**	**112**	
Soil type		Sandy clay loam							-						
pH		7.05							-						
N - levels (kg/ha)															
F1		60:30:30							100:50:50						
F2		90:45:45							150:75:75						
Recommended N:P:K (kg/ha)		60:30:30							100:50:50						
Varieties															
V1		IET-26263							IET-26263						
V2		IET-25795							IET-25795						
V3		IET-25793							IET-25793						
V4		IET-26241							-						
V5		-							-						
V6		KRH 4							KRH 4						
V7		WGL 14							WGL 14						
V8		-							Local Check (BRC KKV 13)						
Available N:P:K of soil (kg/ha)		0.052:16.0:129.0							-						

Table 4.1(g): Contd.

F-levels	Varieties	KAUL						MANDYA						
		Grain Yield (t/ha)	Rank	Panicle /m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	6.15	8	259	2.76	19.77		5.90	13	319	5.25	21.12	98	
	V2	6.15	8	259	2.83	20.07		7.54	3	298	5.08	23.71	93	
	V3	6.97	3	283	2.86	19.20		6.96	6	368	4.41	17.15	83	
	V4	2.99	11	268	2.38	17.93		6.61		425	4.07	14.76	80	
	V5	-		-	-	-		-		-	-	-	-	
	V6	7.65	1	272	3.19	21.80		6.71	9	315	5.27	21.99	90	
	V7	6.46	6	266	2.88	19.03		5.42	14	371	4.51	20.45	104	
	V8	-		-	-	-		6.09	12	368	3.82	18.35	100	
F2	V1	6.20	7	261	2.86	20.10	0.37	8.19	2	305	4.55	23.69	98	22.90
	V2	6.11	10	259	3.02	20.27	-0.30	8.86	1	333	6.18	23.36	93	13.20
	V3	6.97	3	286	2.87	19.20	0.00	7.24	4	378	4.43	17.13	84	2.80
	V4	2.99	11	267	2.40	17.97	0.00	7.02		406	4.78	14.45	80	4.10
	V5	-		-	-	-		-		-	-	-	-	
	V6	7.65	1	274	3.26	21.97	0.00	6.24	11	319	5.50	22.72	90	-4.70
	V7	6.54	5	261	2.89	18.77	0.59	6.82	7	354	4.10	18.67	104	14.00
	V8	-		-	-	-		6.75	8	410	4.26	18.53	100	6.60
Interaction														
F at same V		NS		NS	NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		NS	NS	NS		NS		NS	NS	NS	NS	
F1		6.06	2	268	2.82	19.63		6.46	2	352	4.63	19.65	93	
F2		6.08	1	268	2.88	19.71	0.11	7.30	1	358	4.83	19.79	93	8.41
C.D.(0.05)		NS		NS	NS	NS		NS		NS	NS	NS	NS	
C.V.(%)		9.48		2.33	3.09	10.76		21.04		13.63	3.77	6.95	1.04	
Mean of varieties:														
V1		6.18	4	260	2.81	19.94	0.37	7.05	3	312	4.90	22.41	98	22.90
V2		6.13	5	259	2.93	20.17	-0.30	8.20	1	315	5.63	23.54	93	13.20
V3		6.97	2	285	2.87	19.20	0.00	7.10	2	373	4.42	17.14	84	2.80
V4		2.99	6	268	2.39	17.95	0.00	6.82	4	415	4.43	14.61	80	4.10
V5		-		-	-	-		-		-	-	-	-	
V6		7.65	1	273	3.23	21.89	0.00	6.48	5	317	5.39	22.36	90	-4.70
V7		6.50	3	264	2.89	18.90	0.59	6.12	7	362	4.31	19.56	104	14.00
V8		-		-	-	-		6.42	6	389	4.04	18.44	100	6.60
C.D.(0.05)		0.56		15.36	0.23	NS		0.92		72.04	0.72	1.33	1.21	
C.V. (%)		7.63		4.76	6.72	10.35		11.25		17.05	12.77	5.66	1.1	
Expt. Mean		**6.07**		**268**	**2.85**	**19.67**		**6.88**		**355**	**4.73**	**19.72**	**93**	
Soil type		Clay loam						Red sandy loam						
pH		8.10						6.50						
N - levels (kg/ha)														
F1		150:60:60						100:50:50						
F2		225:90:90						150:75:75						
Recommended N:P:K (kg/ha)		150:60:60						100:50:50						
Varieties														
V1		IET-26263						IET-26263						
V2		IET-25795						IET-25795						
V3		IET-25793						IET-25793						
V4		IET-26241						IET-26241						
V5		-						-						
V6		KRH 4						KRH 4						
V7		WGL 14						WGL 14						
V8		-						Local Check (JGL 1798)						
Available N:P:K of soil (kg/ha)		160:16:320						363:86:274						

Table 4.1(g): Contd.

F-levels	Varieties	MARUTERU					NAGINA						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	6.55	2	266	4.78		6.34	5	344	3.26	36.61	102	
	V2	6.31	7	261.67	4.25		6.18	7	345	3.25	35.40	101	
	V3	6.38	6	263	4.41		6.09	8	351	3.27	37.09	102	
	V4	6.24	8	253	4.12		6.48	2	344	3.28	36.68	103	
	V5	-		-	-		-		-	-	-	-	
	V6	5.62	10	244.33	3.84		5.72	10	313	3.26	35.89	103	
	V7	5.43	12	229	3.23		5.60	12	316	3.32	36.15	104	
	V8	-		-	-		-		-	-	-	-	
F2	V1	6.73	1	292	4.98	36.36	6.44	3	370	3.41	36.66	102	0.80
	V2	6.5	4	285	4.63	11.26	6.41	4	374	3.43	35.42	100	1.84
	V3	6.54	3	288.33	4.84	53.68	6.30	6	379	3.44	37.22	103	1.68
	V4	6.39	5	284	3.63	12.99	6.71	1	379	3.46	36.66	104	1.84
	V5	-		-	-		-		-	-	-	-	
	V6	5.77	9	275	3.01	32.03	5.88	9	334	3.28	36.15	106	1.28
	V7	5.58	11	262	2.98	64.07	5.62	11	287	3.34	36.24	107	0.16
	V8	-		-	-		-		-	-	-	-	
Interaction													
F at same V		NS		NS	NS		NS		NS	0.03	NS	1.51	
V at same F		NS		NS	NS		NS		NS	0.03	NS	2.06	
F1		6.09	2	253	4.11		6.07	2	335	3.27	36.30	102	
F2		6.25	1	281	4.01	35.06	6.23	1	354	3.39	36.39	104	1.27
C.D.(0.05)		NS		NS	NS		0.07		NS	0.01	NS	NS	
C.V.(%)		5.77		62.02	14.92		0.79		6.33	0.17	0.39	1.32	
Mean of varieties:													
V1		6.64	1	279	4.88	36.36	6.39	2	357	3.34	36.64	102	0.80
V2		6.41	3	273	4.44	11.26	6.30	3	360	3.34	35.41	101	1.84
V3		6.46	2	276	4.63	53.68	6.20	4	365	3.36	37.16	103	1.68
V4		6.32	4	269	3.88	12.99	6.60	1	361	3.37	36.67	104	1.84
V5		-		-	-		-		-	-	-	-	
V6		5.70	5	260	3.43	32.03	5.80	5	324	3.27	36.02	105	1.28
V7		5.51	6	246	3.11	64.07	5.61	6	301	3.33	36.20	105	0.16
V8		-		-	-		-		-	-	-	-	
C.D.(0.05)		0.23		NS	0.49		0.27		25.85	0.02	0.1	1.07	
C.V. (%)		3.08		10.23	10.12		3.58		6.23	0.53	0.23	0.86	
Expt. Mean		**6.17**		**267**	**4.06**		**6.15**		**345**	**3.33**	**36.35**	**103**	
Soil type		-					-						
pH		7.16					7.70						
N - levels (kg/ha)													
F1		90:60:60					150:60:40						
F2		135:90:90					225:90:60						
Recommended N:P:K (kg/ha)		90:60:60					150:60:40						
Varieties													
V1		IET-26263					IET-26263						
V2		IET-25795					IET-25795						
V3		IET-25793					IET-25793						
V4		IET-26241					IET-26241						
V5		-					-						
V6		KRH 4					KRH 4						
V7		WGL 14					WGL 14						
V8		-					-						
Available N:P:K of soil (kg/ha)		151:36:257					21:18.33:209						

Table 4.1(g): Contd.

F-levels	Varieties	RAIPUR					
		Grain Yield (t/ha)	**Rank**	**Panicle/m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)**
F1	V1	7.25	5	272	4.50	20.83	
	V2	7.55	4	254	4.43	21.13	
	V3	6.57	9	278	3.72	17.27	
	V4	5.39	12	236	3.75	12.47	
	V5	-		-	-	-	
	V6	6.49	10	243	3.74	17.43	
	V7	7.06	7	236	5.47	19.93	
	V8	-		-	-	-	
F2	V1	7.67	3	283	4.78	21.07	3.82
	V2	7.68	2	269	4.54	21.13	1.18
	V3	7.19	6	282	3.81	17.30	5.64
	V4	5.54	11	260	3.86	12.73	1.36
	V5	-		-	-	-	
	V6	6.86	8	248	3.79	17.83	3.36
	V7	7.80	1	242	5.72	19.90	6.73
	V8	-		-	-	-	
Interaction							
F at same V		NS		NS	NS	NS	
V at same F		NS		NS	NS	NS	
F1		6.72	2	253	4.27	18.18	
F2		7.12	1	264	4.42	18.33	3.68
C.D.(0.05)		0.36		NS	0.11	NS	
C.V.(%)		3.62		5.06	1.75	3.01	
Mean of varieties:							
V1		7.46	2	278	4.64	20.95	3.82
V2		7.62	1	262	4.49	21.13	1.18
V3		6.88	4	280	3.77	17.29	5.64
V4		5.47	6	248	3.81	12.60	1.36
V5		-		-	-	-	
V6		6.68	5	245	3.77	17.63	3.36
V7		7.43	3	239	5.60	19.92	6.73
V8		-		-	-	-	
C.D.(0.05)		0.56		23.65	0.18	0.56	
C.V. (%)		6.66		7.6	3.47	2.57	
Expt. Mean		**6.92**		**258**	**4.34**	**18.25**	
Soil type		Clay loam					
pH		7.21					
N - levels (kg/ha)							
F1		120:60:40					
F2		180:90:60					
Recommended N:P:K (kg/ha)		120:60:40					
Varieties							
V1		IET-26263					
V2		IET-25795					
V3		IET-25793					
V4		IET-26241					
V5		-					
V6		KRH 4					
V7		WGL 14					
V8		-					
Available N:P:K of soil (kg/ha)		170:21.5:461.9					

Table 4.1(g): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	5.4	4	302	5.25	101		6.08	5
	V2	4.45	11	295	4.23	92		5.93	8
	V3	5.03	8	288	4.81	93		5.94	7
	V4	4.77	9	262	4.18	107		5.28	14
	V5	-		-	-	-			
	V6	5.15	6	293	5.00	92		5.82	9
	V7	4.08	12	252	4.32	103		5.29	13
	V8	-		-	-	-		5.49	11
F2	V1	5.98	1	326	6.14	102	9.67	6.60	1
	V2	5.12	7	314	5.16	92	11.17	6.33	2
	V3	5.62	3	305	6.38	93	9.83	6.26	3
	V4	5.18	5	296	6.24	107	6.83	5.44	12
	V5	-		-	-	-			
	V6	5.65	2	300	6.85	92	8.33	6.00	6
	V7	4.73	10	258	4.98	103	10.83	5.71	10
	V8	-		-	-	-		6.19	4
Interaction									
F at same V		NS		NS	NS	1.51			
V at same F		NS		NS	NS	2.06			
F1		4.81	2	282	4.63	98		5.71	2
F2		5.38	1	300	5.96	98	9.44	6.05	1
C.D.(0.05)		0.5		10.17	0.04	0.24			
C.V.(%)		6.8		2.44	0.54	0.17			
Mean of varieties:									
V1		5.69	1	314	5.70	102	9.67	6.34	1
V2		4.79	5	305	4.70	92	11.17	6.13	2
V3		5.33	3	297	5.60	93	9.83	6.10	3
V4		4.98	4	279	5.21	107	6.83	5.36	7
V5				-	-	-			
V6		5.40	2	296	5.93	92	8.33	5.91	4
V7		4.41	6	255	4.65	103	10.83	5.50	6
V8		-		-	-	-		5.84	5
C.D.(0.05)		0.59		16.28	0.5	0.6			
C.V. (%)		9.63		4.65	7.86	0.5			
Expt. Mean		**5.10**		**291**	**5.30**	**98**		5.99	
Soil type		-							
pH		-							
N - levels (kg/ha)									
F1		120:60:40							
F2		180:60:40							
Recommended N:P:K (kg/ha)		120:60:40							
Varieties									
V1		IET-26263							
V2		IET-25795							
V3		IET-25793							
V4		IET-26241							
V5		-							
V6		KRH 4							
V7		WGL 14							
V8		-							
Available N:P:K of soil (kg/ha)		-							

4.1(h) NMT RSL

AVT-2 entry (IET 25856) was evaluated for its response to levels nutrients on grain yield at two locations i.e. **Faizabad (80:40:40), Pusa (120:0:0)** and **Dhangain** (120:60:40)under two levels of RDF (100% and 150% RDF). The details and data received from these locations are summarized and presented in Table 4.1(h).

RDF doses of nutrient application significantly influenced the grain yield at both the locations and the maximum increase in grain yield was recorded at all the locations with 150% RDF. Application of 150% RDF recorded higher grain yields at **Faizabad** (3.86 t/ha) **Pusa** (3.40 t/ha) and **Dhangain** (5.93 t/ha) and the yield increase was significant. Application of 150% recorded 7.7%, 21.7% and 9.9% higher grain yield at **Faizabad, Pusa** and **Dhangain** respectively over 100% RDF. Higher nutrient response at 150% RDF was recorded at **Faizabad** (3.71), **Pusa** (12.27) and Dhangain (9.92) over 100% RDF.

Grain yield differences among the tested varieties were found to be significant at both the locations. Significantly higher mean maximum grain yield was recorded by IET 25856 at **Faizabad** (4.22 t/ha), **Pusa** (3.25 t/ha) and Dhangain (6.09 t/ha). Higher nutrient response was with the variety Pooja (0.53) at **Faizabad**, with IET 25856 at **Pusa** (14.17) and **Dhangain** (13.83). Interaction effects among RFD x varieties was found to be non-significant at both the locations.

In this trial, 150% RDF was found to be promising and also exhibited higher nutrient recovery efficiency. IET 25856 was found to be promising in terms of grain yield and nutrient response.

Table 4.1(h): Summary of data on grain yield and ancillary characters of selected NMT RSL cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	FAIZABAD					PUSA			
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	4.07	2	254	3.09		2.82	6	293	
	V2	-		-	-		2.49	10	289	
	V3	2.91	6	200	2.95		2.62	9	293	
	V4	-		-	-		2.74	7	296	
	V5	3.70	4	238	3.05		2.65	8	290	
F2	V1	4.36	1	271	3.16	0.36	3.67	1	312	14.17
	V2	-		-	-		3.17	5	297	11.33
	V3	3.33	5	205	3.13	0.53	3.31	4	301	11.50
	V4	-		-	-		3.48	2	307	12.33
	V5	3.88	3	238	3.16	0.23	3.37	3	302	12.00
Interaction										
F at same V		NS		NS	NS		NS		NS	
V at same F		NS		NS	NS		NS		NS	
F1		3.56	2	230	3.03		2.66	2	292	
F2		3.86	1	238	3.15	3.71	3.40	1	304	12.27
C.D.(0.05)		0.27		NS	0.09		0.52		NS	
C.V.(%)		5.64		2.62	2.29		10.96		13.61	
Mean of varieties:										
V1		4.22	1	263	3.13	0.36	3.25	1	303	14.17
V2		-		-	-		2.83	5	293	11.33
V3		3.12	3	203	3.04	0.53	2.97	4	297	11.50
V4		-		-	-		3.11	2	302	12.33
V5		3.79	2	238	3.11	0.23	3.01	3	296	12.00
C.D.(0.05)		0.48		12.68	NS		0.26		NS	
C.V. (%)		11.86		4.97	2.88		6.92		6.8	
Expt. Mean		**3.71**		**234**	**3.09**		**3.03**		**298**	
Soil type		Sandy loam					Silty clay			
pH		7.40					8.40			
N - levels (kg/ha)										
F1		80:40:40					120:0:0			
F2		120:60:60					180:0:0			
Recommended N:P:K (kg/ha)		80:40:40					120:0:0			
Varieties										
V1		IET-25856					IET-25856			
V2		Dhanrasi					Dhanrasi			
V3		Pooja					Pooja			
V4		Savithri					Savithri			
V5		Local Check					Local Check(Rajshree)			
Available N:P:K of soil (kg/ha)		200:24:234					-			

Table 4.1(h): Contd.

F-levels	Varieties	DHANGAIN						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Days to 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	5.67	3	274	5.34	125		4.19	5
	V2	-		-	-	-		2.49	12
	V3	5.00	8	246	4.51	125		3.51	8
	V4	-		-	-	-		2.74	11
	V5	5.50	5	267	5.16	124		5.50	2
	V6	5.17	7	251	4.85	120		3.84	7
F2	V1	6.50	1	325	6.06	126	13.83	4.84	3
	V2	-		-	-	-		3.17	10
	V3	5.44	6	265	4.89	126	7.33	4.03	6
	V4	-		-	-	-		3.48	9
	V5	6.17	2	289	5.90	124	11.17	6.17	1
	V6	5.61	4	263	5.67	119	7.33	4.29	4
Interaction									
F at same V		NS		NS	NS	NS			
V at same F		NS		NS	NS	NS			
F1		5.34	2	260	4.97	124		3.85	2
F2		5.93	1	286	5.63	124	9.92	4.40	1
C.D.(0.05)		NS		19.19	0.42	NS			
C.V.(%)		11.53		4.01	4.53	0.29			
Mean of varieties:									
V1		6.09	1	300	5.70	126	13.83	4.52	2
V2		-		-	-	-		2.83	6
V3		5.22	4	256	4.70	126	7.33	3.77	4
V4		-		-	-	-		3.11	5
V5		5.84	2	278	5.53	124	11.17	5.84	1
V6		5.39	3	257	5.26	120	7.33	4.06	3
C.D.(0.05)		NS		14.05	0.46	0.68			
C.V. (%)		10.62		4.1	6.9	0.44			
Expt. Mean		**5.63**		**273**	**5.30**	**124**		4.12	
Soil type		-							
pH		-							
N - levels (kg/ha)									
F1		120:60:40							
F2		180:60:40							
Recommended N:P:K (kg/ha)		120:60:40							
Varieties									
V1		IET-25856							
V2		-							
V3		Pooja							
V4		-							
V5		MTU 7029							
V6		Local Check(R. Mahsuri-1)							
Available N:P:K of soil (kg/ha)		-							

4.1(i) NMT AL and ISTVT

Saline tolerant culture (IET 22836) was evaluated for its response to different levels of nutrients on grain yield at three different locations i.e. **Kanpur (120:60:50), Lucknow (150:60:40) and Navsari (120:30:0)**. The details and data received from these locations are summarized and presented in Table 4.1(i).

Different RDF doses significantly influenced the grain yield at all the locations and the maximum increase in grain yield was observed with 150% RDF. Application of 150% RDF recorded higher grain yields at **Kanpur** (2.99 t/ha), **Lucknow** (2.53 t/ha) and **Navsari** (3.29 t/ha). Higher nutrient response was recorded with 150% RDF at **Kanpur** (4.21), **Lucknow** (3.60) and **Navsari** (2.58).

Grain yield differences among the tested cultures were found to be significant at all the locations. IET 22836 recorded higher yield at **Kanpur** (3.03 t/ha) followed by Jaya (2.96 t/ha). At **Lucknow**, higher grain yield was obtained by CSR-36 (2.77 t/ha) followed by CSR 10 (2.54 t/ha) and Jaya (2.27 t/ha). CSR 23 (3.50 t/ha) followed by IET 22836 (3.48 t/ha) and CSR 36 (3.25 t/ha) recorded higher yield at **Navsari**. Higher nutrient response was noted with CSR 43 at **Kanpur** (6.42), CSR 10 (4.96) at **Lucknow** and IET 22836 (4.0) at **Navsari**. Interaction effects among RFD x varieties on grain yield was found to be non-significant except at **Navsari** where significant interaction was recorded. Application of 150% RDF with IET 22836 was found to exhibit significant interaction at **Navsari**.

In this trial, 150% RDF was found to be promising and also exhibited higher nutrient recovery. IET 22836 was found to be promising entry and recorded higher grain yield.

Table 4.1(i): Summary of data on grain yield and ancillary characters of selected NMT AL&ISTVT cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	KANPUR					LUCKNOW						
		Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	2.81	5	265	1.87		1.80	12	261	2.69	21.86	93	
	V2	2.25	11	245	1.64		2.23	7	310	2.20	18.53	94	
	V3	2.01	12	239	1.55		1.85	11	273	1.87	22.51	112	
	V4	2.67	8	256	1.75		2.58	3	292	1.79	20.82	106	
	V5	2.74	6	263	1.79		2.13	9	244	2.65	19.84	102	
	V6	2.43	10	254	1.66		1.90	10	325	2.74	18.86	112	
F2	V1	3.25	1	277	1.96	3.67	2.38	5	362	2.41	23.00	92	4.64
	V2	2.72	7	256	1.73	3.92	2.85	2	355	2.04	21.40	96	4.96
	V3	2.58	9	253	1.65	4.75	2.38	5	454	1.51	24.94	114	4.24
	V4	3.02	4	266	1.86	2.92	2.95	1	437	2.10	21.66	108	2.96
	V5	3.17	3	273	1.90	3.58	2.40	4	372	2.70	22.74	103	2.16
	V6	3.20	2	261	1.81	6.42	2.23	7	403	2.52	23.81	114	2.64
Interaction													
F at same V		NS		NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		NS	NS		NS		NS	NS	NS	NS	
F1		2.49	2	254	1.71		2.08	2	284	2.32	20.40	103	
F2		2.99	1	264	1.82	4.21	2.53	1	397	2.21	22.93	105	3.60
C.D.(0.05)		0.21		NS	0.07		0.18		87.58	NS	1.61	NS	
C.V.(%)		5.34		4.42	2.71		5.45		17.92	8.32	5.18	3.89	
Mean of varieties:													
V1		3.03	1	271	1.92	3.67	2.09	5	312	2.55	22.43	93	4.64
V2		2.49	5	250	1.69	3.92	2.54	2	332	2.12	19.97	95	4.96
V3		2.30	6	246	1.60	4.75	2.12	4	363	1.69	23.73	113	4.24
V4		2.85	3	261	1.81	2.92	2.77	1	365	1.95	21.24	107	2.96
V5		2.96	2	268	1.85	3.58	2.27	3	308	2.68	21.29	103	2.16
V6		2.82	4	257	1.74	6.42	2.07	6	364	2.63	21.34	113	2.64
C.D.(0.05)		0.25		7.09	0.11		0.43		NS	0.52	2.09	2.53	
C.V. (%)		7.65		2.27	5.38		15.56		17.02	19.07	8	2.02	
Expt. Mean		**2.74**		**259**	**1.76**		**2.31**		**341**	**2.27**	**21.66**	**104**	
Soil type		Clay loam					Sandy loam						
pH		9.50					8.90						
N - levels (kg/ha)													
F1		120:60:60					150:60:40						
F2		180:90:90					225:90:60						
Recommended N:P:K (kg/ha)		120:60:60					150:60:40						
Varieties													
V1		IET-22836					IET-22836						
V2		CSR 10					CSR 10						
V3		CSR 23					CSR 23						
V4		CSR 36					CSR 36						
V5		Jaya					Jaya						
V6		Local Check (CSR 43)					Local Check						
Available N:P:K of soil (kg/ha)		146.8:28.0:243.0					116.32:28:336.12						

Table 4.1(i): Contd.

F-levels	Varieties	NAVASARI							Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	3.33	5	198	3.44	25.47	101		2.65	8
	V2	2.78	12	178	2.93	24.93	96		2.42	11
	V3	3.37	4	180	2.73	26.23	96		2.41	12
	V4	3.10	8	184	3.48	26.47	96		2.78	7
	V5	2.90	10	189	3.32	24.57	96		2.59	9
	V6	3.11	7	213	3.28	23.20	95		2.48	10
F2	V1	3.63	1	200	3.39	26.07	101	4.00	3.09	2
	V2	2.84	11	171	3.07	26.93	97	0.80	2.80	6
	V3	3.63	1	180	3.79	26.33	97	3.47	2.86	4
	V4	3.39	3	189	3.37	26.00	98	3.87	3.12	1
	V5	3.10	8	182	3.53	24.40	97	2.67	2.89	3
	V6	3.16	6	236	3.23	25.40	96	0.67	2.86	4
Interaction										
F at same V		NS		NS	0.16	1.15	NS			
V at same F		NS		NS	0.16	1.39	NS			
F1		3.10	2	190	3.20	25.15	97		2.56	2
F2		3.29	1	193	3.40	25.86	98	2.58	2.94	1
C.D.(0.05)		NS		NS	0.08	NS	NS			
C.V.(%)		14.6		5.88	1.76	3.19	2.08			
Mean of varieties:										
V1		3.48	2	199	3.42	25.77	101	4.00	2.87	2
V2		2.81	6	174	3.00	25.93	97	0.80	2.61	6
V3		3.50	1	180	3.26	26.28	97	3.47	2.64	5
V4		3.25	3	187	3.43	26.24	97	3.87	2.95	1
V5		3.00	5	186	3.43	24.49	97	2.67	2.74	3
V6		3.14	4	224	3.26	24.30	96	0.67	2.67	4
C.D.(0.05)		0.39		11.65	0.12	0.81	0.9			
C.V. (%)		10.03		5.05	2.9	2.64	0.77			
Expt. Mean		**3.20**		**192**	**3.30**	**25.50**	**97**		2.75	
Soil type		-								
pH		8.58								
N - levels (kg/ha)										
F1		120:30:0								
F2		180:45:0								
Recommended N:P:K (kg/ha)		120:30:0								
Varieties										
V1		IET-22836								
V2		CSR 10								
V3		CSR 23								
V4		CSR 36								
V5		Jaya								
V6		Local Check (Dandi)								
Available N:P:K of soil (kg/ha)		238:120:1021								

4.1(j) NMT CSTVT

Different cultures were evaluated in comparison with standard varieties at **Navsari (120:30:0)** under two recommended level of input (100 and 150% RDF). The data is summarized and presented in Table 4.1(j).

Different levels of RDF did not exhibit significant differences in grain yield and yield attributes at **Navsari**. Application of 150% RDF recorded higher yield of 4.09 t/ha but the yield increase was not significant and was comparable to followed by 100 % RDF which recorded yield of 3.58 t/ha. Nutrient response (kg grain / kg Nutrients) was higher at 150% RDF (6.83).

Average yield of varieties ranged from 3.50 to 4.31 t/ha. IET 25059 (4.31 t/ha) followed by CSR 10 (3.92 t/ha) was found to be promising over other varieties. Nutrient response (kg grain/kg nutrient) was higher with IET 25059 (8.67) followed by Local check (8.00) and CSR 10 (7.73). Interaction effects of N levels and varieties were found to be non-significant.

In this trial, 150% RDF was found to be promising and also exhibited higher nutrient recovery. AVT-2 entry IET 25059 was found to be promising in terms of grain yield.

Table 4.1(j): Summary of data on grain yield and ancillary characters of selected NMT CSTVT cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	NAVASARI							Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	3.98	3	216	3.30	26.47	101		3.98	3
	V2	3.63	5	194	3.33	24.97	96		3.63	5
	V3	3.39	7	178	3.33	24.87	96		3.39	7
	V4	3.30	8	211	3.53	25.20	96		3.30	8
F2	V1	4.63	1	234	3.37	26.33	101	8.67	4.63	1
	V2	4.21	2	202	3.23	25.20	96	7.73	4.21	2
	V3	3.61	6	187	3.57	25.10	95	2.93	3.61	6
	V4	3.90	4	218	3.67	26.20	96	8.00	3.90	4
Interaction										
F at same V		NS		NS	NS	NS	NS			
V at same F		NS		NS	NS	NS	NS			
F1		3.58	2	200	3.37	25.38	97		3.58	2
F2		4.09	1	210	3.46	25.71	97	6.83	4.09	1
C.D.(0.05)		NS		NS	NS	NS	NS			
C.V.(%)		16.68		20.49	4.89	4.32	1.86			
Mean of varieties:										
V1		4.31	1	225	3.34	26.40	101	8.67	4.31	1
V2		3.92	2	198	3.28	25.09	96	7.73	3.92	2
V3		3.50	4	182	3.45	24.99	96	2.93	3.50	4
V4		3.60	3	215	3.60	25.70	96	8.00	3.60	3
C.D.(0.05)		0.47		NS	0.15	NS	1.18			
C.V. (%)		9.69		12.18	3.38	4.54	0.96			
Expt. Mean		**3.83**		**205**	**3.42**	**25.54**	**97**		3.83	
Soil type		-								
pH		8.58								
N - levels (kg/ha)										
F1		120:30:0								
F2		180:45:0								
Recommended N:P:K (kg/ha)		120:30:0								
Varieties										
V1		IET-25059								
V2		CSR 10								
V3		Jaya								
V4		Local Check (Dandi)								
Available N:P:K of soil (kg/ha)		219:129:1033								

4.1(k) NMT Aerobic

Aerobic rice cultivation is a system where it is grown under aerated conditions without standing water as against the usual transplanted rice which is grown under unaerated flooded conditions. Here rice is grown on dry but irrigated soils like other irrigated dry (ID) crops such as wheat and barley. The crop is provided with irrigation water depending upon the season and specific needs of the crop. It is characterized by the presence of air in the soil medium and its limited water requirement as compared to the irrigated rice.

Seven AVT-2 entries (IET 25618, IET26198, IET 26157, IET 26171, IET 26194, IET 26170 and IET 26168) were evaluated at for their response to two fertilizer levels on grain yield at nine locations viz. **Hazaribagh (80:40:30), Jagdalpur (80:50:30), Kaul (150:60:60), Kota (120:60:40), Ludhiana (150:30:30), Nawagam (80:25:0), Pantnagar (120:60:40), Raipur (120:60:40) and Vadgaon (100:50:50).** The data received from four locations are summarized and presented in Table 4.(k).

Different doses of RDF exhibited significant differences in grain yield at **Jagdalpur, Kota, Nawagam** and **Vadgaon**. Application of 150% RDF recorded higher yield at **Kota** (5.69 t/ha), **Nawagam** (2.61 t/ha) and **Vadgaon** (6.67 t/ha). 100 % RDF realised higher grain yield at **Jagdalpur** (2.50 t/ha). Nitrogen response (kg grain / kg N) was higher at 150 % RDF over 100% RDF at **Hazaribagh** (15.99), **Kaul** (0.59), Kota (1.25), **Nawagam** (3.45) and **Vadgaon** (4.59).

Grain yield of cultures differed significantly at all locations. Among the entries tested, IET 26198 recorded higher yield at **Hazaribagh** (2.1 t/ha), **Jagdalpur** (2.88 t/ha) and **Pantnagar** (4.48 t/ha), IET 25618 recorded higher yield at **kaul** (6.20 t/ha), whereas IET 26170 performed better at Kota (6.54 t/ha). IET 26168 at Ludhiana (6.15 t/ha), **Nawagam** (3.19 t/ha) and **Vadgaon** (8.02 t/ha), IET 26157 (5.43 t/ha) was found to be promising at **Raipur** over other entries. Average over the locations, the performance of IET 26168 (6.90 t/ha) was found to be promising. Interaction effects of N doses and varieties was found to be non-significant at all the locations except **Ludhiana**. 150% RDF with IET 26168 realised higher grain yield at Ludhiana.

Summarised over the locations, application of 150% RDF was found to be promising and also exhibited higher nutrient recovery. IET 26168 was found to be promising with higher grain yield across the locations.

Table 4.1(k): Summary of data on grain yield and ancillary characters of selected NMT Aerobic cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	HAZARIBAGH							JAGDALPUR					Kaul				
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	20.67	9	220	2.87	2.65	82		2.69	4	275	3.33		6.13	2	260	2.94	
	V2	20.78	8	270	2.91	3.86	80		3.70	1	296	3.57		6.05	4	267	2.84	
	V3	18.01	19	207	2.86	3.74	82		2.63	5	286	3.60		5.47	11	252	2.7	
	V4	17.42	20	167	2.94	3.44	87		2.36	6	239	3.57		6.04	5	267	2.82	
	V5	20.34	10	241	2.57	4.01	80		1.89	11	201	3.60		5.2	15	286	2.28	
	V6	18.17	18	248	2.58	2.88	82		3.02	3	193	3.43		5.76		316	2.26	
	V7	18.34	16	228	3.07	2.92	80		3.55	2	198	3.50		5.07		249	2.54	
	V8	28.28	2	193	3.07	2.76	60		0.94	18	185	3.23		4.34		237	2.29	
	V9	-		-	-	-	-		-		-	-		-		-	-	
	V10	22.20	5	252	2.50	3.26	79		2.00	10	179	3.83		5.44		266	2.56	
	V11	-		-	-	-	-		-		-	-		-		-	-	
	V12	18.47	15	273	3.32	2.68	81		2.22	7	207	4.23		5.06		242	2.62	
F2	V1	19.61	13	253	2.93	3.79	80	-14.13	1.55	13	256	2.97	-14.25	6.26	1	262	2.99	0.96
	V2	21.30	7	288	3.25	4.46	79	6.93	2.05	9	281	3.47	-20.63	6.07	3	269	2.84	0.15
	V3	18.56	14	233	3.08	3.89	82	7.33	1.53	14	280	3.47	-13.75	5.65	9	254	2.79	1.33
	V4	20.13	12	218	3.95	3.54	86	36.13	1.41	15	233	3.20	-11.88	6.03	6	266	2.83	-0.07
	V5	21.58	6	271	2.81	5.00	85	16.53	0.99	17	176	3.40	-11.25	5.28	13	287	2.3	0.59
	V6	18.27	17	286	3.11	3.40	83	1.33	1.70	12	207	3.73	-16.50	5.88		318	2.3	0.89
	V7	22.99	3	240	3.32	3.28	81	62.00	2.09	8	194	3.23	-18.25	5.21		251	2.57	1.04
	V8	29.15	1	194	2.90	3.21	60	11.60	0.71	20	175	3.53	-2.88	4.36		237	2.41	0.15
	V9	-		-	-	-	-		-		-	-		-		-	-	
	V10	22.87	4	276	3.70	3.57	80	8.93	1.19	16	135	3.63	-10.13	5.53		267	2.58	0.67
	V11	-		-	-	-	-		-		-	-		-		-	-	
	V12	20.21	11	300	3.53	3.55	78	23.20	0.86	19	182	3.93	-17.00	5.09		246	2.69	0.22
Interaction																		
F at same V		NS		NS	0.47	NS	2.18		NS		NS	NS		NS		NS	NS	
V at same F		NS		NS	0.55	NS	2.71		NS		NS	NS		NS		NS	NS	
F1		20.27	2	230	2.87	3.22	79		2.50	1	226	3.59		5.46	2	264	2.59	
F2		21.47	1	256	3.26	3.77	79	15.99	1.41	2	212	3.46	-13.65	5.54	1	266	2.63	0.59
C.D.(0.05)		NS		16.48	NS	NS	NS		0.94		NS	NS		NS		NS	NS	
C.V.(%)		6.8		6.11	11.98	18.24	2.54		43.22		16.14	4.32		3.28		3.1	1.75	

Table 4.1(k): Contd.

F-levels	Varieties	HAZARIBAGH							JAGDALPUR					Kaul				
		Grain Yield (t/ha)	Rank	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:																		
V1		20.14	6	237	2.90	3.22	81	-14.13	2.12	4	266	3.15	-14.25	6.20	1	261	2.97	0.96
V2		21.04	3	279	3.08	4.16	80	6.93	2.88	1	288	3.52	-20.63	6.06	2	268	2.84	0.15
V3		18.29	9	220	2.97	3.82	82	7.33	2.08	5	283	3.54	-13.75	5.56	5	253	2.75	1.33
V4		18.78	8	192	3.45	3.49	86	36.13	1.89	6	236	3.39	-11.88	6.04	3	267	2.83	-0.07
V5		20.96	4	256	2.69	4.51	83	16.53	1.44	9	189	3.50	-11.25	5.24	7	287	2.29	0.59
V6		18.22	10	267	2.85	3.14	82	1.33	2.36	3	200	3.58	-16.50	5.82	4	317	2.28	0.89
V7		20.67	5	234	3.20	3.10	81	62.00	2.82	2	196	3.37	-18.25	5.14	8	250	2.56	1.04
V8		28.72	1	194	2.99	2.99	60	11.60	0.83	10	180	3.38	-2.88	4.35	10	237	2.35	0.15
V9		-		-	-	-	-		-		-	-		-		-	-	
V10		22.54	2	264	3.10	3.42	80	8.93	1.60	7	157	3.73	-10.13	5.49	6	267	2.57	0.67
V11		-		-	-	-	-		-		-	-		-		-	-	
V12		19.34	7	287	3.43	3.12	79	23.20	1.54	8	195	4.08	-17.00	5.08	9	244	2.66	0.22
C.D.(0.05)		2.16		41.81	0.33	0.46	1.54		0.64		34.57	0.39		0.6		21.05	0.2	
C.V. (%)		8.85		14.75	9.25	11.25	1.66		28.19		13.54	9.6		9.29		6.81	6.64	
Expt. Mean		**20.87**		**243**	**3.06**	**3.49**	**79**		**1.95**		**219**	**3.52**		**5.50**		**265**	**2.61**	
Soil type		Clay loam							-					Clay loam				
pH		6.80							-					8.10				
N - levels (kg/ha)																		
F1		80:40:30							80:50:30					150:60:60				
F2		120:60:45							120:75:25					225:90:90				
Recommended N:P:K (kg/ha)		80:40:30							80:50:30					150:60:60				
Varieties																		
V1		IET 25618							IET 25618					IET 25618				
V2		IET 26198							IET 26198					IET 26198				
V3		IET 26157							IET 26157					IET 26157				
V4		IET 26171							IET 26171					IET 26171				
V5		IET 26194							IET 26194					IET 26194				
V6		IET 26170							IET 26170					IET 26170				
V7		IET 26168							IET 26168					IET 26168				
V8		AAUDR – 1							AAUDR – 1					AAUDR – 1				
V9		-							-					-				
V10		CR Dhan 202							CR Dhan 202					CR Dhan 202				
V11		-							-					-				
V12		Local Check (Sahbhagi Dhan)							Local Check (MTU 1010)					Local Check (HKT 47)				
Available N:P:K of soil (kg/ha)		-:19.8:421							-					160:16:320				

Table 4.1(k): Contd.

F-levels	Varieties	KOTA					LUDHIANA						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	5.35	13	289	3.24		5.93	6	531	2.42	21.67	88	
	V2	6.09	8	317	3.54		6.21	5	443	2.62	21.00	84	
	V3	4.47	18	260	2.74		4.43	13	437	2.16	20.30	87	
	V4	5.76	10	298	3.34		3.16	16	536	2.16	18.76	92	
	V5	6.26	6	325	3.6		6.48	4	549	2.05	21.36	80	
	V6	6.44	4	331	3.73		5.38	8	525	2.50	18.60	81	
	V7	6.61	3	252	3.97		5.75	7	441	2.21	20.64	79	
	V8	4.06	20	253	2.69		2.81	18	437	2.45	26.81	74	
	V9	-		-	-		-		-	-	-	-	
	V10	5.63	12	294	3.27		-		-	-	-	-	
	V11	-		-	-		-		-	-	-	-	
	V12	4.84	16	276	2.86		7.05	1	493	2.49	22.79	79	
F2	V1	5.09	14	292	3.25	-2.36	4.65	11	501	2.40	20.71	90	-12.19
	V2	6.26	6	328	3.73	1.55	4.59	12	483	2.67	22.48	86	-15.43
	V3	4.57	17	265	2.87	0.91	4.03	14	448	2.10	20.32	86	-3.81
	V4	5.9	9	305	3.41	1.27	3.74	15	480	2.11	18.50	91	5.52
	V5	6.41	5	336	3.82	1.36	5.37	9	469	2.43	21.76	82	-10.57
	V6	6.63	2	342	3.9	1.73	5.33	10	480	2.26	18.20	83	-0.48
	V7	7.01	1	361	4.02	3.64	6.54	3	509	2.54	21.60	78	7.52
	V8	4.27	19	259	2.9	1.91	2.93	17	392	2.34	26.20	73	1.14
	V9	-		-	-		-		-	-	-	-	
	V10	5.75	11	300	3.35	1.09	-		-	-	-	-	
	V11	-		-	-		-		-	-	-	-	
	V12	4.99	15	280	2.98	1.36	6.86	2	531	2.43	20.83	80	-1.81
Interaction													
F at same V		NS		32.87	NS		0.78		NS	NS	NS	NS	
V at same F		NS		33.13	NS		1.08		NS	NS	NS	NS	
F1		5.55	2	290	3.30		5.24	1	488	2.34	21.33	83	
F2		5.69	1	307	3.42	1.25	4.89	2	477	2.36	21.18	83	-3.34
C.D.(0.05)		0.02		14.31	NS		NS		NS	NS	NS	NS	
C.V.(%)		0.31		4.32	7.77		17.06		4.75	14.73	3.62	0.85	

Table 4.1(k): Contd.

F-levels	Varieties	KOTA					LUDHIANA						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:													
V1		5.22	7	291	3.25	-2.36	5.29	6	516	2.41	21.19	89	-12.19
V2		6.18	4	323	3.64	1.55	5.40	4	463	2.65	21.74	85	-15.43
V3		4.52	9	263	2.81	0.91	4.23	7	443	2.13	20.31	86	-3.81
V4		5.83	5	302	3.38	1.27	3.45	8	508	2.14	18.63	92	5.52
V5		6.34	3	331	3.71	1.36	5.93	3	509	2.24	21.56	81	-10.57
V6		6.54	2	337	3.82	1.73	5.36	5	503	2.38	18.40	82	-0.48
V7		6.81	1	307	4.00	3.64	6.15	2	475	2.38	21.12	78	7.52
V8		4.17	10	256	2.80	1.91	2.87	9	415	2.40	26.51	74	1.14
V9		-		-	-		-		-	-	-	-	
V10		5.69	6	297	3.31	1.09	-		-	-	-	-	
V11		-		-	-		-		-	-	-	-	
V12		4.92	8	278	2.92	1.36	6.96	1	512	2.46	21.81	79	-1.81
C.D.(0.05)		0.45		23.24	0.26		0.55		52.14	NS	1.9	1.56	
C.V. (%)		6.9		6.68	6.63		9.35		9.26	16.24	7.65	1.61	
Expt. Mean		**5.62**		**298**	**3.36**		**5.07**		**483**	**2.35**	**21.25**	**83**	
Soil type		-					Sandy loam						
pH		-					7.20						
N - levels (kg/ha)													
F1		120:60:40					150:30:30						
F2		180:90:60					225:45:45						
Recommended N:P:K (kg/ha)		120:60:40					150:30:30						
Varieties													
V1		IET 25618					IET 25618						
V2		IET 26198					IET 26198						
V3		IET 26157					IET 26157						
V4		IET 26171					IET 26171						
V5		IET 26194					IET 26194						
V6		IET 26170					IET 26170						
V7		IET 26168					IET 26168						
V8		AAUDR – 1					AAUDR – 1						
V9		-					-						
V10		CR Dhan 202					CR Dhan 202						
V11		-					-						
V12		Local Check (IR 64)					Local Check (PR 126)						
Available N:P:K of soil (kg/ha)		-					470:27.2:66.6						

Table 4.1(k): Contd.

F-levels	Varieties	NAWAGAM							PANTNAGAR						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	2.29	11	127	2.59	21.27	78		3.60	17	193	2.15	24.13	93	
	V2	2.93	4	156	3.69	22.53	59		4.45	4	206	2.40	24.03	87	
	V3	2.70	5	164	3.36	19.63	77		3.43	18	194	2.06	22.67	93	
	V4	2.28	12	99	3.32	18.73	78		4.02	12	190	2.61	22.97	91	
	V5	1.94	18	129	2.69	19.83	79		3.92	15	192	2.35	23.90	90	
	V6	2.28	12	104	2.90	15.37	81		3.95	14	220	2.26	21.00	88	
	V7	3.03	3	147	3.65	20.77	78		4.13	9	222	2.22	23.13	85	
	V8	2.25	15	117	2.52	27.30	73		-		-	-	-	-	
	V9	-		-	-	-	-		-		-	-	-	-	
	V10	2.14	17	106	2.59	19.40	83		4.08	10	198	2.36	22.27	91	
	V11	-		-	-	-	-		-		-	-	-	-	
	V12	-		-	-	-	-		4.52	2	213	2.47	25.57	98	
F2	V1	2.38	9	113	2.98	20.90	79	1.71	4.06	11	208	2.22	23.67	93	4.18
	V2	2.59	6	137	3.15	21.03	59	-6.48	4.51	3	211	2.39	24.33	89	0.55
	V3	3.32	2	127	3.43	20.30	77	11.81	3.65	16	205	2.17	21.27	93	2.00
	V4	2.57	7	118	3.13	19.10	79	5.52	4.22	6	203	2.46	22.50	93	1.82
	V5	2.18	16	102	2.58	17.43	81	4.57	4.02	12	215	2.17	24.23	91	0.91
	V6	2.31	10	111	2.80	16.73	83	0.57	4.18	8	228	2.07	22.00	85	2.09
	V7	3.34	1	159	3.31	20.80	79	5.90	4.22	6	231	2.24	22.43	87	0.82
	V8	2.26	14	119	3.46	28.30	73	0.19	-		-	-	-	-	
	V9	-		-	-	-	-		-		-	-	-	-	
	V10	2.52	8	120	3.33	18.97	82	7.24	4.32	5	208	2.45	22.03	87	2.18
	V11	-		-	-	-	-		-		-	-	-	-	
	V12	-		-	-	-	-		4.66	1	218	2.47	25.53	91	1.27
Interaction															
F at same V		NS		18.9	0.56	NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		24.57	0.65	NS	NS		NS		NS	NS	NS	NS	
F1		2.43	2	128	3.03	20.54	76		4.01	2	203	2.32	23.30	91	
F2		2.61	1	123	3.13	20.40	77	3.45	4.20	1	214	2.29	23.11	90	1.76
C.D.(0.05)		0.16		NS	NS	NS	NS		NS		NS	NS	NS	NS	
C.V.(%)		5.38		14.78	13.28	3.09	3.1		10.1		6.65	7.4	1.81	4.35	

Table 4.1(k): Contd.

F-levels	Varieties	NAWAGAM							PANTNAGAR						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
Mean of varieties:															
V1		2.34	5	120	2.79	21.09	79	1.71	3.83	8	200	2.19	23.90	93	4.18
V2		2.76	3	147	3.42	21.78	59	-6.48	4.48	2	208	2.40	24.18	88	0.55
V3		3.01	2	146	3.40	19.97	77	11.81	3.54	9	200	2.12	21.97	93	2.00
V4		2.43	4	108	3.23	18.92	79	5.52	4.12	5	197	2.54	22.74	92	1.82
V5		2.06	9	116	2.64	18.63	80	4.57	3.97	7	203	2.26	24.07	91	0.91
V6		2.30	7	108	2.85	16.05	82	0.57	4.07	6	224	2.17	21.50	87	2.09
V7		3.19	1	153	3.48	20.79	79	5.90	4.18	4	226	2.23	22.78	86	0.82
V8		2.26	8	118	2.99	27.80	73	0.19	-		-	-	-	-	
V9		-		-	-	-	-		-		-	-	-	-	
V10		2.33	6	113	2.96	19.19	82	7.24	4.20	3	203	2.41	22.15	89	2.18
V11		-		-	-	-	-		-		-	-	-	-	
V12		-		-	-	-	-		4.59	1	215	2.47	25.55	95	1.27
C.D.(0.05)		0.37		13.37	0.4	1.2	1.08		0.39		15.37	0.15	0.71	4.31	
C.V. (%)		12.67		9.14	11.03	5.04	1.21		8.23		6.32	5.61	2.64	4.09	
Expt. Mean		**2.52**		**125**	**3.08**	**20.47**	**77**		**4.11**		**208**	**2.31**	**23.20**	**90**	
Soil type		Clay loam							Silt loam						
pH		7.78							7.80						
N - levels (kg/ha)															
F1		80:25:0							120:60:40						
F2		120:37.5:0							180:90:60						
Recmd N:P:K (kg/ha)		80:25:0							120:60:40						
Varieties															
V1		IET 25618							IET 25618						
V2		IET 26198							IET 26198						
V3		IET 26157							IET 26157						
V4		IET 26171							IET 26171						
V5		IET 26194							IET 26194						
V6		IET 26170							IET 26170						
V7		IET 26168							IET 26168						
V8		AAUDR – 1							-						
V9		-							-						
V10		CR Dhan 202							CR Dhan 202						
V11		-							-						
V12		-							Local Check (PD 24)						
Available N:P:K of soil (kg/ha)		0.03:38.07:210							232:21.4:223						

Table 4.1(k): Contd.

F-levels	Varieties	RAIPUR							VADGAON						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	5.15	10	272	3.55	26.00	85		6.66	11	252	5.25	2.50		6.50	12
	V2	5.02	12	296	3.63	25.10	83		4.86	18	233	3.74	2.72		6.68	6
	V3	5.47	5	290	3.64	23.20	89		6.70	9	233	5.56	2.69		5.92	20
	V4	5.62	4	337	3.49	22.37	90		6.79	8	243	4.14	2.14		5.94	19
	V5	5.47	5	343	3.65	25.80	89		7.24	5	345	3.86	2.45		6.53	11
	V6	5.65	3	291	3.79	23.33	85		4.90	17	233	3.50	2.27		6.17	16
	V7	5.14	11	265	3.38	23.40	86		7.73	3	280	3.93	2.31		6.59	9
	V8	-		-	-	-	-		4.81	19	308	5.16	2.69		6.78	3
	V9	-		-	-	-	-		-		-	-	-			
	V10	4.80	15	288	3.31	23.37	85		6.13	14	261	4.47	2.22		6.55	10
	V11	-		-	-	-	-		-		-	-	-			
	V12	4.70	16	315	3.29	22.00	84		6.31	13	256	6.14	2.68		6.65	8
F2	V1	5.33	8	288	3.60	26.00	86	1.64	7.03	7	258	5.49	2.57	3.70	6.22	14
	V2	4.84	14	299	3.47	25.30	84	-1.64	5.35	16	239	4.01	2.81	4.90	6.40	13
	V3	5.39	7	295	3.51	23.33	90	-0.73	7.24	5	241	5.74	2.80	5.40	5.99	18
	V4	4.57	17	341	3.41	22.37	90	-9.55	7.36	4	255	4.36	2.33	5.70	6.21	15
	V5	6.18	1	349	3.76	25.87	90	6.45	7.83	2	354	4.05	2.61	5.90	6.65	7
	V6	5.76	2	303	3.86	23.33	86	1.00	5.48	15	243	3.66	2.35	5.80	6.17	17
	V7	5.23	9	277	3.43	23.57	87	0.82	8.30	1	291	4.05	2.40	5.70	7.21	1
	V8	-		-	-	-	-		4.81	19	289	5.34	2.77	0.00	6.93	2
	V9	-		-	-	-	-		-		-	-	-			
	V10	4.85	13	305	3.34	23.50	85	0.45	6.64	12	275	4.64	2.30	5.10	6.71	5
	V11	-		-	-	-	-		-		-	-	-			
	V12	4.49	18	323	3.21	22.00	84	-1.91	6.68	10	278	6.32	2.80	3.70	6.73	4
Interaction																
F at same V		NS		NS	NS	NS	NS		NS		NS	NS	NS			
V at same F		NS		NS	NS	NS	NS		NS		NS	NS	NS			
F1		5.22	1	299	3.53	23.84	86		6.21	2	264	4.58	2.47		6.32	2
F2		5.18	2	309	3.51	23.92	87	-0.38	6.67	1	272	4.77	2.57	4.59	6.41	1
C.D.(0.05)		NS		NS	NS	NS	0.42		0.14		NS	0.09	0.02			
C.V.(%)		7.68		7.47	6.2	0.65	0.42		1.98		4.93	1.71	0.64			

Table 4.1(k): Contd.

F-levels	Varieties	RAIPUR							VADGAON						Over all mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle /m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
Mean of varieties:																
V1		5.24	4	280	3.58	26.00	86	1.64	6.85	5	255	5.37	2.54	3.70	6.36	7
V2		4.93	7	298	3.55	25.20	84	-1.64	5.11	9	236	3.88	2.77	4.90	6.54	6
V3		5.43	3	293	3.58	23.27	90	-0.73	6.97	4	237	5.65	2.75	5.40	5.96	10
V4		5.10	6	339	3.45	22.37	90	-9.55	7.08	3	249	4.25	2.24	5.70	6.08	9
V5		5.83	1	346	3.71	25.84	90	6.45	7.54	2	350	3.96	2.53	5.90	6.59	5
V6		5.71	2	297	3.83	23.33	85	1.00	5.19	8	238	3.58	2.31		6.17	8
V7		5.19	5	271	3.41	23.49	86	0.82	8.02	1	286	3.99	2.36		6.90	1
V8		-		-	-	-	-		4.81	10	299	5.25	2.73		6.86	2
V9		-		-	-	-	-		-		-	-	-		-	
V10		4.83	8	296	3.33	23.44	85	0.45	6.39	7	268	4.56	2.26		6.63	4
V11		-		-	-	-	-		-		-	-	-		-	
V12		4.60	9	319	3.25	22.00	84	-1.91	6.50	6	267	6.23	2.74		6.69	3
C.D.(0.05)		0.44		25.61	0.27	0.5	0.64		0.53		37.53	0.09	0.04			
C.V. (%)		7.19		7.21	6.47	1.78	0.63		7.01		11.98	1.62	1.5			
Expt. Mean		**5.20**		**304**	**3.52**	**23.88**	**87**		**6.44**		**268**	**4.67**	**2.52**		6.36	
Soil type		Clay loam							-							
pH		7.04							7.70							
N - levels (kg/ha)																
F1		120:60:40							100:50:50							
F2		180:90:60							150:75:75							
Recmd N:P:K (kg/ha)		120:60:40							100:50:50							
Varieties																
V1		IET 25618							IET 25618							
V2		IET 26198							IET 26198							
V3		IET 26157							IET 26157							
V4		IET 26171							IET 26171							
V5		IET 26194							IET 26194							
V6		IET 26170							IET 26170							
V7		IET 26168							IET 26168							
V8		-							AAUDR – 1							
V9		-							-							
V10		CR Dhan 202							CR Dhan 202							
V11		-							-							
V12		Local Check (Indra aerobic - 1)							Local Check (PhuleSamruddhi)							
Available N:P:K of soil (kg/ha)		178.6:22.4:450.4							170:16.1:227							

4.1(l) NMT Biofortified

Two AVT-2 entries (IET 26383 and IET-26374) were evaluated for their response to different levels of nutrients (100% and 150% RDF) on grain yield from eight different locations viz., **Coimbatore (150:60:40), Kaul (150:60:60), Pantnagar (120:60:40), Raipur (100:60:40), Rajendranagar (120:60:40), Rewa (120:60:40), Varanasi (90:60:60) and Maruteru (90:60:60)**. The details and data received from these locations are summarized and presented in Table 4.1(l).

Application of different nutrient levels registered significantly higher grain yield at **Pantnagar, Raipur** and **Rewa**. Application of 150% RDF recorded significantly higher grain yields at **Pantnagar** (3.03 t/ha), **Raipur** (5.72 t/ha) and **Rewa** (5.27 t/ha). Higher nutrient response was recorded with 150% RDF over 100% RDF at **Coimbatore** (1.76), **Kaul** (0.27), **Pantnagar** (1.64), **Raipur** (4.96), **Rewa** (6.00), **Varanasi** (1.03) and **Maruteru** (2.42).

Grain yield differences among the tested varieties were found to be significant at all the locations except at **Rewa**. Highest grain yield was recorded by IET 26383 at **Kaul** (5.99 t/ha), **Pantnagar** (3.12 t/ha), **Raipur** (6.75 t/ha), **Rajendranagar** and **Maruteru** (5.31 t/ha). At **Coimbatore**, IET 26375 recorded higher grain yield (5.01 t/ha). Mean over the locations, IET 26383 (5.27 t/ha) performed better and was followed by IET 26375 (4.89 t/ha) with 7.0% higher yield increase. Interaction effects among RDF x varieties was found to be non-significant at all the locations except at Varanasi where significant interaction was noted. Application of 150% RDF with variety BPT 5204 followed by 100% RDF with IET 26383 was the best treatment at Varanasi.

In this trial, mean over the locations nutrient management with 150% had higher grain yield. IET 26383 and IET 26375were found to be promising and recorded higher mean grain yield over the locations.

Table 4.1(l): Summary of data on grain yield and ancillary characters of selected NMT Biofortified cultures grown under transplanted conditions at graded levels of recommended fertilizer doses, kharif 2018.

F-levels	Varieties	COIMBATORE						Kaul					
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	
F1	V1	4.84	5	334	2.75	21.23		5.95	4	238	3.00		
	V2	4.99	3	345	2.80	23.30		5.74	8	238	2.82		
	V3	4.81	6	317	2.50	14.57		6.39	2	271	2.98		
	V4	4.15	10	299	1.83	13.80		5.70	9	241	2.83		
	V5	4.25	9	306	2.55	24.03		5.77	7	265	2.60		
	V6	-		-	-	-		-		-	-		
F2	V1	5.14	1	341	2.75	21.20	4.00	6.03	3	240	3.00	0.59	
	V2	5.03	2	350	3.08	23.20	0.53	5.78	6	238	2.82	0.30	
	V3	4.86	4	324	2.50	14.70	0.67	6.40	1	273	2.99	0.07	
	V4	4.29	8	301	2.10	13.60	1.87	5.69	10	240	2.83	-0.07	
	V5	4.38	7	311	2.60	24.07	1.73	5.83	5	266	2.62	0.44	
	V6	-		-	-	-		-		-	-		
Interaction													
F at same V		NS		NS	NS	NS		NS		NS	NS		
V at same F		NS		NS	NS	NS		NS		NS	NS		
F1		4.61	2	320	2.49	19.39		5.91	2	251	2.85		
F2		4.74	1	325	2.61	19.35	1.76	5.95	1	251	2.85	0.27	
C.D.(0.05)		NS		1.88	NS	NS		NS		NS	NS		
C.V.(%)		1.92		0.37	26.01	2.17		8.52		11.4	7.62		
Mean of varieties:													
V1		4.99	2	337	2.75	21.22	4.00	5.99	2	239	3.00	0.59	
V2		5.01	1	348	2.94	23.25	0.53	5.76	4	238	2.82	0.30	
V3		4.84	3	321	2.50	14.64	0.67	6.40	1	272	2.99	0.07	
V4		4.22	5	300	1.97	13.70	1.87	5.70	5	241	2.83	-0.07	
V5		4.32	4	309	2.58	24.05	1.73	5.80	3	265	2.61	0.44	
V6		-		-	-	-		-		-	-		
C.D.(0.05)		0.12		11.09	0.3	0.41		0.44		19.03	0.2		
C.V. (%)		2.05		2.81	9.63	1.74		6.11		6.2	5.78		
Expt. Mean		**4.67**		**323**	**2.55**	**19.37**		**5.93**		**251**	**2.85**		
Soil type		Clay loam						Clay loam					
pH		8.49						8.10					
N - levels (kg/ha)													
F1		150:60:40						150:60:60					
F2		225:60:40						225:90:90					
Recommended N:P:K (kg/ha)		150:60:40						150:60:60					
Varieties													
V1		IET-26383						IET-26383					
V2		IET-26375						IET-26375					
V3		BPT 5204						BPT 5204					
V4		Chittimuthyalu						Chittimuthyalu					
V5		IR 64						IR 64					
V6		-						-					
Available N:P:K of soil (kg/ha)		277:21:570						-					

Table 4.1(I): Contd.

F-levels	Varieties	MARUTERU					PANTNAGAR						
		Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	5.14	3	320	3.86		3.07	3	167	2.01	14.93	98	
	V2	5.11	4	294	3.84		2.92	6	193	1.69	23.07	107	
	V3	4.74	6	272	3.55		2.37	8	177	1.56	13.17	126	
	V4	3.63	10	203	3.12		-		-	-	-	-	
	V5	4.18	8	268	3.51		3.03	5	199	1.74	23.17	87	
	V6	-		-	-		-		-	-	-	-	
F2	V1	5.48	1	341	4.58	9.52	3.17	2	200	1.82	14.77	99	0.91
	V2	5.37	2	319	4.45	3.14	3.07	3	197	1.77	23.43	97	1.36
	V3	4.96	5	294	4.1	-6.38	2.58	7	191	1.58	12.13	123	1.91
	V4	3.85	9	256	3.52	9.52	-		-	-	-	-	
	V5	4.41	7	280	4.08	0.00	3.29	1	217	1.76	23.33	88	2.36
	V6	-		-	-		-		-	-	-	-	
Interaction													
F at same V		NS		NS	NS		NS		NS	NS	NS	NS	
V at same F		NS		NS	NS		NS		NS	NS	NS	NS	
F1		4.56	2	271	3.58		2.85	2	184	1.75	18.59	105	
F2		4.81	1	298	4.15	2.42	3.03	1	201	1.73	18.42	102	1.64
C.D.(0.05)		NS		16.62	0.11		0.04		0.92	0.05	NS	0.66	
C.V.(%)		6.03		3.72	1.78		1.76		0.95	4.92	2.96	2.15	
Mean of varieties:													
V1		5.31	1	331	4.22	9.52	3.12	2	184	1.92	14.85	98	0.91
V2		5.24	2	307	4.15	3.14	3.00	3	195	1.73	23.25	102	1.36
V3		4.85	3	283	3.83	-6.38	2.48	4	184	1.57	12.65	125	1.91
V4		3.74	5	230	3.32	9.52	-		-	-	-	-	
V5		4.30	4	274	3.80	0.00	3.16	1	208	1.75	23.25	88	2.36
V6		-		-	-		-		-	-	-	-	
C.D.(0.05)		0.37		30.4	0.54		0.12		3.20	0.14	0.42	1.18	
C.V. (%)		6.44		8.72	11.36		2.65		1.48	5.81	1.66	1.71	
Expt. Mean		**4.69**		**285**	**3.86**		**2.94**		**193**	**1.74**	**18.50**	**103**	
Soil type		-					Silt loan						
pH		7.16					7.90						
N - levels (kg/ha)													
F1		90:60:60					120:60:40						
F2		135:90:90					180:90:60						
Recommended N:P:K (kg/ha)		90:60:60					120:60:40						
Varieties													
V1		IET-26383					IET-26383						
V2		IET-26375					IET-26375						
V3		BPT 5204					BPT 5204						
V4		Chittimuthyalu					-						
V5		IR 64					IR 64						
V6		-					-						
Available N:P:K of soil (kg/ha)		151:36:257					234:21.4:223						

Table 4.1(l): Contd.

F-levels	Varieties	RAIPUR						RAJENDRANAGAR - ARI						
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)
F1	V1	6.50	3	211	4.40	18.53		7.00	2	266	2.48	15.70	100	
	V2	5.33	7	246	3.39	28.17		6.55	5	306	2.10	25.33	100	
	V3	4.23	8	263	3.24	16.43		6.34	6	290	1.77	13.90	110	
	V4	3.59	10	259	2.66	11.63		6.02	7	304	2.16	13.43	110	
	V5	6.48	4	237	3.97	26.67		5.06	9	289	2.13	25.87	97	
	V6	-		-	-	-		-		-	-	-	-	
F2	V1	7.00	1	220	4.53	18.63	5.00	7.03	1	264	2.45	15.87	101	0.27
	V2	5.91	5	252	3.55	29.03	5.80	6.56	4	289	2.04	26.70	100	0.09
	V3	5.50	6	283	3.55	17.00	12.70	6.61	3	320	2.04	13.53	112	2.45
	V4	3.67	9	292	2.74	11.77	0.80	4.67	10	349	1.66	10.63	110	-12.27
	V5	6.53	2	248	4.18	26.73	0.50	5.58	8	273	2.20	25.67	97	4.73
	V6	-		-	-	-		-		-	-	-	-	
Interaction														
F at same V		NS		10.43	0.11			NS		NS	NS	NS	NS	
V at same F		NS		9.57	0.1			NS		NS	NS	NS	NS	
F1		5.23	2	243	3.53	20.29		6.19	1	291	2.13	18.85	104	
F2		5.72	1	259	3.71	20.63	4.96	6.09	2	299	2.08	18.48	104	-0.95
C.D.(0.05)		0.33		NS	NS	NS		NS		NS	NS	NS	NS	
C.V.(%)		3.85		4.64	4.18	3.68		20.31		12.06	21.66	11.22	1.15	
Mean of varieties:														
V1		6.75	1	216	4.47	18.58	5.00	7.02	1	265	2.47	15.79	101	0.27
V2		5.62	3	249	3.47	28.60	5.80	6.56	2	298	2.07	26.02	100	0.09
V3		4.87	4	273	3.40	16.72	12.70	6.48	3	305	1.91	13.72	111	2.45
V4		3.63	5	276	2.70	11.70	0.80	5.35	4	327	1.91	12.03	110	-12.27
V5		6.51	2	243	4.08	26.70	0.50	5.32	5	281	2.17	25.77	97	4.73
V6		-		-	-	-		-		-	-	-	-	
C.D.(0.05)		0.43		26.77	0.23	0.69		0.69		NS	0.36	1.32	2.95	
C.V. (%)		6.36		8.71	5.1	2.76		9.19		11.29	13.9	5.78	2.33	
Expt. Mean		**5.47**		**251**	**3.62**	**20.46**		**6.14**		**295**	**2.10**	**18.66**	**104**	
Soil type		Clay loam						Loamy						
pH		7.21						7.99						
N - levels (kg/ha)														
F1		100:60:40						120:60:40						
F2		150:90:60						180:90:60						
Recommended N:P:K (kg/ha)		100:60:40						120:60:40						
Varieties														
V1		IET-26383						IET-26383						
V2		IET-26375						IET-26375						
V3		BPT 5204						BPT 5204						
V4		Chittimuthyalu						Chittimuthyalu						
V5		IR 64						IR 64						
V6		-						-						
Available N:P:K of soil (kg/ha)		170.4:21.5:416.9						226:106:689						

Table 4.1(l): Contd.

F-levels	Varieties	REWA							VARANASI							Overall mean	Rank
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)	Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Nutri. res. (kg grain/kg Nutri.) (Base level 100% RDF)		
F1	V1	4.67	8	446	3.00	24.47	76		4.12	2	224	3.70	17.36	91		5.16	2
	V2	4.77	7	292	2.63	25.00	75		3.11	8	250	2.20	22.40	88		4.82	6
	V3	4.50	11	283	2.83	26.03	77		3.88	4	277	2.10	13.66	123		4.66	8
	V4	4.67	8	297	2.83	26.50	78		1.44	10	224	1.90	16.76	127		4.17	12
	V5	4.63	10	285	2.80	25.07	77		3.20	6	239	2.44	25.00	84		4.58	9
	V6	4.43	12	291	2.63	23.13	78		-		-	-	-	-		4.43	10
F2	V1	5.13	4	306	3.53	25.00	83	4.18	4.04	3	232	3.08	14.94	92	-0.76	5.38	1
	V2	5.47	1	307	3.67	26.03	87	6.36	3.29	5	245	2.67	25.30	88	1.71	5.06	4
	V3	5.10	6	309	3.50	25.07	87	5.45	4.14	1	297	2.19	13.32	122	2.48	5.02	5
	V4	5.47	1	306	3.50	26.03	83	7.27	1.66	9	233	1.85	11.68	128	2.10	4.19	11
	V5	5.33	3	306	3.37	26.50	84	6.36	3.16	7	212	2.44	24.02	84	-0.38	4.81	7
	V6	5.13	4	304	3.50	25.07	84	6.36	-		-	-	-	-		5.13	3
Interaction																	
F at same V		NS		NS	NS	NS	NS		0.13		15.15	0.2	0.54	NS			
V at same F		NS		NS	NS	NS	NS		0.16		15.38	0.19	0.68	NS			
F1		4.61	2	316	2.79	25.03	77		3.15	2	243	2.47	19.04	102		4.64	2
F2		5.27	1	306	3.51	25.62	85	6.00	3.26	1	244	2.45	17.85	103	1.03	4.86	1
C.D.(0.05)		0.25		NS	0.1	NS	6.1		NS		NS	NS	0.6	NS			
C.V.(%)		3.52		28.67	2.12	2.93	5.27		2.98		2.42	2.71	2.07	1.28			
Mean of varieties:																	
V1		4.90	4	376	3.27	24.74	80	4.18	4.08	1	228	3.39	16.15	92	-0.76	5.27	1
V2		5.12	1	300	3.15	25.52	81	6.36	3.20	3	248	2.44	23.85	88	1.71	4.94	2
V3		4.80	5	296	3.17	25.55	82	5.45	4.01	2	287	2.15	13.49	122	2.48	4.84	3
V4		5.07	2	301	3.17	26.27	81	7.27	1.55	5	229	1.88	14.22	127	2.10	4.18	6
V5		4.98	3	296	3.09	25.79	80	6.36	3.18	4	226	2.44	24.51	84	-0.38	4.69	5
V6		4.78		297	3.07	24.10	81	6.36	-		-	-	-	-		4.78	4
C.D.(0.05)		NS		NS	NS	1.08	NS		0.09		10.71	0.14	0.39	1.8			
C.V. (%)		4.33		26.79	7.57	3.54	3.57		2.31		3.6	4.63	1.71	1.44			
Expt. Mean		**4.94**		**311**	**3.15**	**25.33**	**81**		**3.20**		**243**	**2.46**	**18.44**	**103**		4.75	
Soil type		Sandy loam							Sandy loam								
pH		6.70							7.20								
N - levels (kg/ha)																	
F1		120:60:40							90:60:60								
F2		180:90:60							135:90:90								
Recommended N:P:K (kg/ha)		120:60:40							90:60:60								
Varieties																	
V1		IET-26383							IET-26383								
V2		IET-26375							IET-26375								
V3		BPT 5204							BPT 5204								
V4		Chittimuthyalu							Chittimuthyalu								
V5		IR 64							IR 64								
V6		Kalanamak							-								
Available N:P:K of soil (kg/ha)		294:20.2:422							218:19.56:201								

4.1(m) Grain Yield Efficiency Index values (GYEI):

Grain yield is the best measure for evaluation of given genotype in the screening experiments. Field screening results can be interpreted using the grain yield efficiency index (GYEI) for identifying efficient, stable, suitable and promising cultures.

Grain yield efficiency Index (GYEI) was computed for genotype evaluation using the following formula in the present Nitrogen variety evaluation trial.

$$GYEI = \frac{\textbf{(Yield at low nutrient level) (Yield at high nutrient level)}}{\textbf{(Experimental mean yield at low nutrient level) X (Experimental mean yield at high nutrient level)}}$$

Tolerant genotypes have a (GYEI) of 1 or higher and the susceptible ones have a GYEI in the range of 0 to 0.50 and the genotypes between these two limits are considered intermediate types. The results of these trials, if utilized meticulously not only aid to develop promising cultivars but also to reduce the cost of cultivation in rice production.

Based on the GYEI values few promising cultivars identified in different groups is furnished below:

Based on the Grain yield efficiency index GYEI values (stable and efficient genotypes), the top ten identified cultures were *viz*., IET 25121(1.60) and IET 26365(1.10) in AVT-2 E(DS); IET 25746 (1.24) and IET 25764 (1.21) in AVT-2 IME (TP); IET 26027 (1.16), IET 25997 (1.14) and IET 25785 (1.03) in AVT-2 IM; IET 25269 (1.22)in AVT-2 L; IET 26263 (1.15), IET 25795 (1.11) and IET 25793 (1.07) in AVT-2 MS; IET 25856 (1.22) in AVT-2 RSL; IET 22836 (1.09) in AVT-2 AL&ISTVT; IET 25059 (1.26) in AVT-2 CSTVT and IET 26168 (1.17), IET 26194 (1.07), IET 26198 (1.05) and IET 25618 (1.00) in AVT-2 Aerobic; IET 26383 (1.23) and IET 26375 (1.08) in AT-2 Biofortified groups. Further critical analysis of the data based on better GYEI and lesser grain yield reduction due to 50% of RDN over 100% RDN, a total of 11 IET cultures *viz.* **IET 25121 in E(DS), IET 25764 in IME(TP), IET 25997 in IM (TP), IET 25269 in Late, IET 26241 in MA, IET 25856 in RSL, IET 22836 AL&ISTVT, IET 25059 in CSTVT, IET 25618 and IET 26198 in AEROBIC and IET 26383 in Biofotified** (Table 4.1(m) & (n)) were identified as higher nutrient use efficient and also stable cultivars during *Kharif* 2018. These cultivars can be utilised in the breeding programme for reduction in nutrient requirement without any penalty to yield.

Table. 4.1(m): Identification of cultures based on the GYEI values in different groups of cultivars.

AVT-2 EH (Irrigated)			AVT-2 MH (Irrigated)			AVT-2 E-DS			AVT-2-IME (TP)		
Nutrient-Levels	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**
N2	IET 25819	0.85	**N2**	IET 25830	0.86	**N2**	IET 26348	0.92	**N2**	IET 25746	1.24
	Shalimar Rice-3	1.06		Vivekdhan-62	1.02		IET- 26365	1.10		IET 25764	1.21
	Vivekdhan-86	1.31		V L Dhan-65	1.07		IET- 25103(R)	0.99		IET 26079	1.10
	VL Dhan-86	0.95		Local check	1.05		IET - 26356	1.46		IET 25749	1.16
	Local Check: HPR 1068	1.00					IET - 26337	0.78		IET 26125	1.00
							IET - 25121 ®	1.60		IET24731	1.18
							Sahbhagi dhan	1.09		IET 25330	1.03
							Vandana	0.81		IR 64	0.74
							Govind	1.24		PR 113	0.82
							NDR-97	0.81		Lalat	0.81
							Varalu	1.20		Karjat 7	0.67
							CR- Dhan-201	0.88		MTU 1010	0.81
							Local Check	1.03		HC- US 312	1.05
										Local check	0.89
	Mean	**1.03**		**Mean**	**1.00**		**Mean**	**1.07**		**Mean**	**0.98**

Table. 4.1(m): Contd.

AVT-2 IM (TP)			AVT-2 L			AVT-2 MS			AVT 2 - RSL		
Nutrient-Level	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**
N2	IET 26027	1.16	**N2**	IET 25269	1.22	**N2**	IET-26263	1.15	**N2**	IET-25856	1.22
	IET 25997	1.14		NDR 8002	0.78		IET-25795	1.11		Dhanrasi	0.70
	IET 25785	1.03		Salivahana	1.05		IET-25793	1.07		Pooja	0.81
	NDR 359	1.03		Samba Masuri	0.90		IET-26241	0.82		Savithri	0.84
	ZC- Pant Dhan	0.95		Swarna	0.87		KRH 4	1.00		Local Check	1.02
	NDR 8002	0.80		Ranjeet	0.95		WGL 14	0.89			
	Jaya	0.76		Pushyami	1.06		Local Check	0.95			
	Akshayadhan	0.76		Local Check	1.11						
	Local Check	1.04									
	Mean	**0.97**		**Mean**	**0.99**		**Mean**	**1.00**		**Mean**	**0.92**

Table. 4.1(m): Contd.

AL & ISTVT			AVT-2 CSTVT			AVT-2 (Aerobic)			AVT 2- Biofotified		
Nutrient-Level	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**	**Nutrient-Level**	**Varieties**	**Mean**
N2	IET-22836	1.09	**N2**	IET-25059	1.26	**N2**	IET 25618	1.00	**N2**	IET-26383	1.23
	CSR 10	0.90		CSR 10	1.05		IET 26198	1.05		IET-26375	1.08
	CSR 23	0.92		Jaya	0.84		IET 26157	0.88		BPT 5204	1.04
	CSR 36	1.16		Local Check	0.88		IET 26171	0.91		Chittimuthyalu	0.77
	Jaya	1.00					IET 26194	1.07		IR 64	0.98
	Local Check	0.95					IET 26170	0.94		Kalanamak	1.01
							IET 26168	1.17			
							AAUDR – 1	1.16			
							CR Dhan 202	1.09			
							Local Check	1.10			
	Mean	**1.00**		**Mean**	**1.01**		**Mean**	**1.04**		**Mean**	**1.02**

Table. 4.1(n): Identification of cultures performing better with low level of Nutrients application based on the % yield reduction at 50 % of RDN and 100% of RDN.

Group	Group	Entry No	50	100	Diffrence -50	(%) Reduction
EH (Irrigated)	V1	IET 25819	3.04	3.95	0.91	23.10
	V2	Shalimar Rice-3	3.55	4.22	0.68	16.00
	V3	Vivekdhan-86	3.90	4.72	0.82	17.36
	V4	VL Dhan-86	3.08	4.37	1.29	29.44
	V5	Local Check: HPR 1068	3.38	4.20	0.81	19.37
MH (Irriaged)	V1	IET 25830	3.10	3.64	0.54	14.79
	V2	Vivekdhan-62	3.38	3.97	0.59	14.82
	V3	V L Dhan-65	3.54	3.95	0.41	10.44
	V4	Local check	3.58	3.85	0.27	7.06
E(DS)	V1	IET 26348	2.57	2.96	0.39	13.19
	V2	IET- 26365	2.78	3.23	0.45	13.98
	V3	IET- 25103(R)	2.69	3.01	0.32	10.75
	V4	IET - 26356	3.26	3.68	0.43	11.61
	V5	IET - 26337	2.36	2.71	0.35	12.92
	V6	IET - 25121 ®	3.40	3.86	0.46	11.92
	V7	Sahbhagi dhan	2.84	3.15	0.30	9.66
	V8	Vandana	2.40	2.78	0.38	13.61
	V9	Govind	3.00	3.40	0.40	11.77
	V10	NDR-97	2.42	2.73	0.31	11.28
	V11	Varalu	2.97	3.31	0.34	10.34
	V12	CR- Dhan-201	2.54	2.83	0.29	10.25
	V13	Local Check	2.79	3.03	0.25	8.11

Group	Group	Entry No	100	150	Diffrence -50	(%) Reduction
IME (TP)	V1	IET 25746	5.44	5.90	0.45	7.70
	V2	IET 25764	5.40	5.81	0.41	7.11
	V3	IET 26079	5.13	5.55	0.43	7.71
	V4	IET 25749	5.26	5.70	0.44	7.70
	V5	IET 26125	4.95	5.23	0.28	5.32
	V6	IET24731	5.43	5.62	0.19	3.35
	V7	IET 25330	5.07	5.24	0.17	3.30
	V8	IR 64	4.17	4.58	0.41	8.88
	V9	PR 113	4.45	4.78	0.33	6.89
	V10	Lalat	4.44	4.73	0.29	6.10
	V11	Karjat 7	4.05	4.27	0.22	5.15
	V12	MTU 1010	4.40	4.79	0.39	8.12
	V13	HC- US 312	5.08	5.32	0.24	4.54
	V14	Local check	4.69	4.90	0.21	4.32

Table. 4.1(n): Contd.

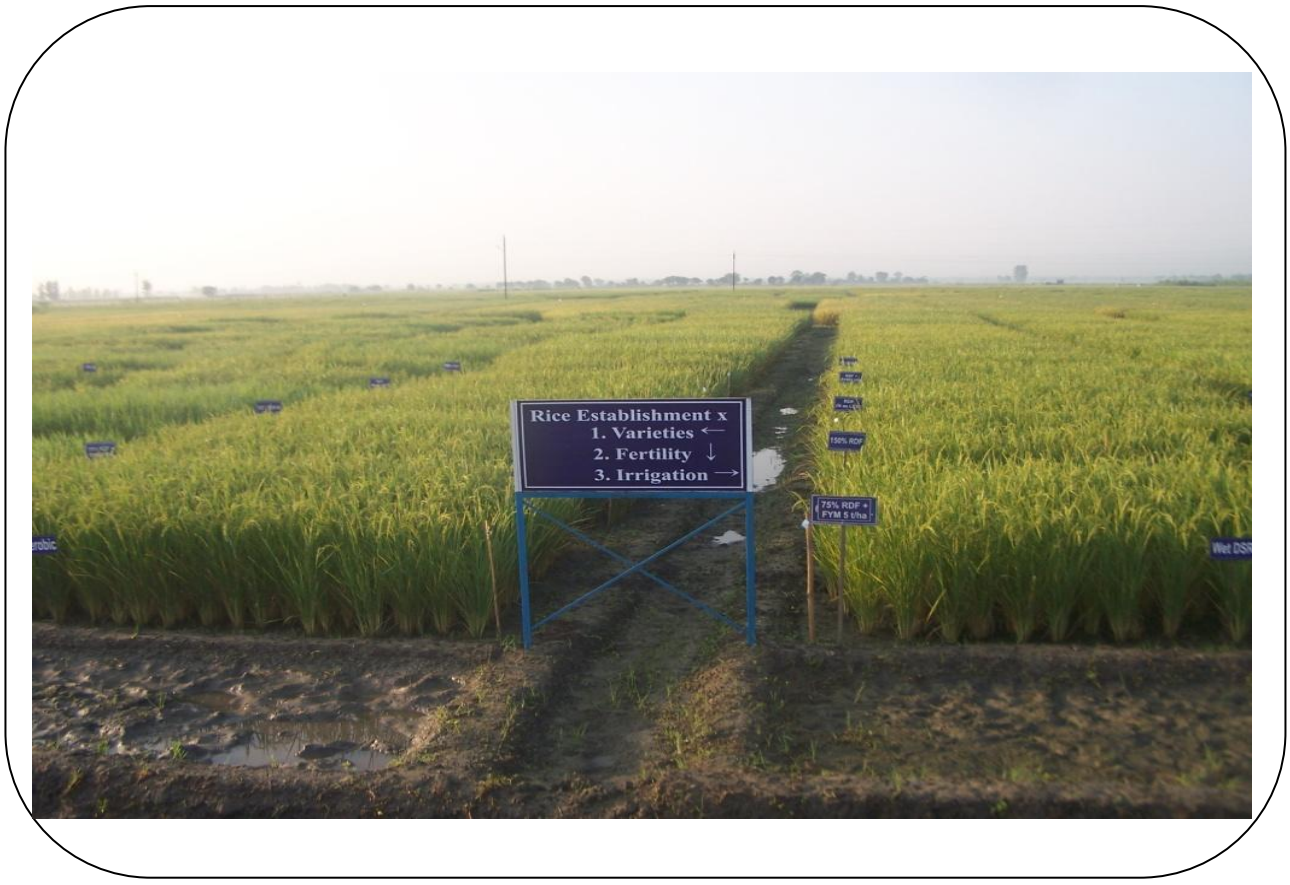
Group	Group	Entry No	50	100	Diffrence -50	(%) Reduction
IM (TP)	**V1**	IET 26027	5.24	5.70	0.46	8.04
	V2	IET 25997	5.23	5.59	0.36	6.49
	V3	IET 25785	4.94	5.37	0.43	7.99
	V4	NDR 359	4.89	5.39	0.50	9.36
	V5	ZC- Pant Dhan	4.61	5.30	0.69	13.02
	V6	NDR 8002	4.20	4.91	0.71	14.52
	V7	Jaya	4.20	4.66	0.46	9.90
	V8	Akshayadhan	4.23	4.60	0.36	7.91
	V9	Local Check	4.95	5.38	0.43	8.03
Late	**V1**	IET 25269	5.75	6.05	0.31	5.08
	V2	NDR 8002	4.56	4.84	0.28	5.87
	V3	Salivahana	5.16	5.78	0.62	10.73
	V4	Samba Masuri	4.97	5.16	0.19	3.64
	V5	Swarna	4.84	5.14	0.30	5.86
	V6	Ranjeet	5.04	5.35	0.31	5.85
	V7	Pushyami	5.23	5.78	0.54	9.39
	V8	Local Check	5.42	5.83	0.42	7.16
Group	**Group**	**Entry No**	**50**	**100**	**Diffrence -50**	**(%) Reduction**
MS	**V1**	IET-26263	6.18	6.69	0.52	7.73
	V2	IET-25795	6.14	6.50	0.37	5.62
	V3	IET-25793	6.06	6.35	0.28	4.48
	V4	IET-26241	5.36	5.49	0.12	2.22
	V5	KRH 4	5.91	6.05	0.14	2.29
	V6	WGL 14	5.47	5.85	0.38	6.52
	V7	Local Check	5.49	6.19	0.70	11.32
RSL	**V1**	IET-25856	3.45	4.02	0.57	14.20
	V2	Dhanrasi	2.49	3.17	0.68	21.45
	V3	Pooja	2.77	3.32	0.56	16.72
	V4	Savithri	2.74	3.48	0.74	21.26
	V5	Local Check	3.18	3.63	0.45	12.41
Group	**Group**	**Entry No**	**50**	**100**	**Diffrence -50**	**(%) Reduction**
AL&ISTVT	**V1**	IET-22836	2.65	3.09	0.44	14.25
	V2	CSR 10	2.42	2.80	0.38	13.67
	V3	CSR 23	2.41	2.86	0.45	15.83
	V4	CSR 36	2.78	3.12	0.34	10.79
	V5	Jaya	2.59	2.89	0.30	10.38
	V6	Local Check	2.48	2.86	0.38	13.39

Table. 4.1(n): Contd.

Group	Group	Entry No	50	100	Diffrence -50	(%) Reduction
CSTVT	**V1**	IET-25059	3.98	4.63	0.65	14.04
	V2	CSR 10	3.63	4.21	0.58	13.78
	V3	Jaya	3.39	3.61	0.22	6.09
	V4	Local Check	3.30	3.90	0.60	15.38
Aerobic	**V1**	IET 25618	6.50	6.22	-0.28	-4.49
	V2	IET 26198	6.68	6.40	-0.28	-4.40
	V3	IET 26157	5.92	5.99	0.07	1.17
	V4	IET 26171	5.94	6.21	0.28	4.43
	V5	IET 26194	6.53	6.65	0.12	1.84
	V6	IET 26170	6.17	6.17	0.00	-0.02
	V7	IET 26168	6.59	7.21	0.62	8.59
	V8	AAUDR – 1	6.78	6.93	0.14	2.06
	V9	CR Dhan 202	6.55	6.71	0.16	2.33
	V10	Local Check	6.65	6.73	0.08	1.24
Biofortified	**V1**	IET-26383	5.16	5.38	0.22	4.02
	V2	IET-26375	4.82	5.06	0.24	4.84
	V3	BPT 5204	4.66	5.02	0.36	7.20
	V4	Chittimuthyalu	4.17	4.19	0.01	0.34
	V5	IR 64	4.58	4.81	0.24	4.96
	V6	Kalanamak	4.43	5.13	0.70	13.65

CULTURAL MANAGEMENT TRIALS

(YIELD ENHANCING TRIAL)



4.2. CULTURAL MANAGEMENT TRIALS

YIELD ENHANCING TRIALS

Cultural management practices include all the activities carried out on the farm before, during and after planting of crops like pre-planting, planting and post-planting operations. These practices are adopted to improve crop growth, prevent or reduce weed problems and increase the grain yields in different systems of rice establishment by manipulating the micro climate. With the idea of utilizing economic and effective cultural practices in enhancing grain yields of rainfed, aerobic, direct sown rice under puddle condition, SRI systems of rice cultivation, a total of **ten** trials were conducted during *Kharif* 2018 & Rabi 2017-18 to enhance production, productivity and profitability of rice. The traditional rice establishment method is transplanting with rice seedlings, which involves replanting of rice seedlings grown in nurseries to puddled soils. However, rising labour costs and the need to intensify rice production through double and triple cropping provide economic incentives for a shift to alternative establishment methods, such as direct sowing, mechanical transplanting, seedling broadcasting or a combination of methods. Simultaneously, the availability of high-yielding, short-duration varieties and chemical weed control methods have made such a switch technically viable.

4.2.1. Nutrient and Weed management for higher productivity in different rice establishment methods

Rice crop suffers more from weed competition unlike other cereal crops. Weed infestation and weed competition are more in direct seeded rice as compared to transplanted rice and SRI because the land is exposed till the initial seedling establishment in direct seeded rice. Crop establishment and weed management techniques are critical in rice farming. So, present investigation to study the weed infestation and nutrient removal by weeds in different crop establishment methods of rice, their influence on productivity of rice and nutrient uptake by rice was taken up. A trial was conducted i) to identify the optimum and cost effective nutrient management practices in different crop establishment methods and ii) to assess the agronomic efficiency, plant and soil nutrient status under different nutrient management practices in various crop establishment methods. The experiment was conducted during *kharif* 2018 in split-plot design with four replications. Treatments consisting of five crop establishment methods {Mechanical Transplanting method (All the principles as per the SRI); M_2: Direct seeding (Use of Drum seeder/ dibbling of sprouted seed at 25 x25 cm) fb SRI principles (saturation method of water management,weeding with cono-weeder and fertilizer management); M_3: Normal Transplanting (20 x15 cm with flooding water management,3-4 seedlings transplanted at 25-30 days old seedlings); M_4: SRI; M_5: Aerobic rice and M_6: Semi dry rice} were assessed for their productivity performance at 17 locations (**Aduthurai, Chatha, Coimbatore, Gangavathi, Ghaghraghat, Kota, Ludhiana, Mandya, Nagina, Navasari, Pantnagar, Puducherry, Pusa, Ranchi, Rewa, Sabour and Varanasi**). The results were summarized and presented in **Table 4.2.2** and the salient findings are as followed.

At **Aduthurai**, the interaction between establishment methods and nutrient management was found non-significant with respect to all growth and yield parameters. Similarly, the effect of main plot treatments on growth and yield parameters were also found to be non-significant. Among nutrient managements, the highest grain yield was recorded at 150% RDF (3.91 t/ha). The highest tiller no./m^2 (330) and panicles/m^2 (322) were also found under 150% RDF treated plots. In sandy clay loam soils of **Chatha**, the highest grain yield was recorded at direct seeding fb SRI with 150% RDF (3.56 t/ha), however, very closely followed by normal transplanting with 100% RDF from inorganic source (3.55 t/ha). Among establishment methods, SRI method registered the highest grain yield (3.38 t/ha) and among nutrient management 150% RDF recorded the highest grain yield (3.39 t/ha). In clay soil of **Coimbatore**, SRI method along with LCC based N application resulted the highest grain yield (6.1 t/ha). SRI method performed the best (5.62 t/ha) among establishment methods and LCC based N application was the best (5.68 t/ha) among the nutrient management treatments. In black clay soil of **Gangavathi**, normal transplanting along with location specific fertilizer management plots recorded the highest grain yield (8.58 t/ha). Among nutrient management 150% RDF resulted the highest grain yield (7.78 t/ha).In sandy loam soil of **Ghaghraghat**, mechanical transplanted plots applied with 150% RDF produced the highest grain yield (4.18 t/ha).In clay loam soils of Kota, SRI method produced the highest grain yield (5.91 t/ha). LCC based N application was the best (5.92 t/ha) among nutrient management treatments. Research farm at **Ludhiana** recorded the highest grain yield under location specific N management.In red sandy loam soils of **Mandya** 150% RDF produced the highest grain yield (6.69 t/ha). Similar results was also observed at **Nagina.**SRImethodwas best (6.44 t/ha) among all establishment methods at **Navasari**. Inorganic dose of 100% gave the highest grain yield (6.26 t/ha). 150% RDF was the best at **Pantnagar** with grain yield of 5.77 t/ha closely followed by location specific N management (5.73 t/ha). In clay loam soils of **Puducherry** and silty clay soils of **Pusa** mechanical transplanting method recorded the highest grain yield (6.37 t/ha and 6.95 t/ha, respectively). At **Ranchi**, normal transplanting recorded the highest grain yield (4.5 t/ha). Similarly, 150% RDF recorded the highest grain yield (4.67 t/ha). At Rewa, SRI method and 150% RDF recorded the highest grain yield (5.64 t/ha and 5.01 t/ha, respectively). In **Sabour**, SRI was found to be the best with 4.28 t/ha followed by normal transplanting (4.23 t/ha). Among nutrient management 150% RDF resulted better grain yield (4.37 t/ha). At Varanasi, normal transplanting resulted the best grain yield (5.21 t/ha) followed by direct seeding fb SRI (4.96 t/ha). LCC based N management found to be good at Varanasi with grain yield of 5.16 t/ha.

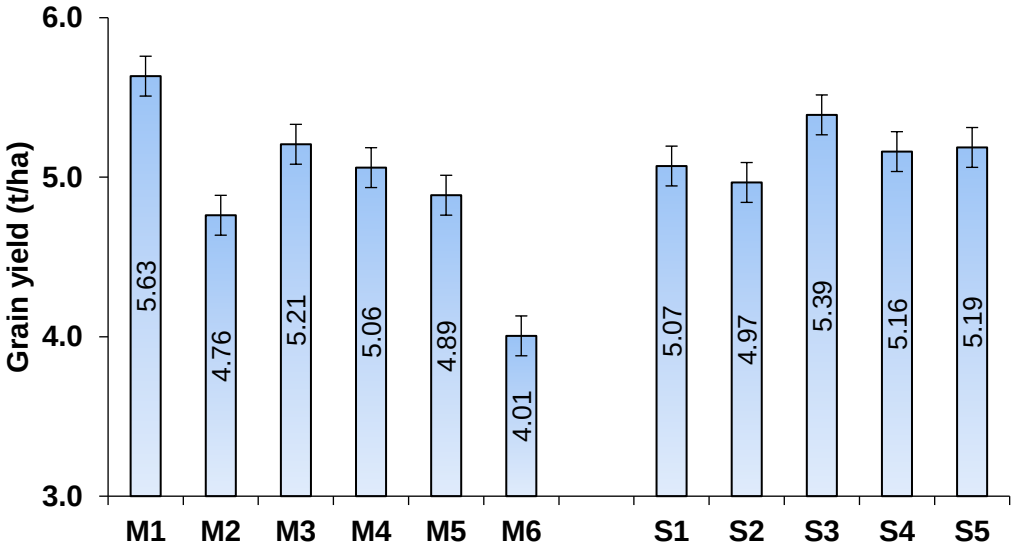


Fig 1. Mean rice grain yield as affected by establishment methods and nutrient management across all locations of India

Overall mean grain yield across the locations revealed that **mechanical transplanting** resulted in the highest grain yield (5.63 t/ha) followed by manual transplanting (5.21 t/ha) and SRI (5.06 t/ha). At 4 locations mechanical transplanting recorded higher grain yield over mean grain yield recorded under same treatment. Similarly, **150% RDF resulted higher grain yield (5.39 t/ha)** than those of other treatments.

Interaction effect of establishment method and nutrient management on weed populations at active tillering stage was found to be non-significant at all locations except **Gangavathi, Puducherry and Rewa.** The highest weed control efficiency recorded at active tillering and panicle initiation stage under different establishment methods were listed below.

Location	Active tillering	Panicle initiation stage
Aduthurai	Normal transplanting	Normal transplanting
Chatha	Normal transplanting and SRI	Normal transplanting and SRI
Coimbatore	SRI	-
Gangavathi	Direct seeding followed by SRI	Direct seeding followed by SRI
Kota	Normal transplanting	-
Mandya	Normal transplanting	Normal transplanting
Nagina	Normal transplanting	Normal transplanting
Navasari	Normal transplanting	Normal transplanting
Puducherry	Mechanical transplanting	Mechanical transplanting
Rewa	SRI	Normal transplanting
Sabour	Normal transplanting	SRI

Table-4.2.1: Evaluation of nutrient and weed management for higher productivity in different rice establishment methods, Kharif-2018.

Treatment		ADUTHURAI								CHATHA						
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle length (cm)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering
M1 - Mechanical Transplanting	S1	3.45	5.65	320	314	24.00	2.16	17.01	75	-	-	-	-	-	-	-
	S2	2.97	5.25	312	301	23.38	2.11	16.44	74	-	-	-	-	-	-	-
	S3	3.70	5.85	326	319	24.73	2.18	17.08	74	-	-	-	-	-	-	-
	S4	3.15	5.63	319	308	24.15	2.10	16.90	75	-	-	-	-	-	-	-
	S5	3.40	5.73	324	316	24.30	2.15	16.81	74	-	-	-	-	-	-	-
M2 - DS fb SRI	S1	3.58	5.70	326	317	24.00	2.11	16.90	71	3.22	4.03	261	209	1.58	18.63	95
	S2	3.18	5.40	297	303	23.50	2.08	16.78	72	2.24	2.80	251	186	1.20	18.00	95
	S3	3.97	5.93	328	321	25.05	2.19	17.06	71	3.56	4.98	272	222	1.69	19.00	98
	S4	3.20	5.60	323	310	24.25	2.13	16.90	72	3.31	4.30	250	212	1.53	18.67	96
	S5	3.53	5.78	324	319	24.40	2.10	17.02	72	-	-	-	-	-	-	-
M3 - Normal Transplanting	S1	3.58	5.80	333	320	25.05	2.16	16.97	78	3.08	3.70	247	204	1.55	19.10	109
	S2	3.25	5.50	317	305	24.00	2.04	16.80	77	2.23	2.68	242	182	1.31	18.07	109
	S3	4.05	6.13	335	326	25.10	2.18	17.14	77	3.35	4.52	263	220	1.61	19.33	113
	S4	3.42	5.45	331	319	24.20	2.11	17.02	77	3.09	3.86	255	211	1.52	19.10	108
	S5	3.58	5.82	331	322	24.25	2.14	17.04	77	-	-	-	-	-	-	-
M4 - SRI	S1	-	-	-	-	-	-	-	-	3.55	4.61	262	221	1.59	20.03	98
	S2	-	-	-	-	-	-	-	-	2.76	3.45	253	200	1.33	18.67	97
	S3	-	-	-	-	-	-	-	-	3.81	5.33	274	233	1.67	20.23	104
	S4	-	-	-	-	-	-	-	-	3.39	4.24	255	222	1.53	20.13	99
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M5 - Aerobic rice	S1	-	-	-	-	-	-	-	-	2.80	3.50	221	204	1.41	19.00	95
	S2	-	-	-	-	-	-	-	-	2.37	2.84	196	184	1.22	18.03	95
	S3	-	-	-	-	-	-	-	-	3.43	4.81	234	220	1.57	19.33	98
	S4	-	-	-	-	-	-	-	-	3.23	4.04	220	213	1.50	19.13	96
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	2.49	3.11	224	193	1.30	19.07	96
	S2	-	-	-	-	-	-	-	-	2.15	2.58	198	183	1.21	18.03	96
	S3	-	-	-	-	-	-	-	-	2.79	3.76	242	210	1.36	19.27	98
	S4	-	-	-	-	-	-	-	-	2.55	3.19	223	200	1.34	19.03	97
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interaction																
M and S		NS	NS	NS	NS	NS	NS	NS	NS	0.09	0.12	5.65	NS	0.02	NS	0.98
S and M		NS	NS	NS	NS	NS	NS	NS	NS	0.09	0.11	5.34	NS	0.02	NS	0.96

Table-4.2.1: Contd.

Treatment		ADUTHURAI								CHATHA						
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle length (cm)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering
Mean of Methods																
M1		3.33	5.62	320	312	24.11	2.14	16.85	74.35	-	-	-	-	-	-	-
M2		3.49	5.68	320	314	24.24	2.12	16.93	71.55	3.08	4.03	259	207	1.5	18.57	96.08
M3		3.58	5.74	329	318	24.52	2.13	16.99	77.05	2.94	3.69	252	204	1.5	18.9	109.75
M4		-	-	-	-	-	-	-	-	3.38	4.41	261	219	1.53	19.77	99.5
M5		-	-	-	-	-	-	-	-	2.96	3.8	218	205	1.43	18.88	96.08
M6		-	-	-	-	-	-	-	-	2.49	3.16	222	197	1.31	18.85	96.67
C.D. (0.05)		NS	NS	NS	NS	NS	NS	0.10	0.48	0.06	0.07	2.82	3.33	0.01	0.05	0.61
C.V. (%)		7.56	6.00	4.3	3.62	2.35	3.07	0.80	0.83	1.98	2.01	1.24	1.72	0.82	0.28	0.65
Method of Nutrition																
S1		3.53	5.72	326	317	24.35	2.14	16.96	74.42	3.03	3.79	243	206	1.49	19.17	98.73
S2		3.13	5.38	309	303	23.62	2.08	16.67	74.33	2.35	2.87	228	187	1.25	18.16	98.53
S3		3.91	5.97	330	322	24.96	2.18	17.09	74.00	3.39	4.68	257	221	1.58	19.43	102.27
S4		3.26	5.56	324	312	24.20	2.12	16.94	74.50	3.12	3.93	241	211	1.48	19.21	98.93
S5		3.50	5.78	326	319	24.32	2.13	16.96	74.33		-	-	-	-	-	-
CD (0.05)		0.19	0.27	10.8	7.44	0.54	0.06	0.14	NS	0.04	0.05	2.53	2.69	0.01	0.1	0.44
C.V. (%)		6.70	5.66	4.05	2.87	2.69	3.18	1.02	1.13	1.84	1.83	1.4	1.75	1.03	0.72	0.59
Experimental Mean		**3.47**	**5.68**	**323.03**	**314.57**	**24.29**	**2.13**	**16.92**	**74.32**	**2.97**	**3.82**	**242.28**	**206.38**	**1.45**	**18.99**	**99.62**
Soil type		-								Sandy clay loam						
pH		-								8.03						
EC		-								0.21						
Variety & Duration		ADT 43 120 days								Basmati-370						
Available NPK kg/ha		-								05:14.3:146.3						
		S1: 100% RDF inorganic(120:60:40) S2: 75% inorganic + 25% organic(equivalent of N dose) S3-150% of recommended dose of fertilizer S4-LCC based N application S5-Location specific fertilizer management (81:60:60 kg NPK/ha)								S1: 100% RDF inorganic(120:60:40) S2: 75% inorganic + 25% organic(equivalent of N dose) S3-150% of recommended dose of fertilizer S4-LCC based N application -						

Table-4.2.1: Contd.

Treatment		COIMBATORE					GANGAVATHI					GHAGHRAGHAT		
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Panicle/m^2 (No.)	Panicle wt (g)
M1 - Mechanical Transplanting	S1	5.27	7.25	313	2.91	14.18	6.95	5.83	358	2.92	14.96	3.67	270	3.80
	S2	5.35	7.31	359	3.21	14.17	6.56	6.25	341	3.28	14.98	3.46	218	3.67
	S3	5.90	7.53	391	2.49	14.27	7.22	5.83	392	3.09	15.62	4.18	267	5.13
	S4	5.93	7.6	396	2.9	14.22	6.48	6.25	338	3.18	15.37	3.93	271	3.70
	S5	5.28	7.34	315	2.84	14.15	6.47	5	378	3.45	15.43	2.81	240	3.78
M2 - DS fb SRI	S1	-	-	-	-	-	6.47	5.83	322	3.61	15.16	2.89	247	5.20
	S2	-	-	-	-	-	6.50	7.08	302	3.06	14.9	2.34	238	3.98
	S3	-	-	-	-	-	7.65	7.08	328	4.23	15.36	3.13	249	4.86
	S4	-	-	-	-	-	6.84	5.42	323	3.64	15.36	3.07	242	4.37
	S5	-	-	-	-	-	7.11	6.67	370	4.00	15.33	2.42	220	3.40
M3 - Normal Transplanting	S1	4.64	5.81	310	2.55	14.25	6.89	6.25	439	3.36	15.19	2.53	235	4.65
	S2	4.75	5.9	332	3.47	14.2	6.56	6.67	331	3.21	14.78	3.11	260	4.42
	S3	4.91	6.1	349	3.05	14.3	8.48	5.83	412	3.98	15.5	2.71	280	5.07
	S4	5.03	6.16	357	2.64	14.4	6.86	5.83	389	3.31	15.51	2.92	258	3.83
	S5	4.68	5.84	323	2.74	14.15	8.58	6.25	343	3.87	15.32	2.17	204	3.14
M4 - SRI	S1	5.25	7.27	322	2.79	14.25	-	-	-	-	-	-	-	-
	S2	5.32	7.36	385	3.13	14.2	-	-	-	-	-	-	-	-
	S3	6.09	7.86	427	3.02	14.3	-	-	-	-	-	-	-	-
	S4	6.10	7.84	425	2.73	14.43	-	-	-	-	-	-	-	-
	S5	5.34	7.3	335	3.41	14.25	-	-	-	-	-	-	-	-
M5 - Aerobic rice	S1	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-
Interaction														
M and S		0.11	0.09	13.28	NS	NS	0.46	NS	32.99	NS	NS	0.28	16.47	0.22
S and M		0.12	0.09	13.02	NS	NS	0.45	NS	29.89	NS	NS	0.27	14.98	0.21

Table-4.2.1: Contd.

Treatment		COIMBATORE					GANGAVATHI					GHAGHRAGHAT		
Methods of crop establishment	**Method of Nutrient**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Panicle/m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Panicle/ m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Grain yield (t/ha)**	**Panicle/m² (No.)**	**Panicle wt (g)**
Mean of Methods														
M1		5.55	7.41	355	2.87	14.2	6.74	5.83	361	3.18	15.27	3.61	253	4.02
M2		-	-	-	-	-	6.92	6.42	329	3.71	15.22	2.77	240	4.36
M3		4.8	5.96	334	2.89	14.26	7.47	6.17	383	3.55	15.26	2.69	248	4.22
M4		5.62	7.52	379	3.02	14.29	-	-	-	-	-	-	-	-
M5		-	-	-	-	-	-	-	-	-	-	-	-	-
M6		-	-	-	-	-	-	-	-	-	-	-	-	-
C.D. (0.05)		0.07	0.07	6.85	NS	NS	0.32	NS	8.45	0.11	NS	0.16	4.77	0.14
C.V. (%)		1.77	1.28	2.49	15.42	0.77	6.92	13.17	3.64	4.79	1.79	8.37	2.98	5.29
Method of Nutrition														
S1		5.05	6.78	315	2.75	14.23	6.77	5.97	373	3.3	15.1	3.03	251	4.55
S2		5.14	6.86	359	3.27	14.19	6.54	6.67	325	3.18	14.89	2.97	239	4.02
S3		5.63	7.16	389	2.85	14.29	7.78	6.25	378	3.77	15.49	3.34	266	5.02
S4		5.68	7.2	393	2.76	14.35	6.73	5.83	350	3.38	15.42	3.31	257	3.97
S5		5.1	6.82	324	3	14.18	7.39	5.97	364	3.78	15.36	2.47	222	3.44
CD (0.05)		0.07	0.05	7.67	0.3	0.06	0.26	0.52	19.05	0.27	0.4	0.16	9.51	0.13
C.V. (%)		1.5	0.88	2.61	12.36	0.55	3.86	8.63	5.47	8.05	2.71	5.47	3.96	3.06
Experimental Mean		**5.32**	**6.96**	**355.83**	**2.93**	**14.25**	**7.04**	**6.14**	**357.87**	**3.48**	**15.25**	**3.02**	**246.78**	**4.20**
Soil type		**Clay**					**Blackclay**					**Sanyloam**		
pH		8.31					8.2					8.06		
EC		0.7					1.6					-		
Variety & Duration		-					GGV-05-01, 135 days					NDR-359		
Available NPK kg/ha		316:39:573					-					208:19.9;183		
		S1: 100% RDF inorganic(120:60:40)					S1: 100% RDF inorganic(120:60:40)					S1: 100% RDF inorganic(120:60:40)		
		S2: 75% inorganic + 25% organic(equivalent of N dose)					S2: 75% inorganic + 25% organic(equivalent of N dose)					S2: 75% inorganic + 25% organic(equivalent of N dose)		
		S3-150% of recommended dose of fertilizer					S3-150% of recommended dose of fertilizer					S3-150% of recommended dose of fertilizer		
		S4-LCC based N application					S4-LCC based N application					S4-LCC based N application		
		S5-Location specific fertilizer management					S5-Location specific fertilizer management					S5- Location specific fertilizer management (100:50 kg NP/ha)		

Table-4.2.1: Contd.

Treatment		KOTA			LUDHIANA							MANDYA						
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Panicle/m^2 (No.)	Panicle wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering
M1 - Mechanical Transplanting	S1	-	-	-	7.44	8.91	294	288	3.41	20.79	88	-	-	-	-	-	-	-
	S2	-	-	-	7.50	9.11	289	287	3.40	19.93	88	-	-	-	-	-	-	-
	S3	-	-	-	7.13	9.20	305	297	3.50	20.37	87	-	-	-	-	-	-	-
	S4	-	-	-	6.81	9.13	243	233	3.16	21.03	89	-	-	-	-	-	-	-
	S5	-	-	-	7.22	8.52	267	260	3.43	20.39	89	-	-	-	-	-	-	-
M2 - DS fb SRI	S1	5.18	295	4.47	-	-	-	-	-	-	-	5.88	7.03	381	381	2.43	26.88	103
	S2	4.73	237	4.23	-	-	-	-	-	-	-	5.64	6.41	319	319	2.12	25.43	103
	S3	5.3	278	4.51	-	-	-	-	-	-	-	6.5	8.53	348	348	2.4	27.19	102
	S4	5.53	289	4.73	-	-	-	-	-	-	-	5.66	6.72	351	351	2.42	25.47	103
	S5	5.29	274	4.57	-	-	-	-	-	-	-	5.39	6.13	291	291	2.05	25.08	104
M3 - Normal Transplanting	S1	5.52	295	5.06	6.84	9.31	359	338	2.66	21.33	99	6.34	7.06	345	345	2.14	25.49	104
	S2	5.07	254	4.45	6.14	9.32	344	335	2.72	20.97	100	5.85	6.09	338	338	1.86	26.63	104
	S3	5.7	312	5.17	7.01	10.34	390	382	2.90	21.17	99	6.75	7.9	369	369	3.59	27.01	104
	S4	5.98	320	5.23	6.81	9.78	366	341	2.64	21.09	99	6.02	7.17	346	346	1.8	26.17	105
	S5	5.65	303	5.1	7.16	9.38	361	343	2.76	21.54	101	6.25	6.78	363	363	2.16	27.01	105
M4 - SRI	S1	5.83	321	5.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	5.38	275	4.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3	6.13	336	5.46	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S4	6.25	348	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5	5.94	327	5.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M5 - Aerobic rice	S1	-	-	-	6.54	9.22	504	472	2.62	20.13	81	-	-	-	-	-	-	-
	S2	-	-	-	6.84	8.73	467	437	2.44	20.84	80	-	-	-	-	-	-	-
	S3	-	-	-	7.41	9.31	528	485	2.47	20.23	79	-	-	-	-	-	-	-
	S4	-	-	-	7.07	9.48	517	483	2.59	21.22	79	-	-	-	-	-	-	-
	S5	-	-	-	7.38	8.88	501	461	2.74	20.54	80	-	-	-	-	-	-	-
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	-	-	5.68	6.5	329	329	2.35	26.55	102
	S2	-	-	-	-	-	-	-	-	-	-	4.89	5.91	322	322	2.2	23.75	104
	S3	-	-	-	-	-	-	-	-	-	-	6.81	8.92	351	351	2.47	26.19	102
	S4	-	-	-	-	-	-	-	-	-	-	5.61	6.71	335	335	2.13	26.61	104
	S5	-	-	-	-	-	-	-	-	-	-	4.61	5.37	304	304	2.05	25.00	103
Interaction M and S		NS	NS	NS	NS	NS	NS	29.99	NS	NS	NS	NS	NS	NS	NS	0.52	NS	NS
S and M		NS	NS	NS	NS	NS	NS	44.40	NS	NS	NS	NS	NS	NS	NS	0.5	NS	NS

Table-4.2.1: Contd.

Treatment		KOTA			LUDHIANA							MANDYA						
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Panicle/m² (No.)	Panicle wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m² (No.)	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m² (No.)	Panicle/ m² (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering
Mean of Methods																		
M1		-	-	-	7.22	8.97	279.62	273.02	3.38	20.50	88	-	-	-	-	-	-	-
M2		5.21	274.65	4.5	-	-	-	-	-	-	-	5.81	6.96	338.17	338.17	2.28	26.01	103
M3		5.58	296.8	5.00	6.79	9.63	363.84	347.76	2.74	21.22	100	6.24	7	352.44	352.44	2.31	26.46	104
M4		5.91	321.3	5.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M5		-	-	-	7.05	9.13	503.47	467.73	2.57	20.59	80	-	-	-	-	-	-	-
M6		-	-	-	-	-	-	-	-	-	-	5.52	6.68	328	328	2.24	25.62	102.8
C.D. (0.05)		0.28	15.04	0.19	NS	NS	50.95	51.70	0.20	NS	1.01	NS	NS	NS	NS	NS	NS	NS
C.V. (%)		6.5	6.53	5.08	19.31	22.24	20.55	21.97	10.65	3.65	1.75	16.4	24.4	12.47	12.47	20.26	6.56	1.67
Method of Nutrition																		
S1		5.51	303.5	4.95	6.94	9.15	386	366	2.90	20.75	89	5.97	6.86	352	352	2.31	26.31	103
S2		5.06	255.33	4.54	6.83	9.05	367	353	2.85	20.58	89	5.46	6.13	326	326	2.06	25.27	103
S3		5.71	308.67	5.05	7.18	9.62	408	388	2.96	20.59	88	6.69	8.45	356	356	2.82	26.79	103
S4		5.92	319	5.15	6.90	9.46	375	352	2.80	21.11	89	5.76	6.87	344	344	2.11	26.08	104
S5		5.62	301.42	5.02	7.25	8.93	376	355	2.98	20.82	90	5.42	6.09	319	319	2.09	25.7	104
CD (0.05)		0.29	16.42	0.2	NS	NS	19.66	17.32	NS	NS	NS	0.54	0.71	NS	NS	0.3	NS	NS
C.V. (%)		6.34	6.69	4.91	8.11	9.67	5.28	4.91	12.19	4.47	1.74	9.51	10.54	10.43	10.43	13.66	4.18	1.12
Experimental Mean		**5.57**	**297.58**	**4.94**	**7.02**	**9.24**	**382.31**	**362.84**	**2.90**	**20.77**	**89.18**	**5.86**	**6.88**	**339.54**	**339.54**	**2.28**	**26.03**	**103.24**
Soil type		Clay loam			Sandy loam							Red sandy loam						
pH		8.14			7.2							6.97						
EC		0.24			-							0.25						
Variety & Duration		P-2511			PR 126, 120 days							MTU 1001, 130 to 135 days						
Available NPK kg/ha		320:62:525			470-27.2-66.6							226:98:276						

S1: 100% RDF inorganic(120:60:40)
S2: 75% inorganic + 25% organic(equivalent of N dose)
S3-150% of recommended dose of fertilizer
S4-LCC based N application
S5- 120:60:40 kg NPK/ha + 25 kg zinc sulphate

S1: 100% RDF inorganic(120:60:40)
S2: 75% inorganic + 25% organic(equivalent of N dose)
S3-150% of recommended dose of fertilizer
S4-LCC based N application
S5- Location specific fertilizer management

S1: 100% RDF inorganic(120:60:40)
S2: 75% inorganic + 25% organic(equivalent of N dose)
S3: 150 % RDF
S4:LCC based N application
S5: Location specific fertilizer management(100 : 50: 50 Kg/ha N: P2O5:K2O)

Table-4.2.1: Contd.

Treatment		MARUTERU				NAGINA						NAVASARI							
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Panicle length (cm)	Test wt (g)	Days for 50% flowering
M1 - Mechanical Transplanting	S1	6.36	261	3.66	22.05	5.27	312	294	34.51	3.63	108	-	-	-	-	-	-	-	-
	S2	5.77	258	3.32	21.15	5.27	321	303	32.03	3.65	108	-	-	-	-	-	-	-	-
	S3	7.57	268	3.71	22.53	5.48	330	318	35.54	3.67	110	-	-	-	-	-	-	-	-
	S4	4.62	252	3.23	22.57	5.16	304	294	34.53	3.63	108	-	-	-	-	-	-	-	-
	S5	6.15	260	3.47	21.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M2 - DS fb SRI	S1	5.28	249	3.63	22.06	4.35	303	285	34.51	3.57	103	-	-	-	-	-	-	-	-
	S2	4.15	245	3.44	22.77	4.45	302	291	34.52	3.58	102	-	-	-	-	-	-	-	-
	S3	6.69	265	3.64	22.33	4.63	313	299	34.54	3.6	105	-	-	-	-	-	-	-	-
	S4	3.67	233	3.32	22.75	4.36	304	287	34.49	3.56	103	-	-	-	-	-	-	-	-
	S5	4.67	248	3.48	22.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M3 - Normal Transplanting	S1	5.79	265	3.46	22.68	5.34	317	297	34.52	3.63	108	6.96	6.29	228	180	2.55	23.52	30.57	91
	S2	5.19	245	3.28	22.63	5.31	321	302	34.54	3.66	108	6.86	6.45	194	163	2.45	23.33	26.40	93
	S3	6.09	268	3.57	22.78	5.68	330	316	34.56	3.68	110	6.46	6.23	249	200	2.38	23.17	28.68	93
	S4	4.89	225	3.37	22.24	5.22	311	295	34.52	3.63	109	5.64	6.20	227	186	2.31	23.28	29.16	93
	S5	5.47	253	3.28	22.63	-	-	-	-	-	-	6.29	6.27	225	190	2.38	22.92	28.80	92
M4 - SRI	S1	-	-	-	-	-	-	-	-	-	-	5.85	5.91	295	186	2.58	23.13	29.49	93
	S2	-	-	-	-	-	-	-	-	-	-	5.19	6.40	293	163	2.53	23.52	30.83	94
	S3	-	-	-	-	-	-	-	-	-	-	5.36	6.04	235	180	2.49	23.43	28.57	92
	S4	-	-	-	-	-	-	-	-	-	-	4.64	5.90	205	186	2.88	22.88	27.89	94
	S5	-	-	-	-	-	-	-	-	-	-	5.16	5.77	261	199	2.55	22.22	28.88	94
M5 - Aerobic rice	S1	-	-	-	-	-	-	-	-	-	-	5.98	5.93	216	186	2.17	22.82	27.02	91
	S2	-	-	-	-	-	-	-	-	-	-	5.39	6.61	227	175	2.23	22.23	27.63	91
	S3	-	-	-	-	-	-	-	-	-	-	5.41	5.77	211	186	2.57	22.18	27.74	92
	S4	-	-	-	-	-	-	-	-	-	-	4.67	5.92	216	203	2.16	22.72	27.36	91
	S5	-	-	-	-	-	-	-	-	-	-	5.29	6.04	261	200	2.47	22.82	28.35	91
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interaction M and S		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	31.03	NS	NS	NS	NS	NS
Interaction S and M		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	32.94	NS	NS	NS	NS	NS

Table-4.2.1: Contd.

Treatment		MARUTERU				NAGINA						NAVASARI							
Methods of crop establishment	**Method of Nutrient**	**Grain yield (t/ha)**	**Panicle/ m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Grain yield (t/ha)**	**Tillers/ m² (No.)**	**Panicle/ m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Days for 50% flowering**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Tillers/ m² (No.)**	**Panicle/ m² (No.)**	**Panicle wt (g)**	**Panicle length (cm)**	**Test wt (g)**	**Days for 50% flowering**
Mean of Methods																			
M1		6.09	259.8	3.48	22.01	5.3	316.56	302.31	34.15	3.64	108	-	-	-	-	-	-	-	-
M2		4.89	248	3.5	22.48	4.44	305.56	290.38	34.51	3.58	103	-	-	-	-	-	-	-	-
M3		5.49	251.2	3.39	22.59	5.39	319.31	302.44	34.54	3.65	109	6.44	6.29	224	184	2.41	23.24	28.72	92
M4		-	-	-	-	-	-	-	-	-	-	5.24	6.01	258	183	2.61	23.04	29.13	93
M5		-	-	-	-	-	-	-	-	-	-	5.35	6.05	226	190	2.32	22.55	27.62	91
M6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.D. (0.05)		0.43	NS	NS	NS	0.15	8.35	NS	NS	0.01	0.99	0.22	0.19	23.09	NS	0.15	NS	NS	1.42
C.V. (%)		11.97	8.35	10.25	3.97	3.39	3.07	4.71	4.86	0.28	1.07	5.08	4.05	12.64	4.38	7.73	8.46	6.51	1.99
Method of Nutrition																			
S1		5.81	258.33	3.58	22.26	4.99	310.42	292.08	34.51	3.61	106	6.26	6.05	246	184	2.43	23.16	29.02	92
S2		5.04	249.33	3.35	22.18	5.01	314.42	298.67	33.69	3.63	106	5.81	6.49	238	167	2.4	23.03	28.29	93
S3		6.78	267	3.64	22.54	5.26	324.08	311	34.88	3.65	108	5.74	6.01	232	189	2.48	22.93	28.33	92
S4		4.39	236.67	3.31	22.52	4.91	306.33	291.75	34.51	3.61	106	4.98	6.01	216	191	2.45	22.96	28.14	93
S5		5.43	253.67	3.41	22.29	-	-	-	-	-	-	5.58	6.03	249	196	2.47	22.65	28.68	92
CD (0.05)		0.49	NS	NS	NS	0.14	6.78	6.7	NS	0.01	0.85	0.4	0.28	17.91	7.61	NS	NS	NS	NS
C.V. (%)		9.26	9.76	8.22	4.87	3.25	2.58	2.68	4.13	0.37	0.95	8.61	5.48	9.2	4.98	9.32	7.46	7.38	2
Experimental Mean		**5.49**	**253**	**3.46**	**22.36**	**5.04**	**313.81**	**298.38**	**34.4**	**3.62**	**106.79**	**5.68**	**6.12**	**236.07**	**185.25**	**2.45**	**22.94**	**28.49**	**92.28**
Soil type		Clay				Sandy loam						Clayey							
pH		7.16				7.7						7.83							
EC		-				-						0.67							
Variety & Duration		MTU 1075				NDR-359						GNR 3, 120-125 days							
Available NPK kg/ha		151:36:257				N 21, .P 18.33, K 209 kg/ha						149:102:314							

S1: 100% RDF inorganic(120:60:40)	S1: 100% RDF inorganic(120:60:40)	S1: 100% RDF inorganic(120:60:40)
S2: 75% inorganic + 25% organic(equivalent of N dose)	S2: 75% inorganic + 25% organic(equivalent of N dose)	S2: 75% inorganic + 25% organic(equivalent of N dose)
S3: 150 % RDF	S3: 150 % RDF	S3: 150 % RDF
S4:LCC based N application	S4:LCC based N application	S4:LCC based N application
S5: Location specific fertilizer management(125 % RDF)	-	S5: Location specific fertilizer management

Table-4.2.1: Contd.

Treatment		PANTNAGAR					PUDUCHERRY							PUSA		
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Plant height (cm)	Grain yield (t/ha)	Panicle/ m^2 (No.)	Panicle weight (g)
M1 - Mechanical Transplanting	S1	-	-	-	-	-	6.15	9.04	465	443	4.26	22.97	131.00	6.72	362	3.41
	S2	-	-	-	-	-	6.41	9.62	488	460	4.57	23.09	139.46	7.43	383	3.34
	S3	-	-	-	-	-	6.55	9.63	507	469	4.64	23.16	143.48	6.31	351	3.37
	S4	-	-	-	-	-	6.74	10.11	522	480	4.66	23.13	149.49	7.11	381	3.32
	S5	-	-	-	-	-	5.99	8.81	460	428	4.12	23.24	128.10	7.18	381	3.29
M2 - DS fb SRI	S1	4.89	5.23	264	2.18	27.51	5.61	6.73	405	381	3.58	22.48	115.38	6.28	352	3.58
	S2	5.36	4.05	282	2.21	27.78	5.73	7.25	410	390	3.9	22.13	126.42	7.17	378	3.6
	S3	5.67	4.08	287	2.22	27.85	6.15	7.59	438	419	4.26	23.12	133.47	6.14	349	3.56
	S4	4.83	5.18	277	2.12	27.64	6.4	7.91	452	438	4.28	23.28	136.35	6.93	374	3.55
	S5	5.65	4.53	304	2.14	27.89	5.33	6.56	390	357	3.32	22.52	110.09	6.89	376	3.33
M3 - Normal Transplanting	S1	5.17	2.85	195	3.03	27.92	5.75	7.68	437	419	4.01	22.69	127.85	5.68	344	3.68
	S2	5.58	3.28	182	3.39	27.90	6.18	8.03	457	437	4.15	22.83	129.80	5.7	347	3.67
	S3	5.92	3.48	206	3.32	27.75	6.38	8.71	480	453	4.4	23.55	142.80	5.46	342	3.6
	S4	5.21	3.27	201	3.18	27.97	6.58	8.77	486	459	4.54	23.27	145.86	5.86	352	3.61
	S5	5.85	3.5	209	3.31	27.79	5.54	7.76	426	398	3.87	22.65	120.59	5.96	355	3.58
M4 - SRI	S1	5.08	5.08	170	3.55	27.91	-	-	-	-	-	-	-	-	-	-
	S2	5.43	6.08	178	3.52	27.97	-	-	-	-	-	-	-	-	-	-
	S3	5.55	5.2	184	3.50	28.05	-	-	-	-	-	-	-	-	-	-
	S4	5.16	5.31	175	3.63	27.98	-	-	-	-	-	-	-	-	-	-
	S5	5.51	5.95	187	3.57	27.55	-	-	-	-	-	-	-	-	-	-
M5 - Aerobic rice	S1	5.47	3.15	341	1.82	27.78	-	-	-	-	-	-	-	-	-	-
	S2	5.53	2.78	362	1.75	27.98	-	-	-	-	-	-	-	-	-	-
	S3	5.92	3.6	392	1.82	27.95	-	-	-	-	-	-	-	-	-	-
	S4	5.69	3.3	370	1.78	27.93	-	-	-	-	-	-	-	-	-	-
	S5	5.89	3.75	396	1.77	27.87	-	-	-	-	-	-	-	-	-	-
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interaction																
M and S		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S and M		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table-4.2.1: Contd.

Treatment		PANTNAGAR					PUDUCHERRY							PUSA		
Methods of crop establishment	**Method of Nutrient**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Panicle/ m^2 (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Tillers/ m^2 (No.)**	**Panicle/ m^2 (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Plant height (cm)**	**Grain yield (t/ha)**	**Panicle/ m^2 (No.)**	**Panicle weight (g)**
Mean of Methods																
M1		-	-	-	-	-	6.37	9.44	488	456	4.45	23.12	138.31	6.95	372	3.34
M2		5.28	4.62	283	2.17	27.73	5.84	7.21	419	397	3.87	22.71	124.34	6.68	366	3.52
M3		5.55	3.28	198	3.25	27.87	6.09	8.19	457	433	4.19	23.00	133.38	5.73	348	3.63
M4		5.35	5.52	179	3.56	27.89	-	-	-	-	-	-	-	-	-	-
M5		5.7	3.32	372	1.79	27.9	-	-	-	-	-	-	-	-	-	-
M6		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.D. (0.05)		0.17	0.46	16.84	0.19	NS	0.09	0.44	7.02	5.08	0.04	NS	1.83	0.09	3.26	0.03
C.V. (%)		3.53	12.43	7.31	8.1	1.11	2.25	8.11	2.38	1.83	1.53	1.94	2.14	2.1	1.39	1.23
Method of Nutrition																
S1		5.15	4.08	242	2.64	27.78	5.84	7.82	436	414	3.95	22.71	124.74	6.23	353	3.56
S2		5.48	4.05	251	2.72	27.91	6.11	8.3	451	429	4.21	22.68	131.89	6.77	369	3.54
S3		5.77	4.09	267	2.72	27.90	6.36	8.64	475	447	4.43	23.28	139.91	5.97	347	3.51
S4		5.22	4.26	256	2.68	27.88	6.57	8.93	486	459	4.49	23.22	143.9	6.63	369	3.49
S5		5.73	4.43	274	2.70	27.77	5.62	7.71	425	394	3.77	22.8	119.59	6.68	371	3.4
CD (0.05)		0.16	NS	13.04	NS	NS	0.15	0.44	9.91	9.98	0.1	NS	2.84	0.35	17.49	ns
C.V. (%)		3.63	15.93	6.12	7.97	1	2.55	5.44	2.24	2.39	2.52	2.47	2.21	5.56	4.97	6.24
Experimental Mean		**5.47**	**4.18**	**257.98**	**2.69**	**27.85**	**6.1**	**8.28**	**454.76**	**428.66**	**4.17**	**22.94**	**132.01**	**6.46**	**361.73**	**3.5**
Soil type		Silt Loam					Clay loam							Silt clay		
pH		7.9					6.62							8.2		
EC		1.2					0.26							-		
Variety & Duration		PNR-121					CO-52(135 days)							Rajendra mahsuri1		
Available NPK kg/ha		232:21.4:223					324.8:36.35:200							-		
		S1: 100% RDF inorganic(120:60:40)					S1: 100% RDF inorganic(120:60:40)							S1: 100% RDF inorganic(120:60:40)		
		S2: 75% inorganic + 25% organic(equivalent of N dose)					S2: 75% inorganic + 25% organic(equivalent of N dose)							S2: 75% inorganic + 25% organic(equivalent of N dose)		
		S3: 150 % RDF					S3: 150 % RDF							S3: 150 % RDF		
		S4:LCC based N application					S4:LCC based N application							S4:LCC based N application		
		S5: Location specific fertilizer management(120-60-40 + 5 t FYM)					S5: Location specific fertilizer management							S5: Location specific fertilizer management(75% of RDF)		

Table-4.2.1: Contd.

Treatment		RANCHI				REWA						
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Panicle/ m^2 (No.)	Filled grain %	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering
M1 - Mechanical Transplanting	S1	-	-	-	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-	-	-	-
M2 - DS fb SRI	S1	4.25	6.81	232	113	4.23	5.23	262	260	2.15	25.80	72
	S2	4.00	6.28	223	108	4.25	5.27	263	260	2.10	27.25	75
	S3	4.77	7.35	255	122	4.30	5.28	266	264	2.22	26.20	73
	S4	4.65	7.13	264	116	4.20	5.23	265	263	2.20	25.50	75
	S5	3.96	6.22	188	105	4.32	5.35	268	267	2.08	26.30	73
M3 - Normal Transplanting	S1	4.42	7.07	266	120	5.20	6.20	289	287	3.33	24.53	83
	S2	4.31	6.77	251	112	5.25	6.30	299	296	3.22	24.83	84
	S3	4.95	7.62	292	122	5.25	6.25	287	285	3.15	26.17	83
	S4	4.85	7.37	288	125	5.43	6.18	292	291	3.32	26.30	79
	S5	3.97	6.23	221	105	5.27	6.23	287	285	3.15	25.50	86
M4 - SRI	S1	-	-	-	-	5.60	6.73	300	297	3.60	24.83	82
	S2	-	-	-	-	5.60	6.70	301	298	3.80	26.20	89
	S3	-	-	-	-	5.70	6.70	303	301	3.55	25.50	87
	S4	-	-	-	-	5.65	6.80	305	302	3.60	26.20	84
	S5	-	-	-	-	5.65	6.65	305	302	3.73	26.35	84
M5 - Aerobic rice	S1	3.82	5.91	290	86	4.80	5.65	275	272	2.63	27.40	73
	S2	3.48	5.47	270	81	4.70	5.65	273	272	2.68	27.42	78
	S3	4.28	6.59	292	101	4.77	5.67	274	273	2.67	27.42	80
	S4	4.23	6.27	290	99	4.65	5.63	276	274	2.65	28.43	79
	S5	3.51	5.52	226	86	4.67	5.75	275	273	2.65	25.07	74
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-	-	-	-
Interaction												
M and S		NS	NS	NS	NS	NS	NS	5.28	4.9	NS	1.29	NS
S and M		NS	NS	NS	NS	NS	NS	5.33	4.86	NS	1.23	NS

Table-4.2.1: Contd.

Treatment		RANCHI				REWA						
Methods of crop establishment	**Method of Nutrient**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Panicle/ m^2 (No.)**	**Filled grain %**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Tillers/ m^2 (No.)**	**Panicle/ m^2 (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Days for 50% flowering**
Mean of Methods												
M1		-	-	-	-	-	-	-	-	-	-	-
M2		4.33	6.76	232	112.8	4.26	5.27	265	263	2.15	26.21	74
M3		4.5	7.01	264	116.8	5.28	6.23	291	289	3.23	25.47	83
M4		-	-	-	-	5.64	6.72	303	300	3.66	25.82	85
M5		3.86	5.95	274	90.6	4.72	5.67	275	273	2.66	27.15	77
M6		-	-	-	-	-	-	-	-	-	-	-
C.D. (0.05)		0.31	0.52	8.93	9.75	0.10	0.11	3.25	2.77	0.19	0.57	1.80
C.V. (%)		9.38	10.3	4.5	11.8	2.91	2.61	1.61	1.38	9.02	3.07	3.17
Method of Nutrition												
S1		4.16	6.6	263	106.33	4.96	5.95	281	279	2.93	25.64	77
S2		3.93	6.17	248	100.33	4.95	5.98	284	281	2.95	26.43	82
S3		4.67	7.19	280	115	5.01	5.97	283	281	2.90	26.32	81
S4		4.58	6.92	281	113.33	4.98	5.96	285	282	2.94	26.61	79
S5		3.81	5.99	212	98.67	4.98	5.99	284	282	2.90	25.81	79
CD (0.05)		0.24	0.43	14.02	5.84	NS	NS	NS	2.45	NS	0.65	2.14
C.V. (%)		6.82	7.9	6.62	6.64	2.65	2.72	1.32	1.23	5.83	3.49	3.81
Experimental Mean		**4.23**	**6.57**	**256.55**	**106.73**	**4.98**	**5.97**	**283.11**	**280.95**	**2.92**	**26.16**	**80**
Soil type		-										
pH		-				6.5						
EC		-										
Variety & Duration		Naveen										
Available NPK kg/ha		240:36:175				292:18.5;423						
		S1: 100% RDF inorganic(120:60:40)				S1: 100% RDF inorganic(120:60:40)						
		S2: 75% inorganic + 25% organic(equivalent of N dose)				S2: 75% inorganic + 25% organic(equivalent of N dose)						
		S3: 150 % RDF				S3: 150 % RDF						
		S4:LCC based N application				S4:LCC based N application						
		S5: Location specific fertilizer management(50% inorganic + 50% 0rganic)				S5: Location specific fertilizer management						

Table-4.2.1: Contd.

Treatment		SABOUR						VARANASI							Over all Mean	Rank
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering		
M1 - Mechanical Transplanting	S1	-	-	-	-	-	-	-	-	-	-	-	-	-	5.70	2
	S2	-	-	-	-	-	-	-	-	-	-	-	-	-	5.64	3
	S3	-	-	-	-	-	-	-	-	-	-	-	-	-	6.00	1
	S4	-	-	-	-	-	-	-	-	-	-	-	-	-	5.55	5
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	5.56	4
M2 - DS fb SRI	S1	3.48	6.49	325	312	7.13	21.01	5.14	6.47	356	285	3.03	20.90	84	4.72	24
	S2	3.59	6.5	344	320	8.03	20.33	4.77	6.01	343	275	2.98	22.06	82	4.54	27
	S3	3.90	7.09	345	322	8.23	19.53	4.86	6.12	348	279	2.98	23.04	82	5.15	13
	S4	3.45	6.1	322	294	7.40	20.28	4.81	6.06	349	279	3.00	22.66	81	4.73	23
	S5	3.53	6.06	319	297	8.63	17.29	5.21	6.56	371	297	3.13	23.50	84	4.87	18
M3 - Normal Transplanting	S1	4.11	6.48	296	284	9.90	21.01	5.24	6.6	380	304	3.06	22.88	89	5.17	12
	S2	4.37	6.89	310	298	8.03	21.67	5.06	6.38	368	294	2.94	23.60	87	5.04	16
	S3	4.53	7.14	322	313	9.90	19.67	5.16	6.5	377	301	3.01	23.11	87	5.49	6
	S4	4.17	6.57	303	288	6.93	20.98	5.16	6.51	377	301	3.02	22.64	86	5.17	11
	S5	3.99	6.29	276	268	7.63	19.60	5.43	6.84	386	309	3.15	23.31	89	5.37	7
M4 - SRI	S1	3.98	5.97	286	270	9.07	21.41	-	-	-	-	-	-	-	5.02	17
	S2	4.38	6.25	294	278	10.77	20.99	-	-	-	-	-	-	-	4.87	20
	S3	4.68	6.68	298	281	11.43	21.00	-	-	-	-	-	-	-	5.33	8
	S4	4.44	6.33	292	283	9.00	21.93	-	-	-	-	-	-	-	5.09	15
	S5	3.93	5.61	267	252	10.20	19.94	-	-	-	-	-	-	-	5.26	10
M5 - Aerobic rice	S1	-	-	-	-	-	-	4.35	5.48	342	274	3.01	23.10	80	4.82	21
	S2	-	-	-	-	-	-	4.54	5.72	318	254	2.99	22.56	80	4.69	25
	S3	-	-	-	-	-	-	4.55	5.73	329	263	2.94	22.76	81	5.11	14
	S4	-	-	-	-	-	-	4.54	5.72	328	263	2.89	22.12	80	4.87	19
	S5	-	-	-	-	-	-	4.86	6.12	348	278	3.10	22.26	79	5.27	9
M6 - Semi dry rice	S1	-	-	-	-	-	-	-	-	-	-	-	-	-	4.09	28
	S2	-	-	-	-	-	-	-	-	-	-	-	-	-	3.52	30
	S3	-	-	-	-	-	-	-	-	-	-	-	-	-	4.80	22
	S4	-	-	-	-	-	-	-	-	-	-	-	-	-	4.08	29
	S5	-	-	-	-	-	-	-	-	-	-	-	-	-	4.61	26
Interaction																
M and S		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.01	NS		
S and M		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.94	NS		

Table-4.2.1: Contd.

Treatment		SABOUR						VARANASI							Over all Mean	Rank
Methods of crop establishment	Method of Nutrient	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/ m^2 (No.)	Panicle/ m^2 (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering		
Mean of Methods																
M1		-	-	-	-	-	-	-	-	-	-	-	-	-	5.68	1
M2		3.59	6.45	331	308.97	7.89	19.69	4.96	6.25	353.5	282.8	3.02	22.43	82	4.77	5
M3		4.23	6.67	301.6	290.27	8.48	20.59	5.21	6.56	377.33	301.87	3.04	23.11	87	5.22	2
M4		4.28	6.17	287.36	272.66	10.09	21.06	-	-	-	-	-	-	-	5.06	3
M5		-	-	-	-	-	-	4.57	5.75	332.92	266.33	2.99	22.56	80	4.89	4
M6		-	-	-	-	-	-	-	-	-	-	-	-	-	4.01	6
C.D. (0.05)		0.3	NS	19.17	17.09	0.84	NS	0.24	0.3	16.49	13.19	ns	ns	1.12		
C.V. (%)		11.59	9.27	9.64	9.07	14.71	11.69	7.56	7.56	7.17	7.17	6.99	2.89	2.08		
Method of Nutrition																
S1		3.86	6.31	302	289	8.7	21.15	4.91	6.18	359	287	3.03	22.29	84	5.11	4
S2		4.11	6.55	316	299	8.94	21	4.79	6.03	343	274	2.97	22.74	83	4.97	5
S3		4.37	6.97	322	305	9.86	20.07	4.86	6.12	351	281	2.98	22.97	83	5.47	1
S4		4.02	6.33	306	288	7.78	21.06	5.16	6.51	368	295	3.13	23.02	84	5.12	3
S5		3.81	5.98	287	272	8.82	18.94	4.84	6.1	351	281	2.97	22.47	82	5.20	2
CD (0.05)		0.26	0.49	22.11	19.73	0.97	NS	0.19	0.24	16.79	13.43	0.10	NS	NS		
C.V. (%)		6.7	7.78	7.41	6.98	11.25	8.36	3.97	3.97	4.87	4.87	3.31	2.63	2.91		
Experimental Mean		**4.03**	**6.43**	**306.65**	**290.63**	**8.82**	**20.44**	**4.91**	**6.19**	**354.58**	**283.67**	**3.02**	**22.70**	**83**		
Soil type		Loamy Sand						Sandy Loam								
pH		7.2						7.34								
EC		0.31						0.37								
Variety & Duration		Sabour Ardhjal, 125 days						HUR 105								
Available NPK kg/ha		128:20.8;152						189.23:24.78:208.46								
		S1: 100% RDF inorganic(120:60:40)						S1: 100% RDF inorganic(120:60:40)								
		S2: 75% inorganic + 25% organic(equivalent of N dose)						S2: 75% inorganic + 25% organic(equivalent of N dose)								
		S3: 150 % RDF						S3: 150 % RDF								
		S4:LCC based N application						S4:LCC based N application								
		S5: Location specific fertilizer management						S5: Location specific fertilizer management(125 % RDF)								

Table-4.2.1: Contd.

Treatment		Weed population no/m2						
Methods of crop establishment	Method of Nutrient	ADUTHURAI		CHATHA		COIMBATORE	GANGAVATHI	
		Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)
M1 - Mechanical Transplanting	S1	13.25(3.68)	7.50(2.81)	-	-	36.48(6.08)	47.67(6.92)	16.33(4.08)
	S2	11.00(3.38)	6.00(2.53)	-	-	36.50(6.08)	18.00(4.30)	19.00(4.40)
	S3	15.25(3.96)	9.00(3.07)	-	-	33.92(5.87)	28.00(5.33)	7.67(2.84)
	S4	11.50(3.44)	5.50(2.44)	-	-	33.38(5.82)	17.33(4.22)	25.67(5.10)
	S5	10.50(3.30)	6.25(2.58)	-	-	37.60(6.17)	33.33(5.80)	40.33(6.36)
M2 - DS fb SRI	S1	15.75(4.02)	10.00(3.22)	1.67(1.46)	25.00(5.04)	-	7.33(2.77)	9.33(3.12)
	S2	13.75(3.75)	9.50(3.12)	1.67(1.44)	24.67(5.02)	-	21.00(4.63)	15.67(3.98)
	S3	18.75(4.37)	11.00(3.38)	1.33(1.34)	25.00(5.05)	-	13.33(3.70)	11.67(3.48)
	S4	16.50(4.10)	10.00(3.23)	1.67(1.46)	22.33(4.78)	-	16.67(4.13)	24.33(4.98)
	S5	15.25(3.94)	9.50(3.13)	-	-	-	8.33(2.96)	20.67(4.59)
M3 - Normal Transplanting	S1	6.00(2.51)	4.75(2.27)	0.00(0.71)	8.33(2.97)	56.97(7.58)	30.33(5.55)	7.33(2.78)
	S2	6.25(2.58)	4.50(2.20)	0.00(0.71)	7.67(2.86)	56.03(7.52)	12.67(3.62)	18.00(4.27)
	S3	7.75(2.84)	5.75(2.48)	0.00(0.71)	9.33(3.13)	51.97(7.24)	21.00(4.63)	15.33(3.95)
	S4	6.00(2.51)	6.00(2.53)	0.00(0.71)	10.00(3.24)	46.87(6.88)	24.00(4.92)	35.67(5.98)
	S5	8.25(2.95)	5.25(2.39)	-	-	56.97(7.58)	12.33(3.57)	18.67(4.35)
M4 - SRI	S1	-	-	0.00(0.71)	8.00(2.91)	32.70(5.76)	-	-
	S2	-	-	0.00(0.71)	8.33(2.97)	31.32(5.64)	-	-
	S3	-	-	0.00(0.71)	9.67(3.19)	31.42(5.65)	-	-
	S4	-	-	0.00(0.71)	8.67(3.03)	29.85(5.50)	-	-
	S5	-	-	-	-	32.15(5.71)	-	-
M5 - Aerobic rice	S1	-	-	1.67(1.44)	33.67(5.84)	-	-	-
	S2	-	-	1.67(1.46)	34.67(5.93)	-	-	-
	S3	-	-	2.00(1.58)	40.00(6.36)	-	-	-
	S4	-	-	2.00(1.58)	35.33(5.99)	-	-	-
	S5	-	-	-	-	-	-	-
M6 - Semi dry rice	S1	-	-	1.67(1.46)	34.00(5.87)	-	-	-
	S2	-	-	2.33(1.68)	34.00(5.87)	-	-	-
	S3	-	-	2.67(1.77)	36.00(6.04)	-	-	-
	S4	-	-	2.33(1.68)	33.00(5.79)	-	-	-
	S5	-	-	-	-	-	-	-
Interaction								
M and S		NS	NS	NS	NS	NS	0.75	0.78
S and M		NS	NS	NS	NS	NS	0.67	0.72
Mean of Methods								
M1		12.30(3.55)	6.85(2.69)	-	-	35.58(6.00)	28.87(5.31)	21.80(4.56)
M2		16.00(4.03)	10.00(3.22)	1.58(1.43)	24.25(4.97)	-	13.33(3.64)	16.33(4.03)
M3		6.85(2.68)	5.25(2.37)	0.00(0.71)	8.83(3.05)	53.76(7.36)	20.07(4.46)	19.00(4.27)
M4		-	-	0.00(0.71)	8.67(3.02)	31.49(5.65)	-	-
M5		-	-	1.83(1.52)	35.92(6.03)	-	-	-
M6		-	-	2.25(1.65)	34.25(5.89)	-	-	-
C.D. (0.05)		0.32	0.2	0.11	0.1	0.15	0.11	NS
C.V. (%)		12.14	9.35	9.4	2.33	3.16	3.9	11.43
Method of Nutrition								
S1		11.67(3.40)	7.42(2.77)	1.00(1.16)	21.80(4.53)	42.05(6.47)	28.44(5.08)	11.00(3.33)
S2		10.33(3.24)	6.67(2.62)	1.13(1.20)	21.87(4.53)	41.28(6.41)	17.22(4.18)	17.56(4.22)
S3		13.92(3.72)	8.58(2.98)	1.20(1.22)	24.00(4.76)	39.11(6.25)	20.78(4.55)	11.56(3.42)
S4		11.33(3.35)	7.17(2.73)	1.20(1.23)	21.87(4.56)	36.70(6.07)	19.33(4.42)	28.56(5.35)
S5		11.33(3.39)	7.00(2.70)	-	-	42.24(6.49)	18.00(4.11)	26.56(5.10)
CD (0.05)		NS	NS	NS	0.12	0.16	0.43	0.45
C.V. (%)		13.45	14.66	14.91	3.47	3.02	9.96	10.8
Experimental Mean		**3.42**	**2.76**	**1.2**	**4.59**	**6.34**	**4.47**	**4.28**

Table-4.2.1: Contd.

Treatment		Weed population no/m2						
		KOTA	MANDYA		NAGINA		NAVASARI	
Methods of crop establishment	Method of Nutrient	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)
M1 - Mechanical Transplanting	S1	10.75(3.35)	-	-	5.87(2.50)	3.63(2.03)	-	-
	S2	12.75(3.64)	-	-	5.26(2.38)	3.54(2.00)	-	-
	S3	9.75(3.20)	-	-	4.86(2.30)	2.24(1.65)	-	-
	S4	8.75(3.04)	-	-	5.91(2.49)	3.11(1.90)	-	-
	S5	10.75(3.35)	-	-	-	-	-	-
M2 - DS fb SRI	S1	11.00(3.39)	4.17(2.12)	11.00(3.38)	5.30(2.39)	5.16(2.37)	-	-
	S2	12.25(3.56)	2.50(1.61)	8.00(2.92)	9.02(3.07)	4.60(2.25)	-	-
	S3	10.00(3.23)	4.50(2.21)	8.67(3.02)	8.61(2.98)	3.41(1.96)	-	-
	S4	10.00(3.23)	1.67(1.39)	9.67(3.19)	9.44(3.14)	4.54(2.24)	-	-
	S5	10.75(3.35)	4.33(2.15)	11.50(3.46)	-	-	-	-
M3 - Normal Transplanting	S1	9.25(3.12)	2.83(1.68)	3.33(1.89)	4.63(2.22)	2.71(1.79)	18.88(4.40)	34.00(5.87)
	S2	11.25(3.42)	3.17(1.91)	2.67(1.78)	4.98(2.32)	2.55(1.75)	20.00(4.53)	35.50(6.00)
	S3	9.50(3.16)	0.83(1.05)	5.00(2.34)	4.93(2.30)	2.86(1.83)	17.75(4.27)	31.13(5.62)
	S4	8.00(2.91)	3.67(2.04)	4.50(2.24)	4.74(2.28)	2.50(1.73)	18.75(4.38)	31.38(5.64)
	S5	8.75(3.04)	2.67(1.65)	2.00(1.58)	-	-	19.13(4.43)	33.13(5.80)
M4 - SRI	S1	-	-	-	-	-	20.00(4.53)	33.75(5.85)
	S2	-	-	-	-	-	20.88(4.62)	35.00(5.96)
	S3	-	-	-	-	-	17.50(4.24)	34.13(5.88)
	S4	-	-	-	-	-	20.63(4.59)	34.38(5.90)
	S5	-	-	-	-	-	19.88(4.51)	33.50(5.83)
M5 - Aerobic rice	S1	-	-	-	-	-	28.25(5.36)	43.63(6.64)
	S2	-	-	-	-	-	28.88(5.42)	44.13(6.68)
	S3	-	-	-	-	-	28.25(5.36)	42.25(6.54)
	S4	-	-	-	-	-	26.88(5.23)	43.63(6.64)
	S5	-	-	-	-	-	-	-
M6 - Semi dry rice	S1	-	2.23(1.63)	7.67(2.86)	-	-	-	-
	S2	-	2.00(1.53)	10.00(3.24)	-	-	-	-
	S3	-	2.00(1.48)	4.67(2.25)	-	-	-	-
	S4	-	2.67(1.65)	11.50(3.46)	-	-	-	-
	S5	-	4.33(2.19)	9.50(3.15)	-	-	-	-
Interaction								
M and S		NS	NS	0.34	NS	NS	NS	NS
S and M		NS	NS	0.36	NS	NS	NS	NS
Mean of Methods								
M1		10.55(3.31)	-	-	5.47(2.42)	3.13(1.90)	-	-
M2		10.80(3.35)	3.43(1.90)	9.77(3.19)	8.09(2.89)	4.43(2.21)	-	-
M3		9.35(3.13)	2.63(1.67)	3.50(1.97)	4.82(2.28)	2.66(1.77)	18.90(4.40)	33.03(5.78)
M4		-	-	-	-	-	19.78(4.50)	34.15(5.88)
M5		-	-	-	-	-	27.98(5.34)	43.18(6.61)
M6		-	2.65(1.70)	8.67(2.99)	-	-	-	-
C.D. (0.05)		0.1	NS	0.29	0.25	0.05	0.13	0.16
C.V. (%)		3.98	17.9	16.6	11.58	3.18	3.63	3.29
Method of Nutrition								
S1		10.33(3.28)	3.08(1.81)	7.33(2.71)	5.27(2.37)	3.84(2.06)	22.38(4.76)	37.13(6.12)
S2		12.08(3.54)	2.56(1.68)	6.89(2.64)	6.42(2.59)	3.56(2.00)	23.25(4.86)	38.21(6.21)
S3		9.75(3.20)	2.44(1.58)	6.11(2.54)	6.13(2.53)	2.83(1.81)	21.17(4.62)	35.83(6.01)
S4		8.92(3.06)	2.67(1.69)	8.56(2.96)	6.70(2.64)	3.38(1.96)	22.08(4.74)	36.46(6.06)
S5		10.08(3.24)	3.78(2.00)	7.67(2.73)	-	-	22.21(4.75)	36.29(6.05)
CD (0.05)		0.19	NS	0.2	NS	0.15	0.1	NS
C.V. (%)		6.99	33.61	7.53	17.28	9.09	2.52	2.77
Experimental Mean		**3.27**	**1.75**	**2.72**	**2.53**	**1.96**	**4.75**	**6.09**

Table-4.2.1: Contd.

Treatment		Weed population no/m2					
		PUDUCHERRY		REWA		SABOUR	
Methods of crop establishment	Method of Nutrient	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)
M1 - Mechanical Transplanting	S1	55.00(7.45)	71.34(8.47)	-	-	-	-
	S2	50.33(7.13)	67.84(8.27)	-	-	-	-
	S3	46.30(6.84)	68.88(8.33)	-	-	-	-
	S4	42.30(6.54)	67.66(8.25)	-	-	-	-
	S5	60.92(7.83)	67.18(8.22)	-	-	-	-
M2 - DS fb SRI	S1	71.88(8.51)	77.45(8.83)	26.58(5.20)	20.20(4.55)	6.00(2.52)	5.00(2.26)
	S2	67.23(8.23)	71.88(8.51)	27.23(5.27)	19.38(4.46)	7.33(2.78)	4.67(2.26)
	S3	66.42(8.18)	75.82(8.73)	26.35(5.18)	16.30(4.10)	12.33(3.56)	6.33(2.60)
	S4	63.30(7.99)	70.72(8.44)	25.33(5.08)	16.40(4.11)	8.00(2.89)	4.33(2.18)
	S5	76.86(8.79)	79.47(8.94)	24.03(4.94)	17.17(4.20)	7.67(2.81)	4.67(2.24)
M3 - Normal Transplanting	S1	65.40(8.12)	72.69(8.55)	10.95(3.38)	5.95(2.54)	1.33(1.29)	4.33(2.20)
	S2	58.36(7.67)	69.34(8.35)	12.88(3.66)	6.20(2.59)	3.33(1.88)	4.67(2.27)
	S3	55.73(7.50)	71.55(8.48)	9.98(3.23)	7.27(2.79)	2.00(1.48)	6.67(2.66)
	S4	52.95(7.31)	67.34(8.23)	11.65(3.48)	7.10(2.76)	1.00(1.17)	4.33(2.20)
	S5	69.27(8.35)	81.67(9.06)	11.17(3.41)	7.80(2.88)	1.33(1.27)	3.00(1.86)
M4 - SRI	S1	-	-	10.27(3.28)	5.97(2.54)	3.00(1.87)	3.33(1.93)
	S2	-	-	10.20(3.27)	6.13(2.57)	6.00(2.54)	5.00(2.34)
	S3	-	-	9.95(3.23)	7.30(2.79)	7.00(2.63)	5.33(2.39)
	S4	-	-	9.73(3.20)	7.20(2.77)	4.00(2.11)	4.33(2.18)
	S5	-	-	11.07(3.40)	7.85(2.89)	3.33(1.93)	3.00(1.86)
M5 - Aerobic rice	S1	-	-	26.50(5.19)	20.20(4.55)	-	-
	S2	-	-	25.13(5.06)	19.38(4.46)	-	-
	S3	-	-	26.48(5.19)	16.30(4.10)	-	-
	S4	-	-	25.28(5.08)	16.40(4.11)	-	-
	S5	-	-	26.03(5.15)	17.18(4.20)	-	-
M6 - Semi dry rice	S1	-	-	-	-	-	-
	S2	-	-	-	-	-	-
	S3	-	-	-	-	-	-
	S4	-	-	-	-	-	-
	S5	-	-	-	-	-	-
Interaction							
M and S		0.17	0.17	0.2	0.07	NS	NS
S and M		0.15	0.16	0.2	0.07	NS	NS
Mean of Methods							
M1		50.97(7.16)	68.58(8.31)	-	-	-	-
M2		69.14(8.34)	75.07(8.69)	25.90(5.13)	17.89(4.28)	8.27(2.91)	5.00(2.31)
M3		60.34(7.79)	72.52(8.54)	11.32(3.43)	6.87(2.71)	1.80(1.42)	4.60(2.24)
M4		-	-	10.24(3.28)	6.89(2.71)	4.67(2.22)	4.20(2.14)
M5		-	-	25.88(5.13)	17.89(4.28)	-	-
M6		-	-	-	-	-	-
C.D. (0.05)		0.07	0.07	0.11	0.04	0.34	NS
C.V. (%)		1.35	1.24	3.49	1.59	24.05	11.65
Method of Nutrition							
S1		64.09(8.02)	73.83(8.62)	18.58(4.26)	13.08(3.55)	3.44(1.89)	4.22(2.13)
S2		58.64(7.68)	69.69(8.37)	18.86(4.31)	12.77(3.52)	5.56(2.40)	4.78(2.29)
S3		56.15(7.50)	72.08(8.52)	18.19(4.21)	11.79(3.44)	7.11(2.56)	6.11(2.55)
S4		52.85(7.28)	68.57(8.31)	17.99(4.21)	11.77(3.44)	4.33(2.06)	4.33(2.19)
S5		69.02(8.32)	76.11(8.74)	18.08(4.23)	12.50(3.54)	4.11(2.00)	3.56(1.99)
CD (0.05)		0.1	0.1	NS	0.03	0.46	0.35
C.V. (%)		1.27	1.2	3.4	1.4	21.69	15.94
Experimental Mean		**7.76**	**8.51**	**4.24**	**3.5**	**2.18**	**2.23**

Table-4.2.1: Contd.

Treatment		Weed dry wt (g/m2)							
		ADUTHURAI		GANGAVATHI		KOTA	LUDHIANA	MANDYA	
Methods of crop establishment	Method of Nutrient	Active tillering (no/m^2)	Panicle initiation (no/m^2)	Active tillering (no/m^2)	Panicle initiation (no/m^2)	Panicle initiation (no/m^2)	Active tillering (no/m^2)	Active tillering (no/m^2)	Panicle initiation (no/m^2)
M1 - Mechanical Transplanting	S1	3.25	4.15	28.70	11.67	11.77	0.39	-	-
	S2	3.22	4.13	13.07	13.97	12.60	0.41	-	-
	S3	4.13	4.90	15.83	7.23	8.92	0.34	-	-
	S4	3.15	4.27	12.87	15.67	8.41	0.32	-	-
	S5	3.03	4.40	25.47	16.90	9.00	0.37	-	-
M2 - DS fb SRI	S1	3.47	4.82	3.97	2.90	10.74	-	0.25	2.93
	S2	4.03	4.55	11.30	6.10	14.78	-	0.67	2.83
	S3	4.95	5.25	6.07	5.80	10.00	-	1.48	3.13
	S4	3.90	4.57	9.47	7.63	9.55	-	1.10	23.81
	S5	3.83	4.75	6.90	4.60	10.56	-	1.37	4.17
M3 - Normal Transplanting	S1	1.85	3.82	17.97	5.43	9.81	0.47	0.40	3.20
	S2	1.90	3.82	7.90	11.43	10.02	0.50	0.80	2.55
	S3	2.70	4.10	14.10	11.40	8.49	0.43	0.11	3.76
	S4	2.08	4.53	14.73	14.77	7.89	0.45	0.80	3.65
	S5	2.20	3.95	6.47	13.57	9.53	0.44	0.83	2.72
M4 - SRI	S1	-	-	-	-	-	-	-	-
	S2	-	-	-	-	-	-	-	-
	S3	-	-	-	-	-	-	-	-
	S4	-	-	-	-	-	-	-	-
	S5	-	-	-	-	-	-	-	-
M5 - Aerobic rice	S1	-	-	-	-	-	0.47	-	-
	S2	-	-	-	-	-	0.39	-	-
	S3	-	-	-	-	-	0.37	-	-
	S4	-	-	-	-	-	0.42	-	-
	S5	-	-	-	-	-	0.38	-	-
M6 - Semi dry rice	S1	-	-	-	-	-	-	0.89	2.90
	S2	-	-	-	-	-	-	0.91	4.33
	S3	-	-	-	-	-	-	0.36	4.38
	S4	-	-	-	-	-	-	0.80	4.41
	S5	-	-	-	-	-	-	1.79	2.92
Interaction									
M and S		NS	NS	6.28	NS	1.17	NS	NS	NS
S and M		NS	NS	5.79	NS	1.17	NS	NS	NS
Mean of Methods									
M1		3.36	4.37	19.19	13.09	10.14	0.37	-	-
M2		4.03	4.79	7.54	5.41	11.13	-	0.97	7.38
M3		2.14	4.04	12.23	11.32	9.15	0.46	0.59	3.18
M4		-	-	-	-	-	-	-	-
M5		-	-	-	-	-	0.41	-	-
M6		-	-	-	-	-	-	0.95	3.79
C.D. (0.05)		0.31	0.31	2.45	3.51	0.68	NS	0.18	NS
C.V. (%)		12.52	9.23	29.10	54.41	8.61	21.32	32.96	214.21
Method of Nutrition									
S1		2.86	4.27	16.88	6.67	10.77	0.45	0.51	3.01
S2		3.05	4.17	10.76	10.50	12.47	0.43	0.79	3.24
S3		3.92	4.75	12.00	8.14	9.14	0.38	0.65	3.76
S4		3.04	4.46	12.36	12.69	8.62	0.40	0.90	10.63
S5		3.02	4.37	12.94	11.69	9.70	0.40	1.33	3.27
CD (0.05)		0.60	NS	3.62	2.96	0.68	0.04	NS	NS
C.V. (%)		22.89	13.42	28.68	30.58	8.09	10.09	96.56	188.08
Experimental Mean		**3.18**	**4.40**	**12.99**	**9.94**	**10.14**	**0.41**	**0.84**	**4.78**

Table-4.2.1: Contd.

Treatment		Weed dry wt (g/m2)						
		NAGINA		NAVASARI		PANTNAGAR	PUDUCHERRY	
Methods of crop establishment	Method of Nutrient	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)
M1 - Mechanical Transplanting	S1	4.02	2.53	-	-	-	43.07	53.00
	S2	3.99	2.49	-	-	-	39.30	49.16
	S3	3.65	2.30	-	-	-	35.12	45.15
	S4	4.07	2.32	-	-	-	28.00	38.00
	S5	-	-	-	-	-	45.75	55.92
M2 - DS fb SRI	S1	5.68	2.68	-	-	73.18	50.43	60.40
	S2	5.61	2.79	-	-	64.28	47.27	58.37
	S3	4.58	2.67	-	-	71.08	46.92	57.12
	S4	5.74	2.67	-	-	68.42	43.86	54.06
	S5	-	-	-	-	68.85	54.72	64.85
M3 - Normal Transplanting	S1	3.45	2.24	32.22	47.70	33.11	45.15	55.18
	S2	4.11	2.31	34.49	52.71	40.22	40.17	50.17
	S3	3.40	2.24	33.66	50.17	34.87	39.01	49.28
	S4	3.98	2.28	34.47	50.50	33.39	33.33	43.43
	S5	-	-	32.52	51.16	31.02	48.48	58.58
M4 - SRI	S1	-	-	34.90	51.17	27.57		
	S2	-	-	36.05	54.32	36.36		
	S3	-	-	35.22	51.08	30.56		
	S4	-	-	34.35	51.85	38.92		
	S5	-	-	34.10	51.70	29.49		
M5 - Aerobic rice	S1	-	-	42.46	58.40	82.20		
	S2	-	-	42.70	57.68	69.45		
	S3	-	-	41.60	58.13	72.06		
	S4	-	-	42.23	59.23	75.38		
	S5	-	-	41.81	58.23	79.19		
M6 - Semi dry rice	S1	-	-	-	-	-		
	S2	-	-	-	-	-		
	S3	-	-	-	-	-		
	S4	-	-	-	-	-		
	S5	-	-	-	-	-		
Interaction								
M and S		NS	NS	NS	NS	NS	2.04	2.58
S and M		NS	NS	NS	NS	NS	1.88	2.37
Mean of Methods								
M1		3.93	2.41	-	-	-	38.25	48.25
M2		5.40	2.71	-	-	69.16	48.64	58.96
M3		3.74	2.27	33.47	50.45	34.52	41.23	51.33
M4		-	-	34.93	52.02	32.58		
M5		-	-	42.16	58.34	75.66		
M6		-	-	-	-	-		
C.D. (0.05)		0.92	0.20	0.82	2.15	5.24	0.77	0.92
C.V. (%)		24.50	9.60	2.89	5.19	11.08	2.78	2.68
Method of Nutrition								
S1		4.38	2.48	36.53	52.43	54.01	46.22	56.19
S2		4.57	2.53	37.75	54.91	52.58	42.24	52.57
S3		3.88	2.40	36.83	53.13	52.14	40.35	50.52
S4		4.60	2.42	37.02	53.86	54.03	35.06	45.16
S5		-	-	36.14	53.70	52.14	49.65	59.78
CD (0.05)		NS	NS	1.04	NS	NS	1.18	1.49
C.V. (%)		30.26	8.26	3.43	3.91	9.73	2.83	2.90
Experimental Mean		**4.36**	**2.46**	**36.85**	**53.60**	**52.98**	**42.70**	**52.84**

Table-4.2.1: Contd.

Treatment		Weed dry wt (g/m2)				
		RANCHI	REWA		SABOUR	
Methods of crop establishment	Method of Nutrient	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)	Active tillering (no/m²)	Panicle initiation (no/m²)
M1 - Mechanical Transplanting	S1	-	-	-	-	-
	S2	-	-	-	-	-
	S3	-	-	-	-	-
	S4	-	-	-	-	-
	S5	-	-	-	-	-
M2 - DS fb SRI	S1	13.20	9.82	5.22	13.27	11.83
	S2	33.15	9.85	4.80	18.43	15.88
	S3	13.60	9.82	4.45	23.08	21.50
	S4	31.73	9.77	4.43	13.95	14.48
	S5	47.35	11.32	4.43	16.07	17.20
M3 - Normal Transplanting	S1	23.30	4.23	2.53	2.93	7.43
	S2	27.15	4.35	2.47	8.80	11.43
	S3	18.90	3.90	3.05	4.17	12.20
	S4	22.88	4.05	3.18	2.03	6.77
	S5	31.13	4.42	3.83	2.03	5.23
M4 - SRI	S1	-	4.70	2.53	5.33	8.70
	S2	-	5.18	2.47	12.80	11.97
	S3	-	5.20	3.05	14.90	12.27
	S4	-	4.53	3.18	6.43	10.03
	S5	-	5.58	3.83	6.30	5.77
M5 - Aerobic rice	S1	25.88	10.77	5.23	-	-
	S2	59.78	10.82	4.80	-	-
	S3	21.53	9.60	4.45	-	-
	S4	63.97	9.30	4.43	-	-
	S5	60.60	10.77	4.43	-	-
M6 - Semi dry rice	S1	-	-	-	-	-
	S2	-	-	-	-	-
	S3	-	-	-	-	-
	S4	-	-	-	-	-
	S5	-	-	-	-	-
Interaction						
M and S		NS	NS	0.28	NS	NS
S and M		NS	NS	0.28	NS	NS
Mean of Methods						
M1		-	-	-	-	-
M2		27.81	10.12	4.67	16.96	16.18
M3		24.67	4.19	3.01	3.99	8.61
M4		-	5.04	3.01	9.15	9.75
M5		46.35	10.25	4.67	-	-
M6		-	-	-	-	-
C.D. (0.05)		13.67	1.40	0.15	3.12	3.04
C.V. (%)		53.63	26.45	5.51	47.99	40.70
Method of Nutrition						
S1		20.79	7.38	3.88	7.18	9.32
S2		40.03	7.55	3.64	13.34	13.09
S3		18.01	7.13	3.75	14.05	15.32
S4		39.52	6.91	3.80	7.47	10.43
S5		46.36	8.02	4.13	8.13	9.40
CD (0.05)		9.36	0.60	0.14	3.58	3.46
C.V. (%)		34.43	11.40	5.21	36.69	30.88
Experimental Mean		**32.94**	**7.40**	**3.84**	**10.04**	**11.51**

4.2.1 (R). Evaluation of different nutrient management practices for enhancement of the productivity in different rice establishments methods

Nutrient supply and nutrient requirements in high-yielding cropping systems must be matched in quantity and synchronized in time and space. To realize this goal, some improvements must be made: using a variety of N sources from fertilizers, the environment, and the soil to meet crop demand; calculating the nutrient balance between the inputs and outputs to manage a variety of intrinsic ecosystem processes at multiple scales to recouple elemental cycles; and considering the biological potential of the root system and matching crop requirements by supplying sufficient N only when plant demand exists. In nutrient management, crop yields can be increased while minimizing nutrient losses to the environment by managing nutrient supply in the root zone within a reasonable range, which realizes the biological potential of crops, matches high-yielding crop N requirement, and controls minimal nutrient losses. Hence, to identify the optimum and cost effective nutrient management practices in different crop establishment methods a trial was planned in *rabi* 2017-18 at 2 locations (**Aduthurai and Raipur**). Experiment was laid out in split plot design in *kharif* 2017 with 3 main plots {M_1: Mechanical transplanting method (all the principles as per SRI), M_2: Direct seeding (using Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb SRI principles (saturation method of water management, weeding with cono weeder and fertilizer management) and M_3: Normal transplanting (20 x 15 cm with flood water management, 3-4 seedlings transplanted at 25-30 days old seedlings)} and 5 subplots (S_1: 100% recommended inorganic fertilizer, S_2: 75% inorganic + 25% organic equivalent N dose, S_3: 150% recommended fertilizer dose, S_4: LCC based N application and S_5: Location specific fertilizer management). In *rabi* 2017-18, the sub plots were further divided into 2 sub sub plots (F_0: without fertilizer and F_1: 100% RDF). The results were summarized below {**Table 4.2.1 (R)}**.

The interaction of *kharif* crop establishment methods, nutrient management and *rabi* nutrient management were found to be non significant with respect to *rabi* grain yield in clay soils (pH 7.2) of **Aduthurai.** Among establishment methods rice planted by transplanting recorded the highest grain yield (3.84 t/ha), however, comparable with mechanised transplanting (3.62 t/ha) and direct seeding (3.69 t/ha). Similarly, all *kharif* nutrient management treatments were equally effective in terms of grain yield and location specific nutrient management practices recorded the highest grain yield (3.81 t/ha). Application of 100% recommended dose of fertilizer in *rabi* rice resulted in the highest grain yield (4.5 t/ha) than 2.93 t/ha of no fertilizer treated plots. In terms of system productivity nutrient management in *kharif* and *rabi* season played a major role in enhancing the grain yield of rice. So, **150% RDF in kharif season followed by 100% RDF in rabi season found to be best combination** irrespective of crop establishment methods. At **Raipur**, rabi chickpea resulted the highest yield (2.33 t/ha) when it was grown after mechanized transplanted rice. Location specific nutrient management was found to be best for *rabi* chickpea. Similarly, application of 100% RDF in *rabi* season significantly enhanced the chickpea yield (2.26 t/ha) compared to those of without fertilized plots. In terms of system productivity, similar trend was observed at Raipur as that of **Aduthurai**.

Table 4.2.1(R): Summary of data on grain yield and ancillary characters of evaluation of different nutrient management practices for enhancement of the productivity in different rice establishment methods, Rabi -2017-18.

Method of crop establishment	Sub plot (Nitrogen splits)	Sub sub plot	ADUTHURAI							RAIPUR		
			Grain Yield (t/ha) Kharif 2017	Grain Yield (t/ha) Rabi 17-18	REY	Panicle No/m^2	Panicle wt (g)	Grains per panicle	Test weight(g)	Grain Yield (t/ha) Kharif 2017	Grain Yield (t/ha) Rabi 17-18	REY
M1	S1	F0- Without fertilizer	5.13	2.85	7.98	215	1.78	93	20.03	4.76	2.25	6.39
		F1- 100% of RDF	5.13	4.43	9.56	320	2.30	123	23.29		2.43	6.90
	S2	F0- Without fertilizer	4.45	2.60	7.05	204	1.73	89	19.05	4.35	2.19	6.21
		F1- 100% of RDF	4.45	4.05	8.50	303	2.17	119	21.71		2.39	6.79
	S3	F0- Without fertilizer	5.18	3.18	8.36	221	1.81	95	21.63	5.21	2.27	6.45
		F1- 100% of RDF	5.18	4.93	10.11	338	2.36	130	24.33		2.48	7.03
	S4	F0- Without fertilizer	4.65	2.75	7.40	209	1.74	89	19.12	4.58	2.15	6.10
		F1- 100% of RDF	4.65	3.98	8.63	302	2.20	121	21.81		2.33	6.62
	S5	F0- Without fertilizer	5.05	2.93	7.98	219	1.80	94	20.36	4.96	2.30	6.53
		F1- 100% of RDF	5.05	4.48	9.53	323	2.30	124	23.44		2.55	7.25
M2	S1	F0- Without fertilizer	5.30	2.90	8.20	216	1.79	94	20.10	5.00	2.20	6.26
		F1- 100% of RDF	5.30	4.50	9.80	326	2.31	123	23.59		2.41	6.85
	S2	F0- Without fertilizer	4.72	2.75	7.47	207	1.74	89	19.08	4.76	2.15	6.11
		F1- 100% of RDF	4.72	4.23	8.95	305	2.27	120	22.14		2.38	6.76
	S3	F0- Without fertilizer	5.65	3.23	8.88	222	1.84	97	21.75	5.47	2.22	6.30
		F1- 100% of RDF	5.65	5.00	10.65	342	2.37	129	24.49		2.47	7.00
	S4	F0- Without fertilizer	5.27	2.83	8.10	211	1.77	91	19.33	4.83	2.11	6.00
		F1- 100% of RDF	5.27	4.00	9.27	304	2.26	122	22.22		2.32	6.59
	S5	F0- Without fertilizer	5.50	2.93	8.43	218	1.81	96	20.48	5.19	2.30	6.52
		F1- 100% of RDF	5.50	4.58	10.08	327	2.32	125	23.52		2.52	7.15
M3	S1	F0- Without fertilizer	4.85	2.95	7.80	218	1.80	96	20.40	4.99	1.71	4.85
		F1- 100% of RDF	4.85	4.65	9.50	327	2.33	127	23.66		1.94	5.51
	S2	F0- Without fertilizer	4.30	2.80	7.10	209	1.77	91	19.14	4.69	1.63	4.63
		F1- 100% of RDF	4.30	4.43	8.73	308	2.29	123	22.20		1.87	5.32
	S3	F0- Without fertilizer	5.28	3.33	8.61	224	1.87	99	21.77	5.38	1.73	4.90
		F1- 100% of RDF	5.28	5.18	10.46	347	2.40	129	24.74		1.98	5.61
	S4	F0- Without fertilizer	4.97	2.93	7.90	213	1.79	93	19.38	4.75	1.66	4.72
		F1- 100% of RDF	4.97	4.18	9.15	310	2.30	124	22.25		1.82	5.17
	S5	F0- Without fertilizer	5.15	3.08	8.23	220	1.82	96	20.62	5.09	1.88	5.33
		F1- 100% of RDF	5.15	4.88	10.03	328	2.39	128	23.57		2.03	5.77
	Mean of M levels:											
	M1		4.89	3.62		265	2.02	108	21.48	4.77	2.33	6.63
	M2		5.29	3.69		268	2.05	109	21.67	5.05	2.31	6.55
	M3		4.91	3.84		270	2.07	110	21.77	4.98	1.82	5.18
	C.D.(0.05)		0.27	NS		NS	NS	1.94	0.15	0.11	0.080	
	SE(m)		6.85	0.09		1.67	0.01	0.56	0.04	3.54	0.020	

Table 4.2.1(R): Contd.

Method of crop establishment	Sub plot (Nitrogen splits)	Sub sub plot	ADUTHURAI							RAIPUR		
			Grain Yield (t/ha) Kharif 2017	Grain Yield (t/ha) Rabi 17-18	REY	Panicle No/M2	Panicle weight (g)	Grains per panicle	Test weight(g)	Grain Yield (t/ha) Kharif 2017	Grain Yield (t/ha) Rabi 17-18	REY
	Mean of Sub Plots:											
	S1		5.09	3.71	8.81	270	2.05	109	21.84	4.92	2.16	6.13
	S2		4.49	3.48	7.97	256	1.99	105	20.55	4.60	2.10	5.97
	S3		5.37	4.14	9.51	282	2.11	113	23.12	5.35	2.19	6.22
	S4		4.96	3.44	8.41	258	2.01	107	20.68	4.72	2.07	5.87
	S5		5.23	3.81	9.04	272	2.07	110	22.00	5.08	2.26	6.42
	C.D.(0.05)		0.19	NS		6.54	0.04	2.86	0.24	0.21	0.089	
	SE(m)		4.55	0.18		2.28	0.01	1.00	0.08	4.47	0.030	
	Mean of Sub-sub Plots:											
	F0 Without fertilizer		**-**	2.93	7.96	215	1.79	93.45	20.15	**-**	2.05	5.82
	F1 100% RDF		**-**	4.50	9.53	321	2.30	124.32	23.13	**-**	2.26	6.42
	C.D.(0.05)		**-**	NS		3.19	0.03	1.627	0.12	**-**	0.052	
	SE(m)		**-**	0.105		1.12	0.011	0.571	0.04	**-**	0.018	
	Interactions											
				NS		NS	NS	NS	NS		NS	
	Expt. Mean		**5.03**	**3.72**	**8.75**	**268**	**2.05**	**109**	**21.64**	**4.93**	**2.16**	**6.12**
	Soil type			Clay						-		
	pH			7.2						-		
	Variety			-						-	Chickpea(JG 130)	
	Location specific RDF NPK (kg/ha)			150:60:60						-		
	Availabe NPK of soil (kg/ha)			28.5:72.5:132						-		
				Rice-Rice						MSP for Chickpea Rs.4400/Q		
M1: Mechanised planting			S1:100% recommended inorganic fertilizers (120:60:40 kg NPK/ha)							Dry DSR with normal seed rate before onset of monsson		
M2: Direct seeding			S2:75% inorganic + 25% (equivalent of N dose) organic							Dry DSR after onset of monsson		
M3: Normal transplanting			S3:150% recommended fertilizer dose							Normal transplanting		
			S4:LCC based N application									
			S5:Location specific fertiliser management									

4.2.2. Water management for enhancing water use efficiency and weed control efficiency in different rice establishment methods

Increasing water scarcity is becoming real threat to rice cultivation. Hence water-saving technology needs to be developed which not only economically beneficial but also maintains soil health. Any approach that would lessen the amount of water use without compromising the rice yield would certainly be a welcome strategy. Introduction of SRI is an alternative practice to solve water crisis, and as a methodology for increasing the productivity of irrigated rice. AWD is also called 'intermittent irrigation' or 'controlled irrigation'which can reduce the water requirement by 30 % in irrigated rice system. To evaluate the suitable and promising irrigation management practices in different crop establishment methods a trial was formulated and conducted at 8 locations (**Chatha, Gangavathi, Mandya, Pantnagar, Pusa, Puducherry, ARI Rajendranagar and Varanasi**). Split plot design was adopted with 3 main plots of irrigation management {I_1: Flooding throughout crop growth (3 + / - 2 cm), I_2: Saturation maintenance upto PI and (3 + / - 2 cm) after PI and I_3: Alternate wetting and drying (irrigation at 5 -7 days interval with 5 cm/ha of water (5 cm irrigation at 3 DADPW) up to PI and (3 + / - 2 cm) after PI} and 6 subplots of crop establishment methods {T_1: Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice), T_2: Direct wet seeding on puddled soil (Use of Drum seeder/ dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice, T_3: Normal hand transplanting (20 x15 cm with flooding water management, 3-4 seedlings transplanted at 25-30 days old seedlings), T_4: Aerobic rice T_5: Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice and T_6: Optional- Location specific} and replicated thrice. The results were summarized and presented in **Table 4.2.3** and the salient findings are as followed.

In sandy clay loam soils of **Chatha**, Alternate wetting and drying recorded the highest grain yield (3.19 t/ha). Among establishment methods normal transplanting recorded the highest grain yield (3.18 t/ha). However, the lowest weed population and dry weight were observed under flooding throughout crop growth treatment. In black clay soils of **Gangavathi** direct seeding with alternate wetting and drying resulted the highest grain yield (6.78 t/ha). Among irrigation management treatments alternate wetting and drying showed better result (5.97 t/ha) with respect to grain yield than those of other treatments. Among establishment methods direct seeding resulted the highest grain yield (6.23 t/ha). Weed population count did not show a clear trend across different stages of crop. In red sandy loam soils of **Mandya**, normal transplanting with alternate wetting and drying plots registered the highest grain yield of 5.74 t/ha. Irrigation treatments had no significant effect on grain yields. Among crop establishment methods normal transplanting resulted the highest grain yield (5.25 t/ha). Similarly, weed population and weed dry weight were lowest under flooding throughout crop growth. Mechanical transplanted plots also recorded lower weed density and dry weight. In silty loam soils of **Pantnagar** effect of irrigation, establishment methods and interaction effect of both found to be non-significant on grain yield. At **Pusa** flooding throughout crop growth gave higher grain yield of 3.79 t/ha and normal transplanting was the best

(4.05 t/ha) among all the establishment methods. In **Puducherry,** alternate wetting and drying and mechanical transplanting resulted in the highest grain yield of 6.21 t/ha and 6.17 t/ha, respectively. Lower weed population and dry weight were observed in alternate wetting and drying treated plots. Mechanical transplanted plots also registered the lowest weed population and dry weight. At **ARI, Rajendranagar** effect of irrigation was found to be non-significant. Among establishment methods location specific management practices (direct broadcasting of germinated seeds on puddle soil) resulted the highest grain yield (7.58 t/ha). Weed population and dry matter did not show any clear trend. In sandy loam soils of Varanasi location specific wet seeding in puddle soil with alternate wet and drying gave the highest grain yield (4.82 t/ha). Weed population and dry weight were lower under flooding throughout crop growth treatment.

Higher cost of cultivation was recorded under flooding throughout crop growth at Gangavathi (Rs. 45110/-), Mandya (Rs. 45850/-) and Varanasi (Rs. 45850/-). Similarly, input water was saved due to adoption of alternate wetting and drying was 32.5 cm (Pantnagar), 37.6 cm (Gangavathi), 49.0 cm (Varanasi), 62.5 cm (Chatha) and 69.8 cm at Mandya.

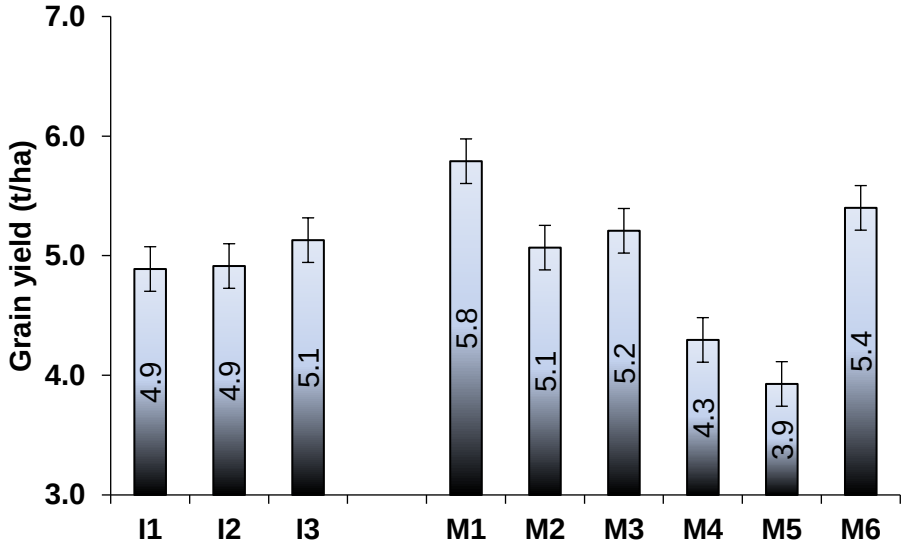


Fig 2. Mean rice grain yield as affected by irrigation management and crop establishment methods across all locations of India

Over all mean grain yield across all the centres revealed that **alternate wetting and drying** resulted the highest grain yield (5.13 t/ha) among irrigation management treatments. Five locations (Gangavathi, Puducherry and Rajendranagar) recorded higher grain yield under alternate wetting and drying than over all mean grain yield under same treatment. Similarly, among crop establishment methods **mechanical transplanting** resulted the highest grain yield (5.79 t/ha). **Mechanical transplanting recorded 11.2% higher grain than that of manual transplanting**.

Table-4.2.2: Evaluation of Water management for enhancing Water use efficiency and Weed control efficiency in different rice establishments methods, Kharif-2018

Treatment		CHATHA										
Main Plot- Irrigation management practices	Crop establishment methods	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/m² (No.)	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Weed population at active tillering (no/m²)	Weed population panicle initiation (no/m²)	Weed dry weight at active tillering (g/m2)	Weed dry weight at panicle initiation (g/m²)
	M1	-	-	-	-	-	-	-	-	-	-	-
I 1- Flooding throughout crop growth (3 +/- 2cm)	M2	2.58	4.78	233	203	1.44	18.47	101	24.00(4.95)	0.00(0.71)	23.83	0
	M3	2.92	5.53	247	218	1.47	19.07	105	20.33(4.56)	0.00(0.71)	19.5	0
	M4	2.69	5.03	242	214	1.45	18.87	101	22.67(4.81)	1.33(1.34)	20.67	0.58
	M5	2.44	4.29	211	186	1.43	18.23	101	20.00(4.53)	1.67(1.46)	18.67	0.58
	M6	-	-	-	-	-	-	-	-	-	-	-
	M1	-	-	-	-	-	-	-	-	-	-	-
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M2	2.86	5.32	235	207	1.45	19.10	97	48.33(6.99)	1.67(1.46)	45	0.75
	M3	3.14	5.68	255	221	1.52	19.40	102	45.33(6.77)	1.67(1.46)	42.33	0.83
	M4	2.93	5.43	246	214	1.52	19.23	97	45.00(6.75)	4.33(2.20)	42.33	2.92
	M5	2.63	5.00	218	190	1.44	19.00	97	46.33(6.84)	4.33(2.20)	43.33	2.95
	M6	-	-	-	-	-	-	-	-	-	-	-
	M1	-	-	-	-	-	-	-	-	-	-	-
I 3- Alternate wetting and drying	M2	3.19	5.41	241	205	1.51	19.17	93	51.00(7.18)	4.00(2.11)	48.67	2.67
	M3	3.48	5.84	259	227	1.55	19.43	102	45.67(6.79)	4.33(2.20)	42.33	2.70
	M4	3.28	5.59	249	221	1.53	19.23	93	47.67(6.94)	7.33(2.80)	45.67	4.75
	M5	2.83	5.38	221	198	1.44	19.10	92	50.67(7.15)	8.00(2.91)	47.92	5.13
	M6	-	-	-	-	-	-	-	-	-	-	-
Interaction												
I and M		NS	0.17	NS	NS	0.01	0.1	0.89	0.14	NS	1.62	0.39
M and I		NS	0.15	NS	NS	0.01	0.1	0.84	0.12	NS	1.45	0.36
Mean of Irrigation												
I1		2.66	4.91	234	205	1.45	18.66	102	21.75(4.71)	0.75(1.06)	20.67	0.29
I2		2.89	5.36	239	208	1.48	19.18	98	46.25(6.84)	3.00(1.83)	43.25	1.86
I3		3.19	5.56	242	213	1.51	19.23	95	48.75(7.02)	5.92(2.50)	46.15	3.81
C.D. (0.05)		0.04	0.05	2.07	2.05	0.01	0.06	0.55	0.05	0.12	0.63	0.19
C.V. (%)		1.74	1.36	1.2	1.36	0.63	0.44	0.77	1.14	8.99	2.38	13.51
Method of Methods												
M1		-	-	-	-	-	-	-	-	-	-	-
M2		2.88	5.17	236	205	1.47	18.91	97	41.11(6.37)	1.89(1.43)	39.17	1.14
M3		3.18	5.68	254	222	1.51	19.30	103	37.11(6.04)	2.00(1.46)	34.72	1.18
M4		2.97	5.35	246	216	1.50	19.11	97	38.44(6.17)	4.33(2.11)	36.22	2.75
M5		2.63	4.89	217	191	1.44	18.78	97	39.00(6.17)	4.67(2.19)	36.64	2.89
M6		-	-	-	-	-	-	-	-	-	-	-
CD (0.05)		0.05	0.1	4.19	2.84	0.01	0.06	0.51	0.08	0.16	0.94	0.23
C.V. (%)		1.56	1.89	1.78	1.37	0.51	0.31	0.53	1.29	9.02	2.58	11.55
Experimental Mean		**2.92**	**5.27**	**238**	**209**	**1.48**	**19.03**	**99**	**6.19**	**1.8**	**36.69**	**1.99**
Soil type		Sandy clay loam										
pH		8.03										
Variety		Basmathi - 370										
Available NPK kg/ha		245:14.3:146.3										

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Optional - Location specific

Table 4.2.2: Contd.

Treatment		GANGAVATHI									
Main Plot- Irrigation management practices	Crop establishment methods	Grain yield (t/ha)	Straw yield (t/ha)	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Weed population at active tillering (no/m2)	Weed population panicle initiation (no/m²)	Weed dry weight at active tillering (g/m2)	Weed dry weight at panicle initiation (g/m²)
I 1- Flooding throughout crop growth (3 +/- 2cm)	M1	5.82	5.00	432	2.20	14.39	105	41.33(6.46)	34.67(5.92)	16.67	18.93
	M2	6.03	4.58	523	2.13	15.41	96	124.67(11.17)	10.33(3.28)	75.63	14.60
	M3	5.34	4.17	474	2.30	14.24	105	47.00(6.88)	29.00(5.35)	24.03	16.77
	M4	5.70	4.58	399	2.57	13.93	101	20.67(4.59)	30.00(5.50)	21.17	12.23
	M5	3.64	3.75	416	3.00	14.09	101	22.00(4.71)	23.33(4.83)	12.97	10.20
	M6	-	-	-	-	-	-	-	-	-	-
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	5.90	5.42	456	2.25	14.19	105	52.67(7.27)	20.67(4.54)	17.47	13.93
	M2	5.89	5.00	516	2.89	14.87	96	45.00(6.75)	15.00(3.68)	42.03	14.27
	M3	5.65	5.42	410	2.06	14.19	106	43.67(6.63)	40.67(6.30)	17.40	11.60
	M4	5.59	5.00	503	2.73	14.23	101	45.00(6.69)	5.67(2.41)	48.70	7.80
	M5	4.51	5.00	448	2.98	15.25	101	65.00(8.06)	13.33(3.68)	51.97	6.80
	M6	-	-	-	-	-	-	-	-	-	-
I 3- Alternate wetting and drying	M1	5.22	5.83	476	2.62	13.99	106	42.00(6.50)	50.00(7.08)	28.47	26.20
	M2	6.78	5.42	428	3.70	15.19	96	44.67(6.72)	5.67(2.45)	27.13	12.07
	M3	6.29	6.25	452	2.25	14.28	105	30.67(5.56)	20.67(4.56)	11.50	20.87
	M4	6.12	6.67	422	2.89	14.31	101	28.00(5.25)	18.67(4.35)	8.47	10.87
	M5	5.45	5.83	372	2.87	14.15	101	27.00(5.24)	31.33(5.60)	11.47	10.50
	M6	-	-	-	-	-	-	-	-	-	-
Interaction											
I and M		0.74	NS	45.71	0.39	NS	NS	1.19	1.57	17.09	NS
M and I		0.67	NS	42.06	0.35	NS	NS	1.08	1.43	16.35	NS
Mean of Irrigation											
I1		5.31	4.42	449	2.44	14.41	102	51.13(6.76)	25.47(4.98)	30.09	14.55
I2		5.51	5.17	466	2.58	14.55	102	50.27(7.08)	19.07(4.12)	35.51	10.88
I3		5.97	6.00	430	2.86	14.38	102	34.47(5.85)	25.27(4.81)	17.41	16.10
C.D. (0.05)		0.16	0.24	16.95	0.09	NS	NS	0.34	NS	NS	NS
C.V. (%)		4.39	7.17	5.83	5.43	2.56	0.51	7.96	17.02	53.04	35.55
Method of Methods											
M1		5.65	5.42	455	2.36	14.19	105	45.33(6.74)	35.11(5.85)	20.87	19.69
M2		6.23	5.00	489	2.91	15.16	96	71.44(8.21)	10.33(3.13)	48.27	13.64
M3		5.76	5.28	445	2.20	14.24	105	40.44(6.36)	30.11(5.41)	17.64	16.41
M4		5.80	5.42	441	2.73	14.16	101	31.22(5.51)	18.11(4.09)	26.11	10.30
M5		4.53	4.86	412	2.95	14.49	101	38.00(6.00)	22.67(4.70)	25.47	9.17
M6		-	-	-	-	-	-	-	-	-	-
CD (0.05)		0.43	NS	26.39	0.22	0.43	0.41	0.69	0.91	9.87	6.27
C.V. (%)		7.87	11.34	6.05	8.72	3.09	0.41	10.74	20.09	36.65	46.57
Experimental Mean		**5.59**	**5.19**	**448**	**2.63**	**14.45**	**102**	**6.56**	**4.64**	**27.67**	**13.84**
Soil type		Black clay									
pH		8.20									
Variety		GGV-05-01									
Available NPK kg/ha		-									

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Optional - Location specific

Table 4.2.2: Contd.

Treatment		MANDYA										
Main Plot-Irrigation management practices	**Crop establishment methods**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Tillers/m² (No.)**	**Panicle/m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Days for 50% flowering**	**Weed population at active tillering (no/m2)**	**Weed population panicle initiation (no/m²)**	**Weed dry weight at active tillering (g/m2)**	**Weed dry weight at panicle initiation (g/m²)**
I 1- Flooding throughout crop growth (3 +/- 2cm)	M1	5.10	7.19	370	370	1.75	23.42	103	0.67(1.05)	4.33(1.97)	0.13	1.48
	M2	4.93	6.28	377	377	2.43	24.64	101	4.67(2.23)	2.83(1.80)	1.3	2.37
	M3	4.81	5.43	290	290	1.90	25.08	105	1.00(1.21)	3.33(1.91)	0.3	2.02
	M4	-	-	-	-	-	-	-	-	-		-
	M5	5.19	5.55	343	343	1.85	24.71	102	2.50(1.58)	9.33(3.13)	1.16	3.30
	M6	4.36	6.16	408	408	2.73	24.73	102	6.50(2.64)	6.33(2.56)	3.27	4.20
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	4.80	7.06	367	367	1.24	22.61	102	2.33(1.65)	4.17(1.96)	0.65	2.26
	M2	5.14	5.50	274	274	2.55	24.37	101	5.50(2.44)	8.50(2.99)	2.63	4.70
	M3	5.20	6.95	340	340	2.03	24.84	105	1.50(1.38)	1.83(1.51)	0.62	1.89
	M4	-	-	-	-	-	-	-	-	-		-
	M5	5.05	7.00	403	403	1.74	24.60	103	7.17(2.76)	11.17(3.41)	1.44	6.18
	M6	3.95	5.43	441	441	2.31	24.12	104	11.00(3.37)	8.50(3.00)	3.35	6.12
I 3- Alternate wetting and drying	M1	5.61	9.57	365	365	2.54	23.13	104	1.00(1.21)	1.50(1.41)	0.53	2.47
	M2	4.18	6.15	310	310	1.80	24.63	101	6.67(2.67)	7.17(2.74)	2.56	4.08
	M3	5.74	7.15	310	310	2.28	25.19	105	0.83(1.15)	1.83(1.47)	0.24	2.60
	M4	-	-	-	-	-	-	-	-	-		-
	M5	4.62	6.44	353	353	1.65	23.36	104	8.33(2.84)	9.17(3.00)	3.14	3.64
	M6	4.09	5.46	437	437	1.41	24.17	104	9.33(3.03)	9.00(3.07)	3.78	6.85
Interaction												
I and M		0.66	0.91	19.61	19.61	0.29	0.24	1.01	NS	NS	NS	NS
M and I		0.68	0.92	18.46	18.46	0.26	0.25	0.97	NS	NS	NS	NS
Mean of Irrigation												
I1		4.88	6.12	358	358	2.13	24.52	103	3.07(1.74)	5.23(2.27)	1.23	2.67
I2		4.83	6.39	365	365	1.98	24.11	103	5.50(2.32)	6.83(2.57)	1.74	4.23
I3		4.85	6.95	355	355	1.94	24.10	103	5.23(2.18)	5.73(2.34)	2.05	3.93
C.D. (0.05)		NS	NS	NS	NS	0.04	0.21	NS	0.27	NS	0.35	0.35
C.V. (%)		16.67	15.78	4.13	4.13	3.17	1.31	0.84	20.1	32.55	32.01	15.09
Method of Methods												
M1		5.17	7.94	367	367	1.84	23.05	103	1.33(1.31)	3.33(1.78)	0.44	2.07
M2		4.75	5.98	320	320	2.26	24.55	101	5.61(2.45)	6.17(2.51)	2.16	3.72
M3		5.25	6.51	313	313	2.07	25.04	105	1.11(1.25)	2.33(1.63)	0.39	2.17
M4		-	-	-	-	-	-	-	-	-		-
M5		4.95	6.33	366	366	1.75	24.22	103	6.00(2.39)	9.89(3.18)	1.91	4.37
M6		4.14	5.69	428	428	2.15	24.34	103	8.94(3.01)	7.94(2.88)	3.46	5.72
CD (0.05)		0.38	0.53	11.32	11.32	0.17	0.14	0.58	0.43	0.56	0.63	1.37
C.V. (%)		8.07	8.32	3.24	3.24	8.5	0.6	0.58	21.27	24.2	38.64	39.13
Experimental Mean		**4.85**	**6.49**	**359**	**359**	**2.01**	**24.24**	**103**	**2.08**	**2.39**	1.67	**3.61**
Soil type		Red Sandy loam										
pH		-										
Variety		MTU 1001										
Available NPK kg/ha		370:87:287										

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Optional - Location specific(Sprouted broadcasted rice in puddled soil)

Table 4.2.2: Contd.

Treatment		PANTNAGAR					PUSA	
Main Plot- Irrigation management practices	Crop establishment methods	Grain yield (t/ha)	Straw yield (t/ha)	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Grain yield (t/ha)	Panicle/m2 (No.)
I 1- Flooding throughout crop growth (3 +/- 2cm)	M1	-	-	-	-	-	-	-
	M2	4.97	5.31	263	2.23	24.83	3.77	215
	M3	5.25	5.32	204	3.01	25.33	4.17	223
	M4	5.14	5.42	312	1.91	24.73	3.68	214
	M5	-	-	-	-	-	3.54	207
	M6	5.05	5.26	208	2.85	24.80	-	-
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	-	-	-	-	-	-	-
	M2	5.22	5.51	267	2.30	24.80	3.43	211
	M3	5.58	5.51	215	2.99	25.13	4.06	219
	M4	5.33	5.70	323	1.93	24.73	3.32	211
	M5	-	-	-	-	-	2.95	198
	M6	5.19	5.41	211	2.78	24.79	-	-
I 3- Alternate wetting and drying	M1	-	-	-	-	-	-	-
	M2	5.14	5.27	254	2.33	24.72	3.33	209
	M3	5.25	5.39	203	2.99	25.03	3.93	217
	M4	5.16	5.52	318	1.88	24.67	3.26	207
	M5	-	-	-	-	-	2.94	199
	M6	5.08	5.30	202	2.99	24.63	-	-
Interaction								
I and M		NS	NS	NS	NS	NS	NS	NS
M and I		NS	NS	NS	NS	NS	NS	NS
Mean of Irrigation								
I1		5.10	5.33	247	2.50	24.93	3.79	215
I2		5.33	5.53	254	2.50	24.87	3.44	210
I3		5.16	5.37	244	2.55	24.76	3.37	208
C.D. (0.05)		NS	NS	NS	NS	NS	0.1	NS
C.V. (%)		6.07	5.88	4.27	5.75	1.47	4.08	5.7
Method of Methods								
M1		-	-	-	-	-	-	-
M2		5.11	5.36	261	2.29	24.78	3.51	212
M3		5.36	5.40	207	3.00	25.17	4.05	220
M4		5.21	5.55	318	1.91	24.71	3.42	211
M5		-	-	-	-	-	3.15	201
M6		5.11	5.32	207	2.87	24.74	-	-
CD (0.05)		NS	NS	15.62	0.11	NS	0.28	NS
C.V. (%)		4.36	5.21	6.35	4.39	1.8	7.97	7.86
Experimental Mean		**5.20**	**5.41**	**248**	**2.52**	**24.85**	3.53	211
Soil type		Silt loam					Silty clay	
pH		7.80					8.20	
Variety		HKR-47					Abhishek	
Available NPK kg/ha		232:21.4;223					-	

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Optional - Unpuddled transplanted

Table 4.2.2: Contd.

Treatment		PUDUCHERRY									
Main Plot- Irrigation management practices	Crop establishment methods	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/m² (No.)	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Weed population at active tillering (no/m2)	Weed population panicle initiation (no/m²)	Weed dry weight at active tillering (g/m2)	Weed dry weight at panicle initiation (g/m²)
I 1- Flooding throughout crop growth (3 +/- 2cm)	M1	5.82	8.17	448	394	3.51	21.87	36.24(6.06)	45.14(6.75)	23.73	31.44
	M2	5.21	7.82	420	340	3.16	21.35	47.08(6.90)	57.17(7.59)	34.24	43.53
	M3	5.43	7.92	428	365	3.28	21.64	41.85(6.51)	51.82(7.23)	29.54	39.00
	M4	-	-	-	-	-	-	-	-	-	-
	M5	-	-	-	-	-	-	-	-	-	-
	M6	5.72	8.01	443	385	3.44	21.83	39.76(6.34)	49.17(7.04)	26.32	36.89
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	6.22	7.47	462	408	3.70	22.24	33.74(5.85)	43.84(6.66)	20.95	28.71
	M2	5.32	6.62	416	346	3.27	21.42	43.89(6.66)	52.49(7.28)	30.27	41.02
	M3	5.73	6.88	440	378	3.52	21.57	38.20(6.22)	49.19(7.05)	26.95	36.60
	M4	-	-	-	-	-	-	-	-	-	-
	M5	-	-	-	-	-	-	-	-	-	-
	M6	6.02	7.22	446	391	3.62	21.90	36.23(6.06)	47.39(6.92)	23.05	33.45
I 3- Alternate wetting and drying	M1	6.46	8.63	476	424	4.20	22.33	29.55(5.48)	41.46(6.48)	18.61	25.63
	M2	5.86	8.19	439	373	3.86	21.83	42.94(6.59)	51.01(7.17)	29.59	34.07
	M3	6.19	8.25	457	399	4.05	22.02	37.70(6.18)	48.47(7.00)	25.88	31.03
	M4	-	-	-	-	-	-	-	-	-	-
	M5	-	-	-	-	-	-	-	-	-	-
	M6	6.32	8.21	463	411	4.11	22.16	34.60(5.92)	45.10(6.75)	22.58	29.00
Interaction											
I and M		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
M and I		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean of Irrigation											
I1		5.55	7.98	435	371	3.35	21.68	41.23(6.45)	50.82(7.16)	28.46	37.72
I2		5.82	7.05	441	381	3.53	21.78	38.01(6.20)	48.23(6.97)	25.31	34.94
I3		6.21	8.32	459	402	4.05	22.09	36.20(6.04)	46.51(6.85)	24.17	29.93
C.D. (0.05)		0.11	0.38	6.96	6.22	0.06	NS	0.04	0.05	0.34	0.73
C.V. (%)		2.57	6.69	2.16	2.23	2.23	2.14	0.96	0.96	1.79	2.95
Method of Methods											
M1		6.17	8.09	462	409	3.81	22.15	33.18(5.80)	43.48(6.63)	21.10	28.59
M2		5.46	7.54	425	353	3.43	21.54	44.64(6.72)	53.56(7.35)	31.37	39.54
M3		5.78	7.68	442	381	3.61	21.74	39.25(6.30)	49.83(7.09)	27.46	35.54
M4		-	-	-	-	-	-	-	-	-	-
M5		-	-	-	-	-	-	-	-	-	-
M6		6.02	7.81	451	396	3.72	21.96	36.86(6.11)	47.22(6.90)	23.99	33.11
CD (0.05)		0.17	0.35	11.87	10.48	0.1	NS	0.08	0.09	0.78	0.83
C.V. (%)		2.86	4.53	2.69	2.75	2.71	2.82	1.32	1.29	3.02	2.46
Experimental Mean		**5.86**	**7.78**	**445**	**385**	**3.64**	**21.85**	**6.23**	**6.99**	**25.98**	**34.20**
Soil type		Clay loam									
pH		6.62									
Variety		CO-52									
Available NPK kg/ha		324.8:36.3:200									

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Optional - Location specific

Table 4.2.2: Contd.

Treatment		RAJENDRANAGAR, ARI										
Main Plot-Irrigation management practices	**Crop establishment methods**	**Grain yield (t/ha)**	**Straw yield (t/ha)**	**Tillers/m² (No.)**	**Panicle/m² (No.)**	**Panicle wt (g)**	**Test wt (g)**	**Days for 50% flowering**	**Weed population at active tillering (no/m2)**	**Weed population panicle initiation (no/m²)**	**Weed dry weight at active tillering (g/m2)**	**Weed dry weight at panicle initiation (g/m²)**
	M1	7.25	8.77	324	292	3.86	12.93	88	45.00(6.22)	8.20(2.91)	3.24	46.88
I 1- Flooding throughout crop growth (3 +/- 2cm)	M2	8.10	9.62	301	274	4.25	12.57	86	41.10(6.23)	10.17(3.22)	2.41	65.14
	M3	7.35	7.98	196	270	3.72	13.27	86	33.53(5.41)	6.87(2.65)	2.96	99.49
	M4	-	-	-	-	-	-	-	-	-	-	-
	M5	-	-	-	-	-	-	-	-	-	-	-
	M6	7.47	8.77	312	260	3.74	13.23	85	28.30(5.35)	7.63(2.81)	4.69	67.32
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	7.37	7.87	291	280	3.85	12.70	85	78.10(8.81)	14.73(3.88)	4.47	43.01
	M2	7.70	7.12	335	316	3.37	12.37	85	32.43(5.50)	19.20(4.27)	6.34	95.86
	M3	6.10	6.57	285	261	3.40	13.33	85	55.97(7.28)	4.00(2.11)	5.48	60.75
	M4	-	-	-	-	-	-	-	-	-	-	-
	M5	-	-	-	-	-	-	-	-	-	-	-
	M6	7.53	7.27	291	252	3.43	13.43	85	76.07(8.74)	18.97(4.40)	9.25	77.37
I 3- Alternate wetting and drying	M1	7.43	6.98	263	246	3.58	13.03	86	16.33(4.06)	14.77(3.86)	4.99	74.21
	M2	8.28	7.23	293	277	3.85	13.17	87	21.30(4.55)	12.87(3.64)	4.25	83.58
	M3	7.78	8.93	319	300	3.43	12.90	87	13.53(3.74)	27.63(5.29)	5.20	74.44
	M4	-	-	-	-	-	-	-	-	-		-
	M5	-	-	-	-	-	-	-	-	-		-
	M6	7.75	7.98	305	287	4.03	13.67	85	28.77(4.90)	14.60(3.88)	7.05	95.33
Interaction												
I and M		NS	NS	NS	NS	NS	NS	NS	NS	1.16	NS	NS
M and I		NS	NS	NS	NS	NS	NS	NS	NS	1.03	NS	NS
Mean of Irrigation												
I1		7.54	8.78	283	274	3.89	13.00	86	36.98(5.80)	8.22(2.90)	171.16	3.33
I2		7.17	7.20	301	277	3.51	12.96	85	60.64(7.58)	14.22(3.67)	6.39	6.39
I3		7.81	7.78	295	278	3.72	13.19	86	19.98(4.31)	17.47(4.17)	5.37	5.37
C.D. (0.05)		NS	NS	NS	NS	0.16	NS	NS	1.54	0.4	NS	0.66
C.V. (%)		17.15	17.1	24.03	15.99	5.9	3.95	1.23	36.07	15.46	551.47	18.05
Method of Methods												
M1		7.35	7.87	292	273	3.76	12.89	87	46.48(6.36)	12.57(3.55)	4.23	4.23
M2		8.03	7.99	310	289	3.82	12.70	86	31.61(5.43)	14.08(3.71)	228.11	4.33
M3		7.08	7.83	267	277	3.52	13.17	86	34.34(5.47)	12.83(3.35)	4.55	4.55
M4		-	-	-	-	-	-	-	-	-	-	-
M5		-	-	-	-	-	-	-	-	-	-	-
M6		7.58	8.01	302	266	3.73	13.44	85	44.38(6.33)	13.73(3.70)	7.00	7.00
CD (0.05)		0.59	NS	NS	NS	NS	NS	0.73	NS	NS	NS	1.12
C.V. (%)		7.97	17.47	17.38	10.52	7.63	6.32	0.86	32.92	18.91	550.31	22.52
Experimental Mean		**7.51**	**7.92**	**293**	**276**	**3.71**	**13.05**	**86**	**5.9**	**3.58**	**60.97**	**5.03**
Soil type		Loamy										
pH		7.70										
Variety		RNR 15048										
Available NPK kg/ha		213:108:781										

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Optional - Location specific: direct broadcasting of germinated seed on puddled soil

Table 4.2.2: Contd.

Treatment		VARANASI									Over all Mean	Rank
Main Plot- Irrigation management practices	Crop establishment methods	Grain yield (t/ha)	Straw yield (t/ha)	Tillers/m² (No.)	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days for 50% flowering	Weed population at active tillering (no/m2)	Weed dry weight at active tillering (g/m2)		
I 1- Flooding throughout crop growth (3 +/- 2cm)	M1	4.44	5.83	305	235	3.39	20.75	96	8.62(3.02)	9.42	5.69	3
	M2	4.46	5.85	311	239	3.55	21.11	96	8.48(3.00)	9.29	5.01	12
	M3	-	-	-	-	-	-	-	-	-	5.04	11
	M4	4.49	6.25	269	207	3.51	19.85	95	9.66(3.19)	11.04	4.34	13
	M5	4.22	5.61	303	233	3.58	20.44	95	11.05(3.40)	12.15	3.81	18
	M6	3.77	5.14	279	214	3.69	19.31	94	9.55(3.17)	10.55	5.27	7
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	4.59	6.09	325	250	3.72	21.21	94	10.05(3.25)	11.91	5.78	2
	M2	4.76	6.34	291	224	3.69	20.90	92	9.38(3.14)	10.56	5.04	10
	M3	-	-	-	-	-	-	-	-	-	5.07	9
	M4	3.95	5.50	304	234	3.17	19.07	93	10.39(3.30)	12.02	4.22	15
	M5	4.44	5.98	295	227	3.62	20.00	93	13.50(3.74)	15.24	3.92	17
	M6	3.86	5.32	310	239	3.78	21.47	94	9.30(3.13)	11.16	5.31	6
I 3- Alternate wetting and drying	M1	4.79	6.34	364	280	3.61	22.03	93	7.43(2.81)	8.32	5.90	1
	M2	4.49	5.89	364	280	3.12	20.93	92	8.49(3.00)	9.79	5.16	8
	M3	-	-	-	-	-	-	-	-	-	5.52	5
	M4	3.80	5.24	275	212	3.47	21.34	93	9.82(3.21)	10.99	4.32	14
	M5	4.48	5.98	317	243	3.59	21.33	91	12.45(3.60)	14.10	4.06	16
	M6	4.82	6.68	315	242	3.07	20.23	92	9.40(3.15)	11.15	5.61	4
Interaction												
I and M		0.14	0.14	22.01	16.93	NS	0.5	NS	0.08	0.55		
M and I		0.13	0.13	21.15	16.27	NS	0.45	NS	0.08	0.51		
Mean of Irrigation												
I1		4.28	5.74	293	226	3.54	20.29	95	9.47(3.15)	10.49	4.89	3
I2		4.32	5.85	305	235	3.60	20.53	93	10.52(3.31)	12.18	4.91	2
I3		4.48	6.03	327	252	3.37	21.17	92	9.52(3.15)	10.87	5.13	1
C.D. (0.05)		0.06	0.07	12.62	9.71	NS	0.14	0.89	0.04	0.22		
C.V. (%)		2.23	1.84	6.31	6.31	11.66	1.07	1.47	1.75	3.06		
Method of Methods												
M1		4.61	6.09	332	255	3.57	21.33	95	8.70(3.03)	9.88	5.79	1
M2		4.57	6.03	322	248	3.45	20.98	93	8.78(3.05)	9.88	5.07	4
M3		-	-	-	-	-	-	-	-	-	5.21	3
M4		4.08	5.66	283	217	3.38	20.09	94	9.95(3.23)	11.35	4.30	5
M5		4.38	5.86	305	234	3.60	20.59	93	12.33(3.58)	13.83	3.93	6
M6		4.15	5.71	301	232	3.51	20.34	93	9.42(3.15)	10.95	5.40	2
CD (0.05)		0.08	0.08	12.71	9.78	NS	0.29	NS	0.05	0.32		
C.V. (%)		1.86	1.4	4.23	4.23	7.23	1.42	1.23	1.51	2.91		
Experimental Mean		**4.36**	**5.87**	**308**	**237**	**3.50**	**20.66**	**94**	**3.21**	**11.18**	4.98	
Soil type		Sandy loam										
pH		7.38										
Variety		-										
Available NPK kg/ha		238.55:19.43:186.34										

M1- Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice)
M2- Direct seeding (Use of Drum seeder/dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice
M3- Normal Transplanting (20 x 15 cm with flooding water management, transplanting of 3-4 seedlings of 25-30 days old
M4-Aerobic rice
M5- Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice (semi dry)
M6- Wet seeding on puddled soil (Broadcasting)

Table 4.2.2: Contd.

Treatment		Cost of cultivation				Total Water Input mm/ha					
Main Plot- Irrigation management practices	**Crop establishment methods**	**CHT**	**GNV**	**MND**	**VRN**	**CHT**	**GNV**	**MND**	**PNT**	**PDC**	**VRN**
I 1- Flooding throughout crop growth (3 +/- 2cm)	M1	-	48383	48065	38485	-	1475	1791	-	42175	1420
	M2	32000	42879	44840	33385	1800	1475	1859	500	40505	1420
	M3	45000	49430	49365	32972	2100	1475	1929	400	44625	1420
	M4	36000	42804	-	30485	1800	1475	-	600	-	1420
	M5	34000	42054	42390	31885	1800	1475	1756	-	-	1420
	M6	-	-	44590	-	-	-	1859	600	49950	
I 2- Saturation maintenance upto PI and (3 +/- 2 cm) after PI	M1	-	48083	45865	38145	-	1270	1329	-	42175	1180
	M2	36000	42579	42640	33045	1500	1270	1399	300	40505	1180
	M3	44000	49130	47165	32632	1700	1270	1469	200	44625	1180
	M4	35000	42504	-	30145	1500	1270	-	400	-	1180
	M5	33000	41754	40190	31545	1500	1270	1299	-	-	1180
	M6	-	-	42390	-	-	-	1399	400	49950	-
I 3- Alternate wetting and drying	M1		47883	44265	37805	-	1098	1088	-	42175	930
	M2	34000	42379	41040	32705	1200	1098	1161	200	40505	930
	M3	42000	48930	45565	32292	1400	1098	1233	300	44625	930
	M4	33000	42304	-	29805	1200	1098	-	100	-	930
	M5	31000	41554	38590	31205	1200	1098	1062	-	-	930
	M6	-	-	40790	-	-	-	1160	200	49950	-
Interaction											
I and M											
M and I											
Mean of Irrigation											
I1		36750	45110	45850	33443	1875	1475	1839	525	44314	1420
I2		37000	44810	43650	33103	1550	1270	1379	325	44314	1180
I3		35000	44610	42050	32763	1250	1098	1141	200	44314	930
C.D. (0.05)											
C.V. (%)											
Method of Methods											
M1		-	48116	46065	38145	-	1281	1403	-	42175	1177
M2		34000	42612	42840	33045	1500	1281	1473	333	40505	1177
M3		43667	49163	47365	32632	1733	1281	1543	300	44625	1177
M4		34667	42537	-	30145	1500	1281	-	367	-	1177
M5		32667	41787	40390	31545	1500	1281	1372	-	-	1177
M6		-	-	42590	-	-	-	1473	400	49950	-
CD (0.05)											
C.V. (%)											
Experimental Mean		**36250**	**44843**	**43850**	**33103**	**1558**	**1281**	**1453**	**350**	**44314**	**1177**

4.2.2(R). Evaluation of different irrigation management practices for their water saving potential and enhancement of the productivity and profitability in different rice establishments methods

To evaluate the suitable and promising irrigation management practices in different crop establishment methods a trial was formulated and continued at **Puducherry**. Split plot design was adopted with 3 main plots of irrigation management {I_1: Flooding throught crop growth (3 + / - 2 cm), I_2: Saturation maintenance upto PI and (3 + / - 2 cm) after PI and I_3: Alternate wetting and drying (irrigating at 5 -7 days interval with 5 cm/ha of water (5 cm irrigation at 3 DADPW) up to PI and (3 + / - 2 cm) after PI} and 6 subplots of crop establishment methods {T_1: Mechanical Transplanting method on puddled soil (crop management methods same as for puddled transplanted rice), T_2: Direct wet seeding on puddled soil (Use of Drum seeder/ dibbling of sprouted seed at 25 x 25 cm) fb crop management practices as per direct wet seeded rice, T_3: Normal manual transplanting (20 x15 cm with flooding water management, 3-4 seedlings transplanted at 25-30 days old seedlings), T_4: Direct drill seeding by (Happy) seeder on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice, T_5: Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice and T_6: Optional- Location specific} and replicated thrice. The results were summarized and presented in **Table 4.2.2(R)** and the salient findings are given below.

At **Puducherry**, interaction effect of irrigation management and crop establishment methods on grain yield of RNR 15048 was found to be non-significant. Similarly, among irrigation management practices alternate wetting and drying method recorded the highest grain yield (6.88 t/ha). Among establishment methods the highest grain yield (6.17 t/ha) was recorded under mechanical transplanting on puddle soil. Grasses and sedges population were higher under flooding throughout crop growth compared to those under saturation maintenance upto PI and after PI and lowest under alternate wetting and drying. Total weed dry matter also followed the similar trend. Total water input was the highest in flodding through out crop growth treated plots (1475 mm/ha), which were 100 and 200 mm higher than saturation maintenance upto PI and after PI and alternate wetting and drying treated plots, respectively. Among crop establishment methods, the lowest water input was recorded in direct broadcast of dry seeds on well prepared unpuddled soil treatments (1396 mm/ha). The cost of cultivation was same (Rs. 42213/ha) under all three irrigation management treatments. However, among crop establishment methods, the lowest cost of cultivation was recorded in direct broadcast of dry seeds on well prepared unpuddled soil treatments (Rs. 40151/ha).

Table 4.2.2(R): Summary of data on grain yield and ancillary characters of evaluation of different irrigation practices for water saving potential and enhancement of the productivity in different rice establishment methods, Rabi-2017-18

Irrigation methods	Establishment methods	PUDEUCHERRY								Rank
		Grain Yield (t/ha)	Panicle Weight (g)	Weed Population /m2			Weed dry matter (g/m2)	Water Input(mm/ ha)	Cost of cultivation (Rs/ ha)	
				Grasses	Sedges	BLW				
I1	S1	6.04	3.12	12.33(3.58)	8.33(2.97)	7.67(2.85)	30.47	1494	42775	*3*
	S2	5.40	2.69	16.67(4.14)	14.00(3.81)	8.33(2.97)	39.09	1431	40901	*10*
	S3	5.73	2.81	16.00(4.06)	12.67(3.62)	7.67(2.85)	37.87	1569	45026	*6*
	S5	5.30	2.58	20.00(4.53)	15.00(3.94)	9.00(3.08)	43.41	1406	40151	*12*
I2	S1	6.15	3.22	11.67(3.49)	7.00(2.72)	6.33(2.61)	28.62	1484	42775	*2*
	S2	5.45	2.75	16.67(4.14)	13.00(3.67)	8.00(2.91)	35.27	1421	40901	*9*
	S3	5.85	2.99	15.33(3.98)	13.00(3.67)	7.33(2.79)	34.88	1559	45026	*5*
	S5	5.38	2.63	19.67(4.49)	14.00(3.81)	8.67(3.03)	38.48	1396	40151	*11*
I3	S1	6.31	3.48	9.67(3.19)	6.67(2.68)	5.00(2.34)	25.85	1474	42775	*1*
	S2	5.66	3.25	16.00(4.06)	11.00(3.39)	7.33(2.79)	30.51	1411	40901	*7*
	S3	5.96	3.33	14.00(3.81)	9.00(3.08)	7.00(2.73)	29.9	1549	45026	*4*
	S5	5.57	3.17	18.33(4.34)	10.00(3.24)	8.00(2.91)	33.55	1386	40151	*8*
Interaction										
N at same V		NS	NS	NS	NS	NS	NS	-	-	
V at same N		NS	NS	NS	NS	NS	NS	-	-	
Irrigation management										
I1		5.62	2.80	16.25(4.08)	12.50(3.58)	8.17(2.94)	37.71	1475	42213	*3*
I2		5.71	2.90	15.83(4.02)	11.75(3.47)	7.58(2.83)	34.31	1465	42213	*2*
I3		5.88	3.31	14.50(3.85)	9.17(3.10)	6.83(2.69)	29.95	1455	42213	*1*
C.D.(0.05)		0.07	0.05	0.03	0.05	NS	0.4	-	-	
C.V.(%)		1.71	2.21	0.88	1.89	7.69	1.64	-	-	
Crop establishment methods										
S1		6.17	3.27	11.22(3.42)	7.33(2.79)	6.33(2.60)	28.31	1484	42775	*1*
S2		5.50	2.90	16.44(4.12)	12.67(3.62)	7.89(2.89)	34.96	1421	40901	*3*
S3		5.85	3.04	15.11(3.95)	11.56(3.46)	7.33(2.79)	34.22	1559	45026	*2*
S5		5.42	2.79	19.33(4.45)	13.00(3.66)	8.56(3.01)	38.48	1396	40151	*4*
C.D.(0.05)		0.32	0.13	0.1	0.13	0.21	1.65	-	-	
C.V.(%)		5.61	4.25	2.47	3.87	7.6	4.89	-	-	
Expt. Mean		**5.73**	**3.00**	3.98	3.38	2.82	**33.99**	**1465**	**42213**	
Soil type		-								
pH		6.1								
Variety		RNR 15048								
Location specific RDF NPK (kg/ha)		12:40:40								
Available NPK of soil (kg/ha)		134:20.7:60.5								

S1:Mechanical Transplanting on puddled soil (Crop management methods same as for puddled transplanted rice)
S2:Direct wet seeding on puddled soil (Use of Drum seeder/dibbling of sprouted seed at 25x25)fb crop management practices as per direct wet seeded rice
S3:Manual Transplanting (20X15 cm with flooding water management, 3-4 seedlings transplanted at 25-30 days old)
S4:direct drill seeding by (Happy) seeder on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice
S5:Direct broadcast dry seeding on well prepared unpuddled soil fb crop management practices for direct dry drill seeded rice
S6: Optional -Location Specific

I1 -Flooding throughout crop growth (3+/-2cm)
I2-Saturation maintenance upto PI and (3+/-2cm) after PI
I3 - Alternate wetting and drying

4.2.3. Enhancing the productivity of direct seeded rice with iron coating under different rice ecologies

Seed treatment of soaking, incubation, and drying increases the germination rate of rice even at low temperatures or under anoxia and that the treatment is effective not only in Japonica but also in Indica cultivars (Yamauchi, 2002; Mori et al., 2012). Andoh and Kobata (2002) reported that seeds that had been soaked and then dried have increased a-amylase activity and a high germination rate. Thus, the treatment of soaking, incubation, and drying is a useful priming method. Primed rice seeds could be utilized in direct seeding in lieu of pre-germinated seeds. The high density Fe-coated seeds are resistant to birds and seedborne diseases. Iron-coated seeds exhibit improved anchorage in water seeding in puddled fields. Hence, the field trial was initiated to study effect of Fe-coating on growth and yield parameters of rice. The trial was laid out in split plot design at 6 locations (**ICAR-IIRR, Coimbatore, Chiplima, Karjat, Maruteru and Raipur**) with 4 date of sowings with one week interval as main plots and 5 establishment methods (T_1- Iron coated seed, seed rate 25 kg/ha, broadcasting in 1-2 mm water level condition (Direct sowing) T_2- Iron coated seed, seed rate 25 kg/ha, broadcasting in wet Condition (Direct sowing) T_3 – Un-coated seed, seed rate 25 kg/ha, broadcasting in 1-2mm water level condition (Direct sowing) T_4 – Un-coated seed, seed rate 25 kg/ha, broadcasting in wet condition (Direct sowing) T_5 – Normal transplanting 21-25 days after sowing as subplots in 3 replications. At **Maruteru**, establishment was poor due to heavy rainfall during sowing time.

At **ICAR-IIRR**, 1st date of sowing (04.07.2018) and 2nd date of sowing (11.07.2018) recorded similar grain yield (4.35 t/ha). However, normal transplanting of rice (5.69 t/ha) outperformed all the iron coated treatments. Similarly, germination was not affected due to delay in sowings. Iron coated seeds broadcasted in 1-2 mm water level condition showed better germination (110 seedling/m^2) than non iron coated treatment. At **Coimbatore**, 1st date of sowing (01.09.2018) resulted the highest grain yield (4.55 t/ha) than those of delayed sowings. There was significant reduction in grain yield due to delay of one week for sowing. The more sowing was delayed the more was yield loss. However, transplanting method showed it superiority (5.46 t/ha) over all other treatments including iron coating treatment. At **Chiplima** also 1st date of sowing (27.07.2018) showed best result in terms of grain yield (4.71 t/ha) compared to those of other delayed date of sowings. Iron coating did not result in higher grain yield over without iron coating (normal transplanting). Similar effect of date of sowing on grain yield was also observed at **Karjat**. The highest grain yield was recorded at 1st date of sowing (4.5 t/ha). Iron coated and broadcasted on 1-2 mm water level resulted higher grain yield (4.13 t/ha) closely followed by transplanting method (4.11 t/ha). Similar yield trend was observed among date of sowing treatments at **Raipur**. The highest was 5.55 t/ha at 1st date of sowing (18.07.2018). Iron coated and broadcasted in wet condition resulted in the highest grain yield (4.79 t/ha). Over all mean grain yield across all the 5 locations revealed that **1st date of sowing was the best time of sowing for all the locations resulting the highest yield of rice (4.18 t/ha)** followed by 2nd(4.29 t/ha), 3rd (4.01 t/ha) and 4th (3.4 t/ha) date of sowing. Iron coated treatments performed better than without coated treatments.

Iron coated seed with seed rate of 25 kg/ha and broadcasted in 1-2 mm water level condition (direct sowing) recorded higher grain yield (4.18 t/ha) than 3.44 t/ha under uncoated seeds. **There is an increase of 11% grain yield due to iron coating of seeds**.

Major pest and diseases were listed below location wise.

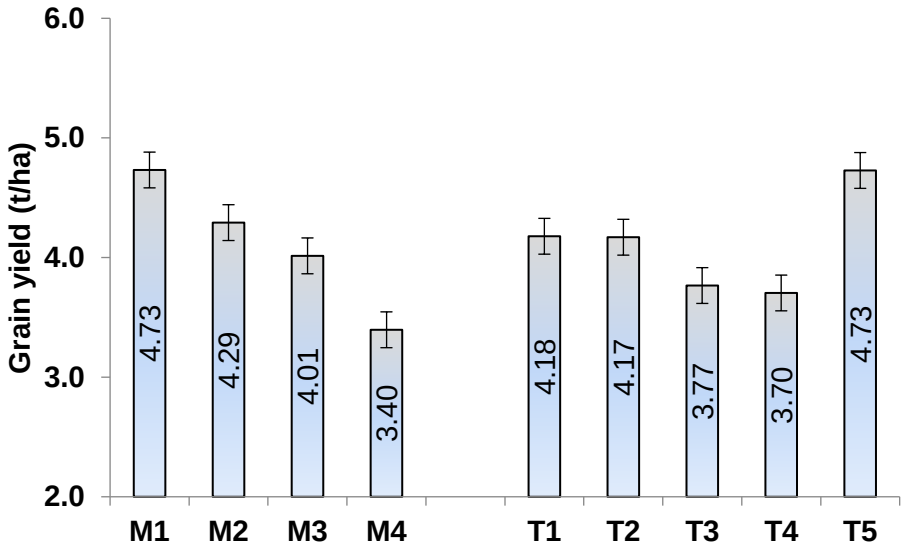


Fig 3. Mean rice grain yield as affected by date of sowings and iron coatings across all locations of India

Table 4.2.3: Enhancing the productivity of Direct seeded rice with Iron coating under different rice ecologies, Kharif-2018.

Main methods	Treatments	COIMBATORE						CHIPLIMA				
		Plant height (cm)	No of tillers/m2	No of panicles/m2	Panicle wt (g)	Grain Yield (t/ha)	Straw Yield (t/ha)	No of panicles/m2	Panicle wt (g)	Days for 50% Flowering	Test wt (g)	Grain Yield (t/ha)
1st sowing	T1	83.10	375	335	2.74	4.70	6.65	259	4.69	98	25.61	4.54
	T2	81.57	353	318	2.41	4.41	6.46	265	4.52	97	26.26	4.89
	T3	75.47	336	300	2.17	4.06	5.60	274	4.18	98	25.89	4.57
	T4	72.77	334	298	2.31	3.85	5.22	273	4.07	97	24.29	5.02
	T5	87.10	408	369	2.79	5.73	7.75	306	4.38	106	23.71	4.53
2nd sowing	T1	81.97	363	323	2.71	4.42	6.48	209	3.85	99	24.44	3.42
	T2	79.37	368	311	2.45	4.07	6.30	221	4.14	100	25.79	3.60
	T3	75.00	340	301	2.40	3.83	5.30	239	4.07	98	26.17	3.85
	T4	73.40	317	282	2.27	3.63	5.19	243	4.16	98	25.93	4.06
	T5	85.43	381	336	2.78	5.54	7.66	251	4.30	109	26.32	4.10
3rd sowing	T1	80.30	338	305	2.47	4.20	6.34	171	3.91	102	22.76	3.17
	T2	79.23	333	294	2.28	4.00	6.23	178	4.00	103	26.04	3.49
	T3	73.67	326	289	2.24	3.84	5.22	196	3.69	104	25.99	3.68
	T4	71.60	313	277	2.19	3.71	5.14	162	3.49	104	26.71	3.19
	T5	85.30	371	325	2.55	5.42	7.52	203	4.33	110	25.59	3.91
4th sowing	T1	80.03	328	289	2.39	4.11	6.25	164	3.75	107	25.20	2.88
	T2	78.87	315	285	2.24	3.86	5.99	157	3.32	106	23.56	2.89
	T3	73.43	302	270	2.19	3.67	5.21	141	3.97	106	23.65	2.96
	T4	70.73	295	264	2.16	3.53	5.07	154	3.57	106	25.31	3.00
	T5	83.63	350	308	2.46	5.16	7.37	178	3.80	113	25.94	3.04
Interaction												
M and T		NS	NS	NS	NS	NS	NS	NS	NS	1.72	1.27	NS
T and M		NS	NS	NS	NS	NS	NS	NS	NS	1.74	1.24	NS
Mean of Main methods												
M1		80.00	361	324	2.48	4.55	6.34	275	4.37	99	25.15	4.71
M2		79.03	354	311	2.52	4.30	6.18	233	4.10	101	25.73	3.81
M3		78.02	336	298	2.34	4.23	6.09	182	3.88	105	25.42	3.49
M4		77.34	318	283	2.29	4.07	5.98	159	3.68	108	24.73	2.95
CD(0.05)		0.86	6.65	8.01	0.11	0.17	0.03	37.25	0.24	1.04	0.64	0.39
CV(%)		1.22	2.17	2.95	4.95	4.37	0.60	19.64	6.71	1.13	2.82	11.78
Mean of Sub methods												
T1-Fe coated 1-2 cm water level		81.35	351	313	2.58	4.36	6.43	201	4.05	102	24.51	3.50
T2-Fe coated wet		79.76	342	302	2.34	4.08	6.24	206	3.99	102	25.41	3.72
T3-Non coated 1-2 cm water level		74.39	326	290	2.25	3.85	5.33	213	3.98	101	25.42	3.77
T4-Non coated wet		72.13	315	280	2.23	3.68	5.15	208	3.82	101	25.56	3.82
T5-NTP		85.37	377	335	2.65	5.46	7.58	234	4.20	110	25.39	3.89
CD(0.05)		0.89	8.48	7.20	0.11	0.14	0.12	19.42	NS	0.86	0.63	NS
CV(%)		1.37	3.00	2.87	5.54	4.08	2.35	11.09	7.41	1.01	3.04	10.54
Experimental Mean		78.60	342	304	2.41	4.29	6.15	212	4.01	103	25.26	3.74

	DOS	Rain fall for specific week	DOS	Rain fall for specific week
***DOS(Date of Sowing)**	01.09.18	0.0	27.07.18	-
	08.09.18	0.0	04.08.18	-
	15.09.18	0.0	13.08.18	-
	22.09.18	0.0	20.08.18	-

Table 4.2.3: Contd.

Main methods	Treatments	IIRR									
		Plant height (cm)	No of tillers/m2	No of panicles/m2	Panicle length (cm)	Panicle wt (g)	Days for 50% Flowering	Germinated seedlings/m2	Grain Yield (t/ha)	Straw Yield (t/ha)	Harvest Index
1st sowing	T1	99.74	337	316	23.23	4.91	93.33	121	5.00	5.58	47.22
	T2	96.03	440	413	23.40	4.62	93.67	113	4.65	5.29	46.79
	T3	96.14	121	114	23.50	4.03	95.00	85	3.24	3.67	46.78
	T4	89.89	108	105	23.50	4.09	95.67	77	2.97	3.43	46.38
	T5	100.29	348	324	22.80	4.51	97.67	108	5.87	6.55	47.27
2nd sowing	T1	94.64	758	698	20.67	5.20	93.00	109	4.77	5.35	47.14
	T2	91.22	636	569	20.62	4.06	93.33	109	4.65	5.01	48.17
	T3	98.88	293	276	22.12	4.16	94.00	86	3.40	3.78	47.27
	T4	90.87	208	195	22.14	3.81	94.67	81	3.10	3.42	47.67
	T5	99.09	299	284	22.38	4.18	97.33	108	5.86	6.43	47.66
3rd sowing	T1	102.14	377	371	23.04	3.53	94.33	112	4.62	5.08	47.61
	T2	96.49	295	284	23.07	4.59	94.33	106	4.50	4.96	47.57
	T3	104.26	191	187	23.50	4.34	95.00	90	3.46	3.86	47.23
	T4	103.89	223	208	22.72	4.42	95.33	86	3.07	3.49	46.78
	T5	100.49	299	292	22.93	4.49	97.00	108	5.68	6.23	47.68
4th sowing	T1	89.32	261	249	22.14	4.45	94.33	100	3.93	4.36	47.40
	T2	105.67	352	338	23.14	4.52	93.67	95	3.85	4.25	47.54
	T3	102.64	304	294	22.54	4.32	96.00	83	3.32	3.70	47.30
	T4	100.91	303	295	23.63	4.68	95.67	77	3.28	3.70	46.98
	T5	101.40	359	348	21.89	5.05	97.67	108	5.34	5.94	47.31
Interaction											
M and T		7.62	144.28	136.7	NS	0.36	NS	NS	NS	NS	NS
T and M		7.11	145.1	136.1	NS	0.37	NS	NS	NS	NS	NS
Mean of Main methods											
M1		96.42	271	254	23.29	4.43	95.07	101	4.35	4.90	46.89
M2		94.94	439	404	21.59	4.28	94.47	98	4.35	4.80	47.58
M3		101.45	277	268	23.05	4.28	95.20	100	4.26	4.72	47.37
M4		99.99	316	305	22.67	4.60	95.47	92	3.95	4.39	47.31
CD(0.05)		2.58	86	77	NS	NS	0.45	NS	0.30	NS	NS
CV(%)		2.94	29	28	6.36	6.36	0.53	10.84	7.99	10.67	2.24
Mean of Sub methods											
T1-Fe coated 1-2 cm water level		96.46	433	408	22.27	4.52	93.75	110	4.58	5.09	47.34
T2-Fe coated wet		97.35	431	401	22.56	4.45	93.75	106	4.41	4.88	47.52
T3-Non coated 1-2 cm water level		100.48	227	218	22.92	4.21	95.00	86	3.35	3.75	47.15
T4-Non coated wet		96.39	210	201	23.00	4.25	95.33	80	3.11	3.51	46.95
T5-NTP		100.32	326	312	22.50	4.56	97.42	108	5.69	6.29	47.48
CD(0.05)		NS	72	68	NS	0.18	0.65	5.44	0.31	0.31	NS
CV(%)		4.7	26.86	26.9	5.25	4.91	0.83	6.73	8.9	8.08	1.99
Experimental Mean		**98.2**	**326**	**308**	**22.65**	**4.4**	**95.05**	**98**	**4.23**	**4.7**	**47.29**

	DOS	Rain fall for specific week
	04.07.18	16.8
***DOS(Date of Sowing)**	11.07.18	64.0
	18.07.18	7.4
	26.07.18	0.0

Table 4.2.3: Contd.

Main methods	Treatments	KARJAT							
		Plant height (cm)	No of tillers/m2	No of panicles/m2	Panicle wt (g)	Days for 50% Flowering	Test wt (g)	Grain Yield (t/ha)	Straw Yield (t/ha)
1st sowing	T1	87.87	318	301	3.30	111	17.46	4.88	6.64
	T2	88.60	301	286	2.95	111	17.45	4.62	6.29
	T3	88.07	272	257	2.41	110	17.41	4.17	5.67
	T4	89.93	258	244	2.17	110	17.40	3.96	5.38
	T5	89.67	319	302	3.30	111	17.46	4.89	6.64
2nd sowing	T1	77.80	291	267	2.76	111	17.43	4.47	6.25
	T2	80.67	276	253	2.48	111	17.43	4.23	5.93
	T3	80.47	245	225	1.95	110	17.39	3.76	5.26
	T4	79.40	231	212	1.73	109	17.38	3.54	4.95
	T5	78.07	292	268	2.77	111	17.43	4.47	6.26
3rd sowing	T1	84.73	256	243	2.14	111	17.43	3.93	5.62
	T2	81.20	241	228	1.89	111	17.43	3.70	5.28
	T3	82.73	210	199	1.43	110	17.39	3.21	4.60
	T4	83.13	197	187	1.27	110	17.38	3.03	4.33
	T5	77.20	257	243	2.14	111	17.43	3.93	5.63
4th sowing	T1	79.60	212	206	1.45	110	17.37	3.24	4.73
	T2	85.13	184	180	1.10	110	17.32	2.83	4.12
	T3	79.47	172	168	0.96	110	17.30	2.64	3.85
	T4	80.53	159	156	0.83	109	17.28	2.45	3.57
	T5	82.87	205	200	1.36	111	17.36	3.13	4.58
Interaction									
M and T		NS	NS	NS	0.20	NS	NS	NS	NS
T and M		NS	NS	NS	0.19	NS	NS	NS	NS
Mean of Main methods									
M1		88.83	294	278	2.83	111	17.44	4.50	6.12
M2		79.28	267	245	2.34	110	17.41	4.09	5.73
M3		81.80	232	220	1.77	111	17.41	3.56	5.09
M4		81.52	186	182	1.14	110	17.33	2.86	4.17
CD(0.05)		2.81	3.61	3.18	0.07	NS	0.01	0.05	0.07
CV(%)		3.79	1.65	1.54	3.72	0.49	0.08	1.53	1.54
Mean of Sub methods									
T1-Fe coated 1-2 cm water level		82.50	269	254	2.41	111	17.42	4.13	5.81
T2-Fe coated wet		83.90	251	237	2.10	111	17.41	3.85	5.40
T3-Non coated 1-2 cm water level		82.68	225	212	1.69	110	17.37	3.45	4.84
T4-Non coated wet		83.25	211	200	1.50	109	17.36	3.24	4.56
T5-NTP		81.95	268	253	2.39	111	17.42	4.11	5.78
CD(0.05)		NS	6.25	5.96	0.10	0.85	0.02	0.10	0.13
CV(%)		3.72	3.09	3.12	6.06	0.93	0.15	3.07	3.09
Experimental Mean		82.86	245	231	2.02	110	17.40	3.75	5.28

	DOS	**Rain fall for specific week**
	01.07.18	0.0
***DOS(Date of Sowing)**	08.07.18	0.0
	15.07.18	0.0
	22.07.18	0.0

Table 4.2.3: Contd.

Main methods	Treatments	RAIPUR					Over all Mean	Rank
		Plant height (cm)	Panicle wt (g)	Test wt (g)	Grain Yield (t/ha)	Straw Yield (t/ha)		
1st sowing	T1	85.37	2.67	19.40	5.19	8.15	4.86	3
	T2	87.80	2.79	19.10	5.32	8.15	4.78	4
	T3	87.60	2.77	18.97	5.92	7.72	4.39	6
	T4	85.60	2.82	19.17	6.08	7.69	4.38	8
	T5	81.40	2.61	19.23	5.23	8.16	5.25	1
2nd sowing	T1	80.80	2.40	19.17	4.82	9.29	4.38	7
	T2	84.27	2.45	18.83	5.20	9.19	4.35	9
	T3	82.93	2.33	18.63	4.80	8.50	3.93	13
	T4	83.07	2.43	18.90	5.10	9.07	3.89	14
	T5	77.13	2.34	18.63	4.63	8.57	4.92	2
3rd sowing	T1	74.13	2.16	18.50	4.41	5.30	4.07	11
	T2	75.20	2.32	18.43	4.95	6.23	4.13	10
	T3	74.87	2.14	18.30	4.32	5.07	3.70	15
	T4	78.40	2.41	18.50	4.52	5.74	3.50	16
	T5	72.60	2.27	18.57	4.43	5.66	4.67	5
4th sowing	T1	63.73	2.01	18.20	2.84	3.08	3.40	18
	T2	67.40	2.11	18.03	3.68	4.42	3.42	17
	T3	63.07	2.01	18.03	2.61	3.01	3.04	20
	T4	66.73	2.07	18.03	2.98	3.56	3.05	19
	T5	66.47	2.05	17.80	3.64	4.10	4.06	12
Interaction								
M and T		NS	NS	NS	0.40	NS		
T and M		NS	NS	NS	0.40	NS		
Mean of Main methods								
M1		85.55	2.73	19.17	5.55	7.98	4.73	1
M2		81.64	2.39	18.83	4.91	8.92	4.29	2
M3		75.04	2.26	18.46	4.53	5.60	4.01	3
M4		65.48	2.05	18.02	3.15	3.63	3.40	4
CD(0.05)		3.56	0.16	0.45	0.22	0.65		
CV(%)		5.18	7.36	2.69	5.55	11.18		
Mean of Sub methods								
T1-Fe coated 1-2 cm water level		76.01	2.31	18.82	4.32	6.45	4.18	2
T2-Fe coated wet		78.67	2.42	18.60	4.79	7.00	4.17	3
T3-Non coated 1-2 cm water level		77.12	2.31	18.48	4.41	6.08	3.77	4
T4-Non coated wet		78.45	2.44	18.65	4.67	6.51	3.70	5
T5-NTP		74.40	2.32	18.56	4.49	6.62	4.73	1
CD(0.05)		NS	NS	NS	0.20	0.51		
CV(%)		5.18	9.44	2.48	5.39	9.42		
Experimental Mean		76.93	2.36	18.62	4.54	6.53	4.11	

	DOS	**Rain fall for specific week**
	18.07.18	75.8
***DOS(Date of Sowing)**	25.07.18	51.4
	31.07.18	31.0
	07.08.18	103.4

4.2.4. Management practices for enhancing grain yield with green manure and nutrient management in rainfed upland rice

The present investigation was taken up to study the effect of phosphorus and green manure on productivity of rice at 4 locations (**Malan, Pattambi, Pusaand Ranchi**). Experiment was laid out in factorial RBD design {M_1: Rice alone, M_2: Rice + GM (Sunhemp/Dhaincha/Green leaf manuring) and 5 subplots of phosphorus treatment (S_1: 0 kg P_2O_5/ha, S_2: 20 kg P_2O_5/ha, S_3: 40 kg P_2O_5/ha, S_4: Optional and S_5: Farmers practice.

In silty clay soils of **Malan** rice + GM without phosphorus treatment resulted the highest grain yield (2.86 t/ha). Growing of green manuring crop could able to increase the rice grain yield than without GM crop. Application of 40 kg P_2O_5/ha recorded the highest grain yield (2.83 t/ha) over without phosphorus treatment. Similarly, filled grains are higher in GM treatment plots and in higher phosphorus dose treated plots. Similar results were observed in red lateritic soils of **Pattambi**. The highest grain yield (5.31 t/ha) was observed at rice grown along with GM crop and 40 kg P_2O_5/ha. In silty clay loam soils of Pusa rice+GM along with 40 kg P_2O_5/ha produced the highest grain yield (5.96 t/ha). Similar trend was observed in **Ranchi** also. The highest grain yield was recorded in rice+GM treated plots (2.96 t/ha). Similarly, higher dose of phosphorus produced the higher grain yield (3.15 t/ha). Mean grain yield of all the locations revealed that **Rice + GM resulted in the highest grain yield (3.83 t/ha) under rainfed condition**. Among phosphorus treatments, **40 kg P_2O_5/ha** along with recommended N and K_2O recorded the highest grain yield (4.03 t/ha). **There is an increase of 19.2% and 6.9% in grain yield due to application of 40 kg P_2O_5/ha over without and 20 kg P_2O_5/ha application of phosphorus, respectively**.

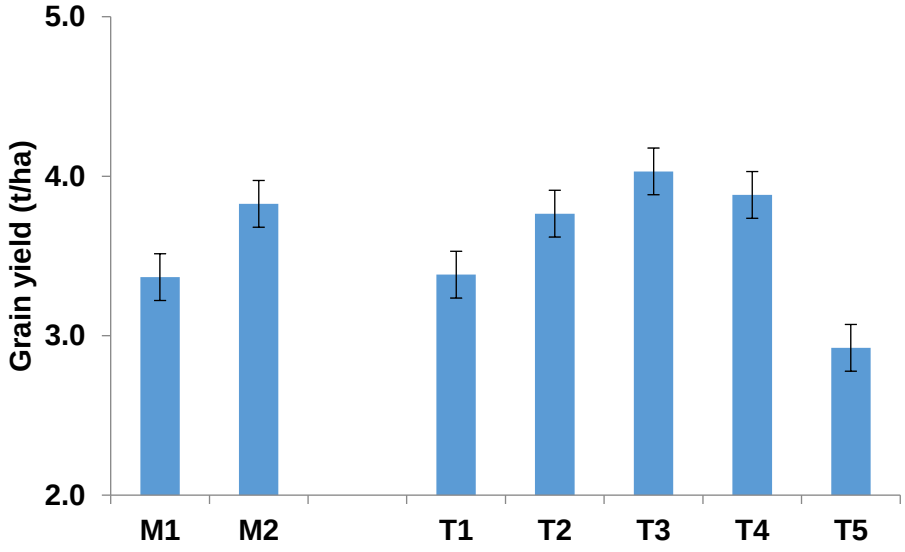


Fig. Effect of green manuring and nutrient management on grain yield of rainfed upland rice

Table 4.2.4: Management practices for enhancing grain yield with green manure and nutrient management in rainfed upland rice, kharif - 2018.

F-levels	Varieties	MALAN						
		Grain Yield (t/ha)	Rank	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Filled grains/Panicle	Unfilled grains/Panicle
M1 Rice alone	T1: 60-0-40	2.56	6	225	1.83	26.49	56.0	6.0
	T2: 60-20-40	2.81	4	233	1.93	26.69	63.7	6.0
	T3: 60-40-40	2.82	3	243	2.00	26.73	62.3	6.8
	T4: Optional	1.96	8	195	1.73	25.32	56.3	5.2
	T5: Farmer practice	1.22	10	138	1.53	24.54	53.3	13.0
M2- Rice+GM (Sunhemp/Dhaincha/ Green leaf manuring)	T1: 60-0-40	2.86	1	238	1.90	25.67	64.7	9.7
	T2: 60-20-40	2.80	5	245	2.03	25.91	66.0	8.1
	T3: 60-40-40	2.83	2	238	2.00	27.00	61.3	13.5
	T4: Optional	2.27	7	200	1.73	26.41	59.0	6.1
	T5: Farmer practice	1.58	9	150	1.63	25.46	54.3	11.7
C.D.(0.05)								
F at same V		0.23		21	0.26	1.50	11.4	2.6
V at same F		0.24		20	0.26	1.37	11.9	2.7
F1		2.27	2	207	1.80	25.95	58.3	
F2		2.47	1	214	1.86	26.09	61.1	2.6
C.D.(0.05)		0.15		10	0.15	0.34	7.9	1.8
C.V.(%)		4.00		3	5.27	0.83	8.4	13.0
Mean of varieties:								
T1: 60-0-40		2.71	3	232	1.87	26.08	60.3	9.7
T2: 60-20-40		2.81	2	239	1.98	26.30	64.8	8.1
T3: 60-40-40		2.83	1	241	2.00	26.87	61.8	13.5
T4: Optional		2.12	4	198	1.73	25.87	57.7	6.1
T5: Farmer practice		1.40	5	144	1.58	25.00	53.8	11.7
C.D.(0.05)		0.16		15	0.19	1.06	8.0	1.8
C.V. (%)		5.57		6	8.29	3.34	11.0	17.2
Expt. Mean		**2.37**		**211**	**1.83**	**26.02**	**59.7**	**9.8**
Soil type		Silty Clay						
pH		5.50						
Variety		HPR 2795						
Available N:P:K of soil (kg/ha)		468:43:239						

Optional:

Table 4.2.4: Contd.

F-levels	Varieties	PATTAMBI						
		Grain Yield (t/ha)	Rank	Panicle/m² (No.)	Panicle wt(g)	Test wt(g)	Filled grains/Panicle	Unfilled grains/Panicle
M1 Rice alone	T1: 60-0-40	4.50	7	431	2.61	27.49	100.0	23.3
	T2: 60-20-40	4.60	6	411	2.69	27.49	100.0	23.7
	T3: 60-40-40	4.50	7	450	2.86	27.08	107.0	20.0
	T4: Optional	4.88	5	394	2.58	27.59	84.0	26.7
	T5: Farmer practice	3.88	10	430	2.58	27.43	82.3	22.0
M2- Rice+GM (Sunhemp/Dhaincha/ Green leaf manuring)	T1: 60-0-40	4.96	4	432	2.65	27.57	96.7	23.7
	T2: 60-20-40	5.28	2	401	2.90	27.75	97.3	26.0
	T3: 60-40-40	5.31	1	391	2.98	27.37	109.3	22.3
	T4: Optional	5.02	3	390	2.59	28.13	89.0	16.3
	T5: Farmer practice	4.46	9	398	2.36	27.78	87.3	22.7
C.D.(0.05)								
F at same V		0.64		81	0.29	1.33	20.0	11.8
V at same F		0.59		90	0.27	1.39	24.7	11.1
F1		4.47	2	423	2.66	27.42	94.7	
F2		5.01	1	402	2.70	27.72	95.9	7.1
C.D.(0.05)		0.16		69	0.10	0.91	21.8	4.1
C.V.(%)		2.12		11	2.49	2.11	14.6	11.6
Mean of varieties:								
T1: 60-0-40		4.73	4	432	2.63	27.53	98.3	23.7
T2: 60-20-40		4.94	2	406	2.80	27.62	98.7	26.0
T3: 60-40-40		4.91	3	420	2.92	27.23	108.2	22.3
T4: Optional		4.95	1	392	2.59	27.86	86.5	16.3
T5: Farmer practice		4.17	5	414	2.47	27.61	84.8	22.7
C.D.(0.05)		0.46		57	0.21	0.94	14.1	8.4
C.V. (%)		7.85		11	6.27	2.79	12.1	30.2
Expt. Mean		**4.74**		**413**	**2.68**	**27.57**	**95.3**	**22.2**
Soil type		Red Lataritic						
pH		5.60						
		Aiswarya						
Available N:P:K of soil (kg/ha)		204:20.4:94						
		Optional: PSB 2L/ha						

Trial 4.2.5: Evaluation of promising cultivars for late planting and management for higher productivity

Late planting of rice is becoming very common due to number of reasons such as weather, late on set of monsoon, machinery breakdown, water availability. There is a yield reduction due to delay in planting. Late planting also delay harvest, reduces the turn around time for second crop. There is a need to find out superior cultivars adopted to late planting and to minimize the loss in productivity of rice with suitable management practices.

The trial to evaluate promising cultivars (DRR Dhan-42, DRR Dhan-44, DRR Dhan-46, MTU-1010, IR-64, RNR-15048, CO-51, Indira Aerobic-1, PR-124, CR Dhan-201, Samalashwari, NLR-40024, NLR-34449, Anjali, IET 24904, IET 24117, US 314 and Indira Barani Dhan-1 at **Mandya** (at RFD), **Rewa** and **Maruteru.** Four treatment combination i.e. RFD with normal spacing, RFD with closed spacing, 125% RFD with normal spacing and 125% RFD with closed spacing was tested at **Rewa** centre. The effect of management practices and cultivars did not differ significantly for grain yield at **Maruteru**. The result are summarized and presented in Table: 4.2.5

At **Mandya**, in sandy loam soils, the cultivars differed significantly for yield attributes as well as grain yield at late planting situation (September sowing). The yield of cultivars ranged from 2.14 t/ha (Anjali) to 4.76 t/ha (NLR-40024). Among the cultivars, NLR-40024 was promising with higher grain yield of 4.76 t/ha followed by Indira Aerobic-1 (4.65 t/ha) and CR Dhan-201 (4.15 t/ha).

The trial was conducted at **Rewa** with four management practices in split plot design. The effect of management practices and cultivars was significant for yield attributes and grain yield at this location. Among the management practices, application of 125% RFD with normal and closed spacing gave significantly higher grain yield of (5.38 – 5.04 t/ha) as compared to RFD application along with normal spacing (4.59 t/ha).

Among the cultivars tested US 314 (5.36 t/ha) followed by IET 24117 (5.11 t/ha), MTU 1010 (5.08 t/ha) and IR 64 (5.06 t/ha) found promising with higher grain yield over other cultivars. Cultivars vix., Indira Baranai Dhan-1 and IET 24904 were found promising and gave higher grain yield at **Maruteru**. Interaction of cultivars X management practices was found significant and most of the cultivars preformed better under 125% of RFD (100:75:50 kg NPK/ha) with closed

spacing (15x10 cm). The yield reduction was reduced under these cultivars due to higher dose and closer spacing even at late planting situation.

The results indicated that, the cultivars viz., NLR 40024, Indira Aerobic-1, CR Dhan 201 were promising for late planting at **Mandya**. However at **Rewa**, cultivars US 314, IET 24117, MTU 1010 and IR 64 and Indira Barani Dhan – 1 And TET 24904 at **Maruteru** found promising with application of 125% of RFD (120:75:50 kg NPK/ha) at closer spacing (15x10 cm) found efficient in reducing yield losses due to late planting.

Table 4.2.5: Evaluation of promising cultivars for late planting and management for higher productivity, Kharif - 2018.

F-levels	Varieties	MANDYA					
		Grain Yield (t/ha)	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering	Rank
F1: Optimum feriliser dose with Normal spacing (20x15cm)	V1 - DRR Dhan-42	3.14	228.58	3.25	22.23	106	10
	V2 - DRR Dhan-44	3.71	321.75	3.58	20.16	103	5
	V3 - DRR Dhan-46	3.9	245.92	3.38	23.72	99.33	4
	V4 - MTU-1010	3.49	319.58	2.45	21.38	98.33	8
	V5 - IR-64	3.08	293.58	2.42	23.9	99.67	11
	V6 - RNR-15048	2.63	241.58	2.81	11.84	101.67	14
	V7 - CO-51	3.54	282.75	3.05	16.75	96	6
	V8 - Indira Aerobic-1	4.65	292.5	3.59	18.66	98	2
	V9 - PR-124	3.54	288.17	3.4	25.01	100.67	6
	V10 - CR Dhan-201	4.15	291.42	2.67	21.66	99	3
	V11 - Samalashwari	3.42	245.92	4.14	19.81	99.67	9
	V12 - NLR-40024	4.76	312	2.6	17.03	103	1
	V13 - NLR-34449	2.67	280.58	2.43	14.29	106.67	13
	V14 -Anjali	2.14	209.08	2.64	22.5	95	17
	V15 - IET 24904	2.09	249.17	3.17	21.82	106	18
	V16 - IET 24117	2.3	271.92	3.97	23.18	101	15
	V17 - US 314 (HC)	2.16	274.08	2.91	19.59	99	16
	V18 - Indira Barani Dhan-1	2.93	277.33	2.47	20.56	99	12
	CD(0.05)	1.29	54.82	0.65	1.7	1.55	1.55
	CV	24.2	12.14	13	5.09	0.93	0.93
	Exp. mean	**3.24**	**273.66**	**3.05**	**20.23**	**100.61**	**100.61**
	Soil type	Red sandy loam					
	pH	7.1					
	EC	0.23					
	Recommended N:P:K (kg/ha)	100:50:50					
	Available N:P:K of soil (kg/ha)	-					

Table 4.2.5: Contd.

F-levels	Varieties	REWA				
		Grain Yield (t/ha)	Panicle/m^2 (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering
F1: Optimum feriliser dose with Normal spacing (20x15cm)	V1	4.56	273	2.50	27.97	67
	V2	4.44	279	2.70	28.13	67
	V3	4.71	294	2.63	30.00	68
	V4	4.66	293	2.67	30.50	67
	V5	4.63	264	2.50	25.23	66
	V6	4.74	270	2.40	26.12	68
	V7	4.73	263	2.57	26.07	67
	V8	4.28	252	2.45	25.70	66
	V9	4.36	273	2.38	26.37	67
	V10	4.58	276	2.47	27.43	67
	V11	4.41	255	2.50	25.60	65
	V12	4.63	277	2.80	26.30	67
	V13	4.62	259	2.57	27.23	68
	V14	4.48	279	2.63	25.83	67
	V15	4.68	251	2.53	26.80	65
	V16	4.67	261	2.60	27.47	67
	V17	4.95	297	3.00	31.15	64
	V18	4.46	253	2.33	25.23	66
F2: Optimum feriliser dose with Closed spacing (15x10cm)	V1	4.60	276	2.50	26.07	67
	V2	4.47	281	2.70	28.13	67
	V3	4.58	296	2.63	26.37	68
	V4	4.56	294	2.67	27.43	67
	V5	4.53	280	2.50	28.07	66
	V6	4.72	280	2.40	26.30	68
	V7	4.68	269	2.57	27.23	67
	V8	4.40	254	2.17	25.83	66
	V9	4.49	282	2.40	26.80	67
	V10	4.68	283	2.47	27.47	67
	V11	4.39	255	2.23	25.73	65
	V12	4.65	287	2.80	26.30	67
	V13	4.62	269	2.57	27.97	68
	V14	4.48	286	2.63	28.13	67
	V15	4.68	260	2.53	30.00	65
	V16	4.67	271	2.60	30.50	67
	V17	4.95	305	3.00	25.23	64
	V18	4.42	253	2.13	25.57	67
F3: Higher feriliser dose (125% of Recommended) with Normal spacing (20x15cm)	V1	5.23	281	3.00	27.97	74
	V2	5.14	289	3.20	28.13	75
	V3	5.08	304	2.90	30.00	75
	V4	5.54	302	3.40	30.50	77
	V5	5.59	279	3.07	25.23	76
	V6	5.12	280	2.90	26.12	76
	V7	5.34	272	3.23	26.07	74
	V8	5.20	260	3.00	25.70	74
	V9	5.60	280	3.20	26.37	75
	V10	5.66	284	3.20	27.43	76
	V11	5.19	259	3.00	25.90	76
	V12	5.25	283	3.23	26.30	75
	V13	5.34	266	3.00	27.23	75
	V14	5.55	286	3.20	25.83	77
	V15	5.49	259	3.17	26.80	74
	V16	5.60	267	3.30	27.47	74
	V17	5.78	304	3.47	31.15	71
	V18	5.17	257	2.80	26.00	75

Table 4.2.5: Contd.

F-levels	Varieties	REWA				
		Grain Yield (t/ha)	Panicle/m² (No.)	Panicle wt (g)	Test wt (g)	Days 50% flowering
F4: Higher feriliser dose (125% of Recommended) with Closed spacing (15x10cm)	V1 - DRR Dhan-42	5.64	283	3.00	26.07	74
	V2 - DRR Dhan-44	5.25	291	3.20	28.13	75
	V3 - DRR Dhan-46	5.34	304	2.90	26.37	75
	V4 - MTU-1010	5.55	304	3.40	27.43	77
	V5 - IR-64	5.49	287	3.07	28.07	76
	V6 - RNR-15048	5.60	286	2.90	26.30	76
	V7 - CO-51	5.60	279	3.23	27.23	74
	V8 - Indira Aerobic-1	5.16	259	2.93	25.83	74
	V9 - PR-124	5.23	290	3.20	26.80	75
	V10 - CR Dhan-201	5.14	293	3.20	27.47	76
	V11 - Samalashwari	5.20	263	2.90	25.77	76
	V12 - NLR-40024	5.54	293	3.23	26.30	75
	V13 - NLR-34449	5.59	273	3.00	27.97	75
	V14 -Anjali	5.12	297	3.20	28.13	77
	V15 - IET 24904	5.34	270	3.17	30.00	74
	V16 - IET 24117	5.48	278	3.30	30.50	74
	V17 - US 314 (HC)	5.77	313	3.47	25.23	71
	V18 - Indira Barani Dhan-1	5.17	264	2.90	26.12	75
Interaction						
Factor(B)at same level of A		0.152	4.078	0.176	1.264	0.949
Factor(A)at same level of B		0.15	4.112	0.177	1.325	0.964
Mean of Fertilizer:						
F1		4.59	271	2.57	27.17	66
F2		4.59	277	2.53	27.17	67
F1		5.38	279	3.13	27.23	75
F2		5.40	285	3.12	27.21	75
C.D.(0.05)		0.035	1.356	0.056	NS	0.348
Mean of varieties:						
V1 - DRR Dhan-42		5.01	278	2.75	27.02	70
V2 - DRR Dhan-44		4.83	285	2.95	28.13	71
V3 - DRR Dhan-46		4.93	299	2.77	28.19	72
V4 - MTU-1010		5.08	298	3.03	28.97	72
V5 - IR-64		5.06	278	2.78	26.65	71
V6 - RNR-15048		5.05	279	2.65	26.21	72
V7 - CO-51		5.09	271	2.90	26.65	71
V8 - Indira Aerobic-1		4.76	256	2.64	25.77	70
V9 - PR-124		4.92	281	2.80	26.58	71
V10 - CR Dhan-201		5.02	284	2.83	27.45	72
V11 - Samalashwari		4.80	258	2.66	25.75	71
V12 - NLR-40024		5.02	285	3.02	26.30	71
V13 - NLR-34449		5.04	267	2.78	27.60	72
V14 -Anjali		4.91	287	2.92	26.98	72
V15 - IET 24904		5.05	260	2.85	28.40	70
V16 - IET 24117		5.11	269	2.95	28.99	71
V17 - US 314 (HC)		5.36	305	3.23	28.19	68
V18 - Indira Barani Dhan-1		4.81	257	2.54	25.73	71
C.D.(0.05)		0.075	2.002	0.087	0.61	0.464
Expt. Mean		**89.82**	**4998**	**51.05**	**489.55**	**1274**
Soil type		-				
pH		6.8				
EC		0.42				
Recommended N:P:K (kg/ha)		80:60:40				
Available N:P:K of soil (kg/ha)		290:18.6;419				

Table 4.2.5: Contd.

F-levels	Varieties	MARUTERU			Over all mean	Rank
		Grain Yield (t/ha)	Panicle/m² (No.)	Panicle wt (g)		
F1: Optimum feriliser dose with Normal spacing (20x15cm)	V1	4.44	260	3.95	4.50	48
	V2	4.02	270	3.96	4.23	66
	V3	3.92	285	3.95	4.32	55
	V4	4.45	265	3.81	4.56	44
	V5	4.60	295	3.49	4.61	42
	V6	3.87	294	3.48	4.31	56
	V7	3.85	290	3.33	4.29	60
	V8	4.29	285	3.85	4.29	61
	V9	4.18	279	3.04	4.27	64
	V10	4.00	288	3.65	4.29	58
	V11	3.96	285	3.91	4.19	69
	V12	4.45	285	3.84	4.54	45
	V13	3.96	293	3.78	4.29	59
	V14	3.82	290	3.35	4.15	71
	V15	4.97	295	3.63	4.82	37
	V16	3.98	260	3.93	4.33	54
	V17	4.57	298	3.79	4.76	38
	V18	4.72	290	3.81	4.59	43
F2: Optimum feriliser dose with Closed spacing (15x10cm)	V1	3.96	205	3.93	4.28	62
	V2	3.95	202	4.02	4.21	68
	V3	4.10	203	3.96	4.34	53
	V4	4.39	204	3.99	4.48	49
	V5	4.40	203	3.02	4.46	51
	V6	4.04	202	3.42	4.38	52
	V7	4.56	203	3.07	4.62	41
	V8	3.63	232	3.83	4.02	72
	V9	3.96	240	3.65	4.23	67
	V10	4.26	237	3.02	4.47	50
	V11	4.16	255	3.91	4.28	63
	V12	4.37	250	3.67	4.51	47
	V13	3.86	242	3.97	4.24	65
	V14	4.11	223	3.90	4.30	57
	V15	4.35	243	4.07	4.51	46
	V16	3.65	210	4.03	4.16	70
	V17	4.47	237	4.04	4.71	39
	V18	4.85	242	3.94	4.64	40
F3: Higher feriliser dose (125% of Recommended) with Normal spacing (20x15cm)	V1	-	-	-	5.23	24
	V2	-	-	-	5.14	32
	V3	-	-	-	5.08	36
	V4	-	-	-	5.54	13
	V5	-	-	-	5.59	9
	V6	-	-	-	5.12	34
	V7	-	-	-	5.34	20
	V8	-	-	-	5.20	26
	V9	-	-	-	5.60	5
	V10	-	-	-	5.66	3
	V11	-	-	-	5.19	28
	V12	-	-	-	5.25	22
	V13	-	-	-	5.34	18
	V14	-	-	-	5.55	11
	V15	-	-	-	5.49	16
	V16	-	-	-	5.60	8
	V17	-	-	-	5.78	1
	V18	-	-	-	5.17	29

Table 4.2.5: Contd.

F-levels	Varieties	MARUTERU			Over all mean	Rank
		Grain Yield (t/ha)	Panicle/m² (No.)	Panicle wt (g)		
F4: Higher feriliser dose (125% of Recommended) with Closed spacing (15x10cm)	V1 - DRR Dhan-42	-	-	-	5.64	4
	V2 - DRR Dhan-44	-	-	-	5.25	22
	V3 - DRR Dhan-46	-	-	-	5.34	18
	V4 - MTU-1010	-	-	-	5.55	11
	V5 - IR-64	-	-	-	5.49	15
	V6 - RNR-15048	-	-	-	5.60	7
	V7 - CO-51	-	-	-	5.60	6
	V8 - Indira Aerobic-1	-	-	-	5.16	31
	V9 - PR-124	-	-	-	5.23	24
	V10 - CR Dhan-201	-	-	-	5.14	32
	V11 - Samalashwari	-	-	-	5.20	27
	V12 - NLR-40024	-	-	-	5.54	13
	V13 - NLR-34449	-	-	-	5.59	9
	V14 -Anjali	-	-	-	5.12	34
	V15 - IET 24904	-	-	-	5.34	20
	V16 - IET 24117	-	-	-	5.48	17
	V17 - US 314 (HC)	-	-	-	5.77	2
	V18 - Indira Barani Dhan-1	-	-	-	5.17	29
Interation						
Factor(B)at same level of A		NS	NS	NS		
Factor(A)at same level of B		NS	NS	NS		
Mean of Fertilizer:						
F1		4.23	284	3.70	4.41	3
F2		4.17	224	3.75	4.38	4
F1		-	-	-	5.38	2
F2		-	-	-	5.40	1
C.D.(0.05)		NS	NS	NS		
Mean of varieties:						
V1 - DRR Dhan-42		4.20	233	3.94	4.60	8
V2 - DRR Dhan-44		3.98	236	3.99	4.40	17
V3 - DRR Dhan-46		4.01	244	3.96	4.47	13
V4 - MTU-1010		4.42	235	3.90	4.75	5
V5 - IR-64		4.50	249	3.26	4.78	4
V6 - RNR-15048		3.96	248	3.45	4.50	10
V7 - CO-51		4.21	247	3.20	4.65	7
V8 - Indira Aerobic-1		3.96	259	3.84	4.36	18
V9 - PR-124		4.07	260	3.34	4.50	11
V10 - CR Dhan-201		4.13	263	3.33	4.57	9
V11 - Samalashwari		4.06	270	3.91	4.43	16
V12 - NLR-40024		4.41	268	3.76	4.71	6
V13 - NLR-34449		3.91	268	3.88	4.48	12
V14 -Anjali		3.97	257	3.62	4.44	15
V15 - IET 24904		4.66	269	3.85	4.85	2
V16 - IET 24117		3.82	235	3.98	4.46	14
V17 - US 314 (HC)		4.52	268	3.91	4.94	1
V18 - Indira Barani Dhan-1		4.79	266	3.88	4.80	3
C.D.(0.05)		NS	NS	NS		
Expt. Mean		**75.58**	**4570**	**66.99**	**82.70**	
Soil type		-				
pH		-				
EC		-				
Recommended N:P:K (kg/ha)		-				
Available N:P:K of soil (kg/ha)		-				

4.2.6(R). Yield maximization of rice through Site Specific Nutrient Management

The conventional blanket fertilizer recommendation causes low fertilizer use efficiency. Estimation of field specific fertilizer requirements needs site-specific knowledge of crop nutrient requirements, indigenous nutrient supply, and recovery efficiency of applied fertilizer. The site-specific nutrient management (SSNM) approach emphasizes 'feeding' rice with nutrients as and when needed and to enable the farmers to optimally fill the deficit between the nutrient needs of a high-yielding crop and the nutrient supply from naturally occurring indigenous sources such as soil, organic amendments, crop residues, manures, and irrigation water. The SSNM approach does not specifically aim to either reduce or increase fertilizer use. Instead, it aims to apply nutrients at optimal rate and time to achieve high yield and high efficiency of nutrient use by the rice crop, leading to high cash value of the harvest per unit of fertilizer invested. Many still perceive SSNM is complex, requiring an understanding of concepts and methods outside their experience and this slowed the wide-scale promotion and adoption of SSNM by the farmers. For more rapid adoption of SSNM technology by farmers, efforts were made in the consolidation of SSNM research conducted over the last decade across Asia into a simple delivery system by International Plant Nutrition Institute (IPNI) in the form of Nutrient Expert, an easy to use interactive computer based decision support that can rapidly provide nutrient recommendations for farmers in the presence or absence of soil testing data. Hence, to validate this tool, this collaborative (Soil Science & Agronomy) trial was constituted along with IPNI and continued in *rabi* 2017-18 at **Puducherry**. The treatments were as follows: T_1 – Recommended fertilizer recommendation of that region, T_2 – SSNM based on Nutrient Expert (Varies for each location), T_3 – Farmers fertilizer practice and T_4: Absolute control (Without NPK).

In clay loam acidic soils of **Puducherry** the trial was conducted at research farm. SSNM based on Nutrient Expert treatment resulted the highest grain yield (6.8 t/ha) of cultivar CGZR-1 followed by RFD treated plots (6.5 t/ha). The higher no. of panicles/m^2 (367), test weight (23), filled grains/panicle (352) were observed under the same treatment.

Table- 4.2.6(R).: Summary of data on grain yield and ancillary characters of rice from the trial on yield maximisation of rice through Site Specific Nutrient Management, Rabi-2017-18.

Treatments	PUDUCHERRY					
	Grain Yield (t/ha)	Panicle no/m2	Test weight (g)	Filled grains/panicle	Unfilled grains/panicle	Rank
T1-RDF+A6:A31	6.5	346	22	341	10	**2**
T2-SSNM based on Nutrient Expert	6.8	367	23	352	7	**1**
T3-Farmers fertilizer practice	6.0	329	19	326	14	**3**
T4 - Absolute control(without NPK)	4.6	278	18	267	19	**4**
Expt. Mean	6.0	330	21	322	12	
CD(0.05)	0.84	44.87	3.10	42.34	5.33	
CV(%)	7.01	6.81	7.55	6.59	21.39	
Soil type	Clay loam					
pH	5.84					
Variety	CGZR-1 (105 Days)					
Location specific RDF NPK (kg/ha)	-					
Available NPK of soil (kg/ha)	179:51:75					

4.2.7(R). Development of technology for enhancing the productivity of organic rice

Organic farming which is responsible for material circulation in agricultural ecosystem and crop production with a minimal environmental load has played a crucial role from two points of view i.e. ecological protection and agricultural production. Since no chemical fertilizers and minimal inputs are allowed in organic farming nutrients for the crop production are mostly supplied with organic fertilizer such as compost containing different organic materials. Therefore, the management of soil fertility in organic farming should be differentiated with other conventional farming. There is need to standardise organic rice cultivation and enhance the productivity of the system. With this view the present trial is initiated in *kharif* 2017 and continued in rabi 2017-18 to standardise and economise the practices for enhancing the productivity of the organic rice cultivation and to evaluate the direct and indirect effect of organic fertilisers and its influence on nutrient use efficiency and soil health. The trial was conducted in RBD with 4 replications. The treatments were T_1: 100% RDF through inorganic fertilizers; T_2: 100% RDF through organic manure (equivalent of nitrogen); T_3: INM (75% through inorganic and 25% through organic sources equivalent of N); T_4: Control (No fertilizer application) and T_5: Farmers practice (location specific). Data were received from 4 centres (**Kanpur, Mandya, Puducherry and Pattambi**) and presented in Tables 4.2.8 (R).

In sandy clay soils of **Kanpur**, INM treated plots recorded the highest wheat grain yield (4.91 t/ha). However, it was at par with 100% RDF through inorganic fertilizers (4.79 t/ha). The highest system productivity of rice-wheat system was recorded under INM treatment (10.74 t/ha) followed by 100% RDF through inorganic treatment (10.48 t/ha). Similarly, INM treated plots recorded the highest *rabi* crop yield in **Mandya** (cowpea, 0.8 t/ha) and **Puducherry** (Rice, 6.48 t/ha). In **Pattambi**, 100% RDF through inorganic treatment resulted the highest rice grain yield (3.91 t/ha), however, on par with INM treatment (3.85 t/ha). The highest system productivity at **Kanpur** (Rice-wheat, 10.74 t/ha), **Mandya** (Rice-cowpea, 9.09 t/ha) and **Pudducherry** (Rice-Rice, 13.34 t/ha)were recorded under INM and 100% RDF through inorganic fertilizers, respectively. First year of the experimentation revealed that there is **11 % and 5.4% reduction in grain yield** due to adoption of organic nutrient management compared to 100% RDF through inorganic sources and INM practices, respectively in *kharif*. Similar trend was followed in *rabi* season also. **System productivity of rice-wheat and rice-cowpea systems revealed that organic fertilizer management resulted 13.9 and 11.7% less system yield compared to that of INM and 100% RDF through inorganic fertilizers**.

Table 4.2.7(R): Development of technology for enhancing the productivity of organic rice in Rabi - 2017-18.

Treatment	KANPUR						MANDYA				
	Grain Yield (t/ha)	Kharif-2017 Grain Yield(t/ha)	Panicle No/m2	Panicle wt (g)	REY	(K+R)REY	Grain Yield (t/ha)	Kharif-2017 Grain Yield(t/ha)	Plant population/m2	REY	(K+R)REY
T1	4.79	5.23	388	1.92	5.25	10.48	0.78	6.37	15.44	2.72	9.09
T2	4.26	4.58	379	1.79	4.67	9.25	0.62	5.00	16.79	2.16	7.16
T3	4.91	5.35	396	2.05	5.39	10.74	0.8	5.77	17.28	2.79	8.56
T4	2.01	2.47	253	1.42	2.20	4.67	0.59	3.92	18.00	2.06	5.98
T5	4.02	4.63	370	1.73	4.41	9.04	0.7	5.53	17.25	2.44	7.97
C.D. (0.05)	0.2	0.21	8.58	0.03			0.14	0.33	2.72		
C.V	2.69	2.53	1.28	0.88			12.99	4.06	10.42		
res(t)	**	**	**	**			*	**	NS		
Expt. Mean	4.00	4.45	357	1.78			0.7	5.32	16.95		
Applied fertilizer dose (N-P-K-ZnSO4)	120:60;60						25:50:25				
Soil type	Sandy loam						Red Sandy Loam				
pH	7.95						7.35				
System	Rice-Wheat (PBW 343)						Rice-Pulse (Cowpea-PGCP-6)				
Available NPK9Kg/ha)	204:17:198										
	MSP Wheat - Rs.1700/Q						MSP Cowpea - Rs.5400/Q				

T1-100% RDF through inorganic fertilizers

T2-100% RDF through organic manure (equivalent nitrogen)

T3-INM (75% through inorganic and 25% through organic sources equivalent of N)

T4- Control (No fertilizer application)

T5- Farmers practice (Location specific)

Table 4.2.7(R): Contd.

Treatment	PUDUCHERRY					PATTAMBI				Overall mean GY t/ha	Rank
	Grain Yield (t/ha)	Kharif-2017 Grain Yield(t/ha)	Panicle No/m2	Panicle wt (g)	(K+R)REY	Grain Yield (t/ha)	Panicle No/m2	Panicle wt (g)	Test wt (g)		
T1	6.09	6.50	346	3.62	12.59	3.91	363	2.32	28.97	4.49	2
T2	5.76	6.20	324	3.49	11.96	3.78	285	2.23	28.71	4.09	3
T3	6.48	6.86	386	3.76	13.34	3.85	276	2.19	28.8	4.63	1
T4	3.53	3.88	223	2.99	7.41	1.93	174	1.84	25.7	2.43	5
T5	5.58	5.81	277	3.22	11.39	3.71	400	2.16	28.79	4.03	4
C.D. (0.05)	0.58	0.48	35.58	0.44		0.39	92.78	0.43	1.66		
C.V	5.61	4.38	6.07	6.8		7.3	20.11	12.91	3.82		
res(t)	**	**	**	*		**	*	NS	*		
Expt. Mean	5.49	5.85	311	3.42		3.43	299	2.15	28.19	4.46	
Applied fertilizer dose (N-P-K-ZnSO4)	120:40:40					90:45:45					
Soil type	Clay loam					-					
pH	5.84					5.6					
System	Rice-Rice (CGZR-1)					Rice-Rice (Jyoti)					
Available NPK9Kg/ha)	179:59:79					206:19:98					

T1-100% RDF through inorganic fertilizers

T2-100% RDF through organic manure (equivalent nitrogen)

T3-INM (75% through inorganic and 25% through organic sources equivalent of N)

T4- Control (No fertilizer application)

T5- Farmers practice (Location specific)

4.2.8. Enhancing the productivity of New Plant Types under best management practices

4.2.9. Enhancement of Nitrogen Use Efficiency in irrigated rice

4.2.10. Enhancement of Phosphorous Use Efficiency in irrigated rice

As these trials are collaborative trials, for detailed information kindly refer the Voulme – I, Progress Report- 2018, Varietal Improvement, ICAR-Indian Institute of Rice Research.

WEED MANAGEMENT TRIALS



4.3. WEED MANAGEMENT TRIALS (WMTs)

Among the various constraints, weed competition is going to be the major factor limiting higher productivity. In transplanted conditions, the yield loss due to weeds range from 15 to 30%. Most of the farmers in the intensive cropping areas are shifting to direct seeding practices, due to shortage of labour or scarcity of water, energy, electricity etc. Additionally, the late onset of monsoon and unpredictable rainfall patterns (which are indirectly due to global warming) during recent years are also prompting farmers to go for dry direct seeding or wet direct seeding under puddled conditions. In drill seeded or direct seeded rice under puddled conditions, the weeds grow vigorously and the level of infestation and competitiveness are going to be the major challenges to farmers and researchers alike and the grain yield losses in these rice ecosystems are much more (30-91%). Therefore, it is necessary to incorporate the chemical methods aimed at inhibiting the metabolic processes, in integrated weed management practices

4.3.1. Integrated Pest Management–(Collaborative trial with Entomology and Pathology)

In recent years, intensive cultivation of rice has resulted in the frequent occurrence of biotic stresses that formed major constraint in rice production. Although, IPM has been accepted as the most effective option for protection of crops from the ravages of pests, however, its implementation at the farmer's level has been limited. As IPM involves a number of components, farmers must have capability of taking decisions and selecting IPM options accordingly for economical and long term management. Most of these options also need to be refined at individual farm level keeping in view the availability of resources and feasibility to farmers. Therefore, IPM involves working with the farmers in their fields and devising technologies suitable to their conditions. Keeping this in view, IPM special trial was conducted with an aim to manage pests (including insects, diseases and weeds) in a holistic way in farmers' fields involving them in a participatory way and allowing them to select IPM practices from a basket of options available. The IPM practices recommended for weed management is given in the below table.

Treatment	IPM block	FP block
Nursery	❖ Apply **butachlor** or **pretilachlor + safener @ 5 ml/lt** water at 8-10 days after sowing. ❖ If weed intensity is more apply **bispyribacsodium @ 8 ml/lt** water at 2-3 leaf stage of weeds	❖ As per the local farmers practice. ❖ Please record the practices followed by farmers whenever you go for observation / visit
Main field	❖ Transplant seedlings at a spacing of 20 x 15 cm. ❖ Leave alleyways of 30 cm after every 2 m or 10 rows.	❖ As per the local farmers practice ❖ Please record the practices followed by farmers whenever you go for observation / visit

	❖ Fertilizers should be applied as per local recommended fertilizer dose. ❖ Apply herbicide within one week after transplanting the crop.	
30 – 59DAT	❖ Depending on weed intensity spray post emergence herbicide as given N top dressing to be taken up as given in protocol using Leaf Color Chart ❖ Mid season drainage	❖ As per the local farmers practice (mention the quantities) ❖ Please record the practices followed by farmers whenever you go for observation / visit
> 90 DAT up to harvest	❖ Mark 5 x 5 m^2 area and take yield, at 5 places (5 repl.) in this block	❖ Mark 5 x 5 m^2 and take yield, at 5 places (5 repl.) in this block
	❖ Also record the cost involved for each practice/ operation taken in IPM starting from nursery to harvest to estimate cost of cultivation as given in data sheet	❖ Also record the cost involved for each practice/ operation taken up by farmers starting from nursery to harvest to estimate cost of cultivation as given in data sheet

During *Kharif* 2018, the trial was conducted at 11 locations viz. **Chatha, Chinsurah, Gangavathi, Malan, Mandya, Nagina, Navsari, Puducherry, Raipur, Titabar and Vadagaon.** The data on weed parameters during critical period of crop weed competition and grain yields were reported and the results are summarized and presented in **Tables 4.4.3.**

At **Chatha,** the weed population and weed biomass were recorded at 30 and 60 DAT; with relatively higher weed intensity in farmers practices adopted fields (14 & 13% more weed population and, 13 & 30% higher weed biomass was recorded in farmers practice. The mean relative grain yield advantage by IPM adopted farmers was 12.3%. At **Chinsurah**, the trial was conducted in the village Bele, Pandva Block of Hooghly District. The data on weed population and weed biomass were recorded at 30 and 60 DAT. Significant decrease in weed population (31 & 32%) and biomass (49 & 44%) in IPM implemented has resulted in higher growth, yield attributes and grain yield increase by 24% of the variety Swarna. At **Gangavathi,** with the variety BPT 5204, the mean grain yield increase of 14.44% was reported in IPM adopted field. The weed population was comparatively low (29% & 22%) in IPM adopted fields, at 30 & 60 DAT. The weed biomass was less in IPM fields by 29 & 30 % (Table 4.3.1).

In **Malan,** in IPM field, the variety HPR 2880 was used and in farmers practice Hybrid Raftaar was used. The weed population was 57% lower in IPM adopted field, at 30 DAT and 65.2% lower at 60 DAT. The relative grain yield advantage was 45.26%, emphasizing the necessity of adopting IPM practices. At **Mandya**, the trial was conducted using Hybrid KRH4.

The data recorded on weed population at 30 and 60 DAT showed decrease in IPM fields than farmer's practice (71.4 & 80%). The weed biomass was less by 86 & 87.4% at 30 & 60 DAT. The mean grain yield advantage was 12.04% in IPM adopted plot. At **Nagina**, the trial was conducted using the variety NDR359. The farmers practice is also ideal for weed management resulting in comparable grain yields in both systems. At **Navsari,** the results indicated that weed population at 60 DAT was lower in IPM practiced fields 5.5%. The weed biomass in IPM fields at 30 & 60 DAT was reduced by 8.3 & 6% respectively, which has reflected in higher grain yields (6.31% yield increase).

At **Puducherry,** the field trial was conducted in the village Koodapakkam using the variety BPT5204. The weed population in IPM plots was lower by 15 & 16% than farmers practice at 30 & 60 DAT. The weed biomass in IPM plots was lower by 15 & 23%. The mean grain yield advantage was 15.4% in IPM adopted plots. At **Raipur**, the trial was conducted using the variety Swarna. The data on weed population and weed biomass was recorded at 30 and 60 DAT. The weed biomass was less in IPM fields by 12 & 10% respectively. The weed population was less in IPM fields (13 & 11% respectively) compared to farmers practice, resulting in an yield advantage of 12.06%. At **Titabar**, the trial conducted in farmer's field using variety Ranjit, and the data on grain yield showed that IPM practice implemented fields were significantly superior over farmers practice and recorded 24% yield increase. The data on weed biomass indicated 59% low in IPM adopted fields. At **Vadagaon**, significant reduction in weed population in IPM adopted fields was recorded (Phule Samrudhi). Significant improvement in grain yield was noticed (81.35%) in IPM adopted fields. (Table 4.3.1)

Integrated Pest Management (IPMs) trial was conducted at 11 locations during *Kharif* 2018 with an objective of managing all pests i.e., weeds, insects, diseases in a holistic way in farmers' fields involving them in a participatory mode. Across the locations, weeds, insect pests, and disease incidence was low in IPM plots. Weed population and weed biomass recorded at all the locations were considerably reduced by two to five times in IPM implemented plots compared to farmers practice, resulted in significantly higher grain yields.

(For more details regarding pest and diseases please see Volume.2 Progress Report 2018 (**Entomology and Pathology –IPMspecial trial).**

Table 4.3.1: Weed parameters, Yield parameters and Grain yield of IPM trial as influenced by IPM vs Farmers Practice in Kharif - 2018.

Location	Mean/standard error	Treatments	Panicle No/m²	Panicle wt (g)	Grain Yield (t/ha)	Yield Advantage	Weed Population No/m²				Weed Dry Biomass g/m²			
							30 DAT	% Reduction	60 DAT	% Reduction	30 DAT	% Reduction	60 DAT	% Reduction
CHATHA	Mean	IPM	292	1.69	3.65	12.30	20.33	12.86	30.33	30.00	11.50	13.21	30.50	32.35
		Farmers Practice	230	1.56	3.20		23.33		43.33		13.25		45.08	
	Standard errors		12	0.04	0.17		1.53		1.53		1.15		2.29	
			4	0.02	0.05		2.08		2.08		1.52		0.63	
CHINSURAH	Mean	IPM	332	3.25	5.42	24.00	41.80	31.00	77.20	32.40	5.28	49.15	9.60	44.32
		Farmers Practice	294	3.21	4.13		72.60		114.20		10.38		17.24	
	Standard errors		16	0.03	0.22		11.30		14.01		1.42		1.68	
			11	0.01	0.14		10.69		24.32		1.13		3.13	
GANGAVATHI	Mean	IPM	482	2.96	7.20	14.44	32.00	29.00	27.60	22.00	15.64	28.52	12.72	30.33
		Farmers Practice	447	2.78	6.16		44.80		36.00		21.88		18.25	
	Standard errors		68	0.21	0.43		4.64		5.08		1.41		1.77	
			21	0.22	0.38		4.60		8.86		2.78		4.06	
MALAN	Mean	IPM	227	2.28	4.75	45.26	12.80	56.76	16.00	65.20	5.76	65.38	18.84	49.97
		Farmers Practice	201	1.84	2.60		29.60		46.40		16.64		37.66	
	Standard errors		14	0.08	0.50		5.22		4.90		0.83		5.65	
			7	0.11	0.40		6.07		9.21		1.68		12.98	
MANDYA	Mean	IPM	369	5.28	7.63	12.04	1.50	71.40	2.70	79.55	0.20	86.84	1.00	87.45
		Farmers Practice	346	4.92	6.81		6.80		13.20		1.51		7.98	
	Standard errors		20	0.27	0.50		1.50		2.56		0.22		1.07	
			29	0.21	0.44		2.39		4.80		1.02		2.50	
NAGINA	Mean	IPM	318	3.64	5.48	6.02	8.09	11.00	5.20	16.60	6.71	26.21	3.53	29.57
		Farmers Practice	305	3.63	5.15		8.82		6.47		9.09		5.01	
	Standard errors		7	0.01	0.16		2.19		1.42		1.33		0.78	
			14	0.02	0.26		2.79		2.17		1.26		0.79	
NAVASARI	Mean	IPM	215	3.77	5.38	6.30	-	-	33.60	5.50	33.18	8.30	51.82	5.95
		Farmers Practice	204	3.78	5.04		-	-	36.44		36.42		55.10	
	Standard errors		13	0.30	0.32		-	-	2.10		0.80		1.96	
			13	0.19	0.17		-	-	1.89		0.96		2.10	

Table 4.3.1: Contd.

Location	Mean/standard error	Treatments	Panicle No/m²	Panicle wt (g)	Grain Yield (t/ha)	Yield Advantage	Weed Population No/m²				Weed Dry Biomass g/m²			
							30 DAT	% Reduction	60 DAT	% Reduction	30 DAT	% Reduction	60 DAT	% Reduction
RAIPUR	Mean	IPM	362	3.47	5.14	12.06	25.50	16.12	41.48	9.10	14.53	11.97	62.48	9.91
		Farmers Practice	324	3.08	4.52		30.40		45.64		16.51		69.35	
	Standard errors		20	0.19	0.06		6.53		6.39		3.11		8.58	
			13	0.08	0.15		6.15		6.34		2.89		8.83	
VADAGAON	Mean	IPM	267	5.82	6.42	44.80	4.60	65.67	10.20	48.66	7.10	57.23	7.95	62.78
		Farmers Practice	191	3.29	3.54		13.40		19.87		16.60		21.37	
	Standard errors		10	0.306	0.20		1.95		0.84		1.57		1.76	
			10	0.117	0.26		2.41		4.08		2.49		3.15	

Table 4.3.1: Contd.

Location	Mean/standard error	Treatments	Grain Yield t/ha	Yield Advantage	Panicle No/m2	Panicle wt (g)	Weed Dry Biomass g/m2	% Reduction
TITABBAR	Mean	IPM	5.0	24.00	236.00	4.52	28.974	59.08
		Farmers Practice	3.8		204.60	3.70	70.80	
	Standard errors		0.4		9.75	0.38	12.08	
			0.3		8.76	0.30	20.55	

Table 4.3.1: Contd.

Location	Mean/standard error	Treatments	Panicle No/m²	Panicle wt (g)	Grain Yield t/ha	Yield Advantage	Weed Population No/m²				Weed Dry Biomass g/m²			
							30 DAT	% Reduction	60 DAT	% Reduction	30 DAT	% Reduction	60 DAT	% Reduction
PUDUCHERRY	Mean	IPM	335.47	3.33	5.43	15.40	40.47(6.36)	14.75	45.93(6.77)	16.38	28.73	16.65	33	22.90
		Farmers Practice	292.47	2.95	4.59		47.47(6.89)		54.93(7.42)		34.47		42.8	
	CD(0.05)		18.66	0.22	0.1		0.27		0.19		3.27		2.64	-

4.3.2. Evaluation of Bio efficiency of Thiobencarb in wet direct sown rice

Thiobencarb is a systemic, pre emergence herbicide that acts by inhibiting shoots of emerging weed seedlings. It controls many annual grasses and some selected broad leaves, with good selectivity between rice and weeds, With the objective of evaluating the bio efficiency of thiobencarb at different doses in wet direct sown rice in comparison to the promising pre and post emergence herbicides at different locations viz**., ICAR-Indian Institute of Rice Research-Hyderabad, Malan, Puducherry** and **Raipur** during *kharif* 2018, The results are presented in the table 4.3.2 and discussed here under.

At **ICAR-IIRR**, the test variety DRR Dhan 50 has recorded mean grain yield of 5.57 t/ha, HPR-2656 (2.33t/ha) at **Malan**, CO-52 (6.18 t/ha) at **Puducherry** and IGKV R1 (5.18t/ha) at **Raipur**. The grain yield was higher at all the locations except **Malan** due to delayed sowing and water problem. At **Raipur**, hand weeding twice has contributed to higher yield and significantly superior over herbicides. At **ICAR-IIRR** & **Malan**, hand weeding twice and standard post emergence herbicide were onpar and superior over other test treatments. At **Puducucherry**, thiobencarb @ 4.5 and 5 l/ha and standard post emergence herbicide bispyribacsodium@ 300 ml/ha were superior over other treatments. (Table 4.4.4)

The data on weed population (Table 4.3.2) indicated dominance of grasses followed by sedges at **ICAR-IIRR**; BLWs followed by grasses and BLW at **Puducherry**. The herbicides drastically reduced the grasses and sedges at **ICAR-IIRR**, 15 days after herbicide application at **Raipur**; grasses broad leaf weeds and sedges at **Malan**; total weed population at **Puducherry**. The data at 45-50 days after herbicide application (DAHA) showed second flush of grasses & sedges at **ICAR-IIRR,** reduced weed population at **Puducherry**; similar weed population at **Malan**. Similar trend was observed regarding weed biomass before herbicide application; 10-15days after herbicide application and 45-50 days after herbicide application in different locations.

The data on weed control efficiency (Table 4.3.2) indicated the superiority of hand weeding twice and standard post emergence herbicide bispyribacsodium at **IIRR**, **Malan** and **Raipur**; Thiobencarb @ 5 l/ha and standard post emergence bispyribacsodium at Puducherry.

Pooled analysis of the multi-locational data indicated that the loss of grain yield due to weeds was lowest 2.58% with standard check post emergence herbicide bispyribacsodium @ 300 ml/ha and highest (33.57%) with un weeded control. Among the dosages of thiobencarb, 5 l/ha contributed to higher grain yield of 5.16 t/ha and lower grain yield loss (4.79%), and was onpar with standard check herbicide bispyribacsodium. Thiobencarb@ 4 l/ha and pre emergence standard check herbicide Pyrazosulfuron-ethyl @ 200g/ha were on par and inferior to higher dose i.e., 5 l/ha. The hand weeding twice significantly out yielded other treatment combinations. Straw yield was significantly higher with hand weeding twice and post emergence standard check herbicide bispyricbacsodium @ 300 ml/ha.

The data on weed population showed that thiobencarb @ 5 l/ha, standard post emergence herbicide bispyricbacsodium and hand weeding twice are superior in reducing weed population as well as weed biomass at 15 days after herbicide application and recorded higher weed control efficiency.

Based on the one season multi-location study at **ICAR-IIRR Hyderabad, Malan, Puducherry and Raipur**, the systemic post emergence herbicide thiobencarb @ 5 l/ha was found superior resulting in higher weed control efficiency; higher grain yields; and the performance was comparable to hand weeding twice and standard post emergence herbicide bispyribacsodium @ 300 ml/ha.

Table 4.3.2: Evaluation of bioefficacy of Thiobencarb 80 Ec against weeds of puddle DSR rice, Kharif – 2018

Treatments	Grain Yield (t/ha)				Straw Yield (t/ha)				No. of panicles/m²			
	IIRR	Malan	Puducherry	Raipur	IIRR	Malan	Puducherry	Raipur	IIRR	Malan	Puducherry	Raipur
T1	5.42 c	2.00 d	6.26 b	4.30 c	6.90 c	3.14 dc	7.50 b	4.33 c	651 c	205 c	417 c	212 bc
T2	5.84 bc	2.09 dc	6.41 ba	5.29 b	7.13 bc	3.17 dc	7.67 ba	5.44 ba	703 b	207 bc	438 b	245 ba
T3	6.13 b	2.33 bc	6.59 a	5.62 ba	7.45 bac	3.54 bc	7.89 a	5.61 ba	707 b	235 a	467 a	259 a
T4	5.39 c	2.53 ba	5.64 d	5.01 b	6.75 c	3.96 ba	6.74 d	5.08 bc	645 c	230 ba	369 d	239 bac
T5	6.34 ba	2.75 a	6.44 ba	5.58 ba	7.84 ba	4.07 a	7.71 ba	5.75 ba	778 a	243 a	450 ba	251 a
T6	3.09 d	1.83 d	5.21 e	4.29 c	4.20 d	2.90 d	6.23 e	4.57 c	533 d	166 d	313 e	205 c
T7	6.81 a	2.76 a	6.02 c	6.13 a	7.88 a	4.02 a	7.21 c	5.97 a	784 a	238 a	406 c	269 a
Exp. mean	**5.57**	**2.33**	**6.08**	**5.18**	**6.88**	**3.54**	**7.28**	**5.25**	**686**	**218**	**409**	**240**
LSD(0.05)	**0.67**	**0.30**	**0.19**	**0.62**	**0.75**	**0.46**	**0.25**	**0.84**	**45.89**	**24.60**	**20.93**	**34.38**
Applied fertilizer doses (N-P-K-Zn kg/ha)	120:50:60	60:30:30	**120:40:40**	**100:60:40**								
Name of the variety	DRR Dhan 50	HPR 2656	**CO- 52 (135 days)**	IGKV R1								
Soil type	Clay	Silty clay loam	**Clay**	Clay loam								
pH	7.2	-	**6.62**	7.21								
EC	-	-	**0.2**	0.23 dSm-1								

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	Panicle weight(g)			Filled grains % per panicle			Test weight (g)				Grain yield loss %			
	IIRR	Malan	Puducherry	IIRR	Puducherry	Raipur	IIRR	Malan	Puducherry	Raipur	IIRR	Malan	Puducherry	Raipur
T1	35.90 c	1.53 dc	4.94 c	85.94 ba	93.50 ba	86.02 a	15.85 bdc	24.81 a	22.96 a	32.67 a	20.41	27.53	-3.98	29.85
T2	38.87 bc	1.67 bc	5.12 b	87.65 a	94.55 a	88.32 a	16.27 bac	24.74 a	23.31 a	32.43 a	14.24	24.27	-6.47	13.7
T3	41.00 ba	1.80 bac	5.3 a	88.36 a	96.10 a	90.85 a	16.39 ba	24.90 a	22.98 a	32.23 a	9.98	15.57	-9.46	8.31
T4	36.80 c	1.83 bac	4.46 e	83.58 b	89.43 bc	87.67 a	15.54 dc	24.83 a	21.54 b	32.80 a	20.85	8.33	6.31	18.27
T5	37.25 bc	1.97 ba	5.23 ba	88.78 a	94.77 a	88.89 a	16.56 ba	25.81 a	22.99 a	33.17 a	6.90	0.362	-6.97	8.97
T6	30.65 d	1.23 d	4.36 e	79.10 c	85.49 c	87.39 a	15.11 d	24.34 a	21.09 b	33.27 a	54.62	33.69	13.45	30.01
T7	43.37 a	2.03 a	4.78 d	89.74 a	92.70 ba	88.53 a	16.98 a	24.99 a	22.59 a	32.63 a	-	-	-	-
Exp. mean	37.69	1.72	4.89	86.16	92.36	88.24	16.10	24.92	22.50	32.74	-	-	-	-
LSD(0.05)	3.82	0.33	0.15	3.90	4.18	6.57	0.81	1.76	0.72	2.53	-	-	-	-

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	IIRR						
	Weed population at 45-50 DAHA no/m^2			Weed population at 15 DAHA No/m^2			
	Grasses	Sedges	Total weeds	Grasses	Sedges	BLWs	Total weeds
	(Echinocloa colona)	(Cyperus difformis)		(Echinocloa colona)	(Cyperus difformis)	Eclipta alba	
T1	46.33 (6.84) a	29.33 (5.44) b	72.33 (8.53) b	6.67 (2.68) b	8.67 (3.02) cb	1.33 (1.18) b	16.67 (4.14) b
T2	32.67 (5.74) b	20.33 (4.55) c	62.00 (7.90) c	6.33 (2.58) cb	1.67 (1.35) c	2.00 (1.56) b	10.00 (3.18) b
T3	31.00 (5.59) b	15.67 (4.01) dc	46.67 (6.86) d	4.33 (2.20)cbd	3.67 (1.83) cb	1.33 (1.18) b	9.33 (3.03) b
T4	34.00 (5.82) b	12.00 (3.53) d	46.00 (6.77) d	2.00 (1.43) cd	3.67 (1.60) cb	0.00 (0.71) b	5.67 (2.20) b
T5	18.00 (4.29) c	20.00 (4.52) c	38.00 (6.20) d	0.67 (1.00) d	15.33 (3.43) b	0.67 (1.00) b	17.00 (3.61) b
T6	52.00 (7.22) a	37.67 (6.18) a	84.00 (9.19) a	36.67 (6.09) a	31.33 (5.62) a	5.00 (2.33) a	73.00 (8.57) a
T7	8.67 (3.02) c	16.33 (4.10) dc	25.00 (5.05) e	2.00 (1.56) cd	5.67 (2.48) cb	1.00 (1.17) b	8.67 (3.02) b
Exp. mean	5.5	4.62	7.21	2.5	2.76	1.3	3.96
LSD(0.05)	0.77	0.67	0.73	0.87	2.08	0.78	2.19

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	Malan											
	Weed parameters before herbicide application/ 1st hand weeding (Species wise)				Weed parameters at 10-15 DAHA (days after herbicide application) (Species wise)				Weed parameters at 45-50 DAHA (days after herbicide application) (Species wise)			
	Weed population no/m2				Weed population no/m2				Weed population no/m2			
	Grasses	Sedges	BLWs	Total weeds	Grasses	Sedges	BLWs	Total weeds	Grasses	Sedges	BLWs	Total weeds
T1	13.33 (3.68) a	19.33 (4.42) a	22.33 (4.78) a	55.00 (7.44) a	12.67 (3.63) ba	31.33 (5.59) ba	17.33 (4.20) ba	61.33 (7.83) ba	19.67 (4.46) b	35.00 (5.96) b	24.00 (4.93) b	78.67 (8.89) b
T2	11.67 (3.49) a	23.33 (4.88) a	25.33 (5.08) a	60.33 (7.80) a	11.00 (3.39) ba	29.33 (5.40)ba	16.00 (3.93) ba	56.33 (7.47) b	17.33 (4.22) b	32.00 (5.70) b	16.67 (4.12) cb	66.00 (8.15) cb
T3	12.33 (3.58) a	23.67 (4.92) a	20.00 (4.52) a	56.00 (7.51) a	8.33 (2.93)b	24.67 (4.97) b	10.67 (3.33)bc	43.67 (6.61)c	14.33 (3.83) cb	32.00 (5.69) b	14.67 (3.88) c	61.00 (7.83) c
T4	-	-	-	-	9.33 (3.03) b	5.33 (2.12) c	9.33 (3.12) bcd	24.00 (4.91) d	13.33 (3.71) cb	5.67 (2.17) c	10.67 (2.94) c	29.67 (5.39) d
T5	16.33 (4.10) a	18.67 (4.34) a	21.33 (4.67)a	56.33 (7.52) a	8.00 (2.86)bc	2.00 (1.47) c	1.33 (1.18) d	11.33 (3.38) e	5.67 (2.45) c	1.00 (1.10) c	2.67 (1.65) d	9.33 (3.13) e
T6	15.33 (3.97) a	22.67 (4.81) a	21.33 (4.65) a	59.33 (7.72) a	15.67 (4.02) a	33.67 (5.82) a	20.00 (4.49) a	69.33 (8.32) a	37.67 (6.09) a	41.33 (6.46) a	32.33 (5.68) a	111.33 (10.57) a
T7	14.33 (3.83) a	18.00 (4.25) a	22.33 (4.75) a	54.67 (7.42) a	2.67 (1.65) c	1.33 (1.29) c	2.6 (1.65) cd	6.67 (2.64) e	4.00 (2.11) c	0.33 (0.88) c	2.67 (1.65) d	7.00 (2.72) e
Exp. mean	**3.77**	**4.6**	**4.74**	**7.57**	**3.07**	**3.81**	**3.13**	**5.88**	**3.84**	**3.99**	**3.55**	**6.67**
LSD(0.05)	**0.76**	**0.67**	**0.73**	**0.79**	**1.05**	**1.35**	**1.08**	**0.55**	**1.03**	**1.08**	**1.34**	**1.00**

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	Puducherry			Raipur			
	Weed parameters before herbicide application/ 1st hand weeding	Weed parameters at 10-15 DAHA (days after herbicide application)	Weed parameters at 45-50 DAHA (days after herbicide application)	Weed parameters at 15 DAHA (days after herbicide application) (Species wise)			
	Weed population no/m2			Weed population no/m2			
	Total weeds			Grasses	Sedges	BLWs	Total weeds
T1	48.21 (6.98) e	20.33 (4.56)cd	28.14 (5.35)cd	25.53 (4.97)b	26.94 (5.08) cb	9.63 (3.08)ba	62.10 (7.80)b
T2	50.66 (7.15) dc	17.99 (4.30)d	26.16 (5.16)ed	24.17 (4.83) b	8.20 (2.92)cd	4.20 (2.08)dc	36.57 (6.01)cb
T3	52.47 (7.28)c	12.32 (3.58) e	19.79 (4.50) f	12.28 (3.54)c	0.00 (0.71)d	0.00 (0.71)d	12.28 (3.54)c
T4	54.96 (7.45) b	24.46 (4.99) b	34.01 (5.87) b	29.59 (5.03)b	8.13 (2.93)cd	0.00 (0.71)d	37.72 (5.84)cb
T5	48.95 (7.03) de	14.70 (3.90) e	23.72 (4.92)ef	8.50 (2.97)d	34.71 (5.80)b	5.57 (2.43)bc	48.78 (6.90)b
T6	54.73 (7.43) b	88.99 (9.46)a	118.83 (10.92) a	30.28 (5.53)a	70.80 (8.43)a	12.38 (3.56)a	113.46 (10.65)a
T7	58.21 (7.66) a	23.13 (4.86) cb	31.20 (5.63)cb	13.58 (3.74)c	44.15 (6.58)b	4.18 (2.13)dc	61.91 (7.87)b
Exp. mean	**7.28**	**5.09**	**6.05**	**4.37**	**4.64**	**2.1**	**6.95**
LSD(0.05)	**0.12**	**0.16**	**0.18**	**0.21**	**1.78**	**0.78**	**2.22**

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	IIRR						
	Weed dry weights at 45-50 DAHA g/m²			Weed dry weight at 15 DAHA g/m²			
	Grasses (Echinocloa colona)	Sedges (Cyperus difformis)	Total weeds	Grasses (Echinocloa colona)	Sedges (Cyperus difformis)	BLWs Eclipta alba	Total weeds
T1	4.34 d	19.87 a	24.21 b	14.33 b	7.69 ba	0.84 cb	22.86 b
T2	6.72 b	19.94 a	26.66 a	14.03 b	3.26 b	1.42 b	18.71 b
T3	5.4 c	9.18 e	17.54 d	12.59 c	3.91 b	0.84 cb	17.33 b
T4	4.34 d	11.08 d	14.37 f	12.41 c	3.85 b	0.00 c	16.26 b
T5	3.29 e	12.43 c	16.77 e	0.48 e	8.93 ba	0.30 cb	9.71 b
T6	8.36 a	14.45 b	19.85 c	32.27 a	14.11 a	4.85 a	51.23 a
T7	3.27 e	8.58 e	11.86 g	4.45 d	4.24 b	0.33 cb	9.02 b
Exp. mean	**5.1**	**13.65**	**18.75**	**12.94**	**6.57**	**1.23**	**20.73**
LSD(0.05)	**0.52**	**0.63**	**0.71**	**1.3**	**7.78**	**1.2**	**15.52**

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	Malan			Puducherry		
	Weed parameters before herbicide application/ 1st hand weeding (Species wise)	Weed parameters at 10-15 DAHA (days after herbicide application) (Species wise)	Weed parameters at 45-50 DAHA (days after herbicide application) (Species wise)	Weed parameters before herbicide application/ 1st hand weeding	Weed parameters at 10-15 DAHA (days after herbicide application)	Weed parameters at 45-50 DAHA (days after herbicide application)
	Weed dry biomass g/m2			Weed dry biomass g/m2		
T1	7.67 a	43.67 b	80.33 b	13.52 f	5.79 c	8.74 d
T2	7.83 a	38.67 cb	77.00 b	15.56 e	4.88 d	7.87 ed
T3	7.97 a	31.33 c	48.33 c	16.36 d	3.94 e	5.90 f
T4	-	20.67 d	37.00 dc	18.36 c	6.68 b	12.31 b
T5	7.70 a	17.33 d	26.00 d	13.78 f	4.25 ed	6.87 ef
T6	7.73 a	60.00 a	105.00 a	19.21 b	18.98 a	33.97 a
T7	8.20 a	12.00 d	12.00 e	22.28 a	6.53 b	10.97 c
Exp. mean	**6.73**	**31.95**	**55.10**	**17.01**	**7.29**	**12.38**
LSD(0.05)	**0.91**	**10.04**	**11.49**	**0.67**	**0.67**	**1.22**

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	Raipur			
	Weed parameters at 15 DAHA (days after herbicide application) (Species wise)			
	Weed dry biomass g/m²			Total weeds
	Grasses	Sedges	BLWs	
T1	49.35 a	5.17 b	6.67 a	61.19 b
T2	43.36 b	3.38 c	0.21 c	46.95 d
T3	18.99 c	0.00 e	0.00 c	18.99 e
T4	47.44 a	2.87 d	0.00 c	50.31 c
T5	10.70 d	3.76 c	0.56 c	15.02 f
T6	49.83 a	19.64 a	2.60 b	72.07 a
T7	5.69 e	4.27 b	1.99 b	11.95 g
Exp. mean	**32.19**	**5.58**	**1.72**	**39.50**
LSD(0.05)	**3.34**	**0.48**	**1.53**	**35.24**

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2: Contd.

Treatments	Weed Control Efficiency					
	Weed dry weight at 15 DAHA g/m2	Weed parameters at 10-15 DAHA (days after herbicide application) (Species wise)		Weed parameters at 45-50 DAHA (days after herbicide application) (Species wise)		Weed parameters at 15 DAHA (days after herbicide application) (Species wise)
	IIRR	Malan	Puducherry	Malan	Puducherry	Raipur
T1	55.37	27.21	69.49	23.49	74.27	15.09
T2	63.47	35.55	74.28	26.66	76.83	34.85
T3	66.17	47.78	79.24	53.97	82.63	73.65
T4	68.26	65.55	64.80	64.76	63.76	30.19
T5	81.04	71.11	77.60	75.23	79.77	79.15
T6	-	-	-	-	-	-
T7	82.39	80.00	65.59	88.57	67.70	83.41
Exp. mean						
LSD(0.05)						

T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application
T6- Control (weedy)
T7- Hand weeding twice

Table-4.3.2:.Effect of different post - emergence herbicides on weed population, dry weight and yield of rice

Treatments	Total weed population before herbicide application	Total weed biomass before herbicide application	Total weed population 15 days after herbicide application	Total weed dry biomass 15 days after herbicide application	Weed control efficiency	Panicles no/m^2	Grain yield t/ha	Straw yield t/ha	Grain yield loss %
T1-Thiobencarb @ 4.00 L/ha with 500 L water/ha post-emergence application at 20 DAS	65.5 bc	15.55 ba	40.1 b	33.6 b	44.82	371 c	4.49 d	5.47 d	17.15
T2-Thiobencarb @ 4.50 L/ha with 500 L water/ha post-emergence application at 20 DAS	73.1 a	16.80 a	30.2 cb	24.7 cb	59.44	398 b	4.90 c	5.85 bc	9.59
T3-Thiobencarb @ 5.00 L/ha with 500 L water/ha post-emergence application at 20 DAS	69.2 ba	14.86 ba	19.4 d	16.22 c	73.36	417 ba	5.16 b	6.12 ba	4.79
T4-Standard check(Recommended herbicide)pyrazosulfuron ethyl 10 % @ 200 g/ha. Pre-emergence application	33.6 f	16.36 a	22.9 cd	20.3 c	66.66	371 c	4.64 d	5.63 dc	14.39
T5-Standard check(Recommended herbicide) Bispyribacsodium 10 % @ 300 ml/ha. Post-emergence application	59.8 c	13.91 b	22.9	20 c	67.15	431 a	5.28 b	6.34 a	2.58
T6- Control (weedy)	53.5 d	15.59 ba	82.4 a	60.9 a	-	304 d	3.60 e	4.47 e	33.57
T7- Hand weeding twice	45.9 e	14.11 b	25.0 cd	22.3 c	63.38	424 a	5.42 a	6.27 a	-
LSD(P =0.05)	**5.71**	**2.20**	**9.90**	**10.3**		**21**	**0.23**	**0.37**	

RICE BASED CROPPING SYSTEMS

(Conservation Agriculture / System Based Management)





4.4. RICE BASED CROPPING SYSTEM

CONSERVATION AGRICULTURE/SYSTEM BASED MANAGEMENT (CA/SM)

4.4.1. Conversation Agriculture/system base management practices in rice and rice based cropping systems (crop diversification) to utilise the resources and enhancing the profitability and productivity

Conservation agriculture systems utilize soils for the production of crops with the aim of reducing excessive mixing of the soil and maintaining crop residues on the soil surface in order to minimize damage to the environment. **The three principles** of CA are: minimum tillage and soil disturbance, permanent soil cover with crop residues live mulches and crop rotation and intercropping.

Among the various cropping systems being practiced in India, Rice based cropping systems is considered to be the most important because of its large area coverage and contribution to total food grain production. Transplanting is the most dominant and traditional method of establishment in irrigated lowland rice. However, due to non-availability of irrigation water, shortage of labour during peak period of transplanting and escalating labour costs make the transplanting technique more expensive which invariably leads to delay in transplanting and resulting in reduction of yield. Crop residue especially Rice-Straw containing about 1-2% of 'K' a good source of the especially for intensively cropped soils. Residue incorporation is known to help *Rabi* crops in rice-based cropping systems. To address this problem, alternate methods of crop establishment need to be evolved to substitute manual transplanting method under various agro-ecologies. Hence, this trial was initiated with a view to evaluate systems of rice crop establishment under different residue management to realize the production potential of alternate systems of crop establishment under different residue retention.

A trial was laid out in split plot design with four replications during *Kharif* 2017 at three locations continued at **Titabar**, **Aduthurai, Krajat, Rajendranagar** and **Vadgoan** during 2018 to assess the effect of different crop establishment methods under various residue/straw management practices. Main plot treatments comprised of three different crop establishment methods (M_1: Transplanting, M_2: Wet seeding (line sowing under puddled conditions) and M3: Aerobic rice – Dry rice cultivation). The sub plot treatments comprised of three different residue/straw management (S_1: No residue, S_2: 15cm height of rice straw from ground, S_3: 30cm height of rice straw from ground) to be superimposed for *Rabi* crops. The results are summarized and presented in Table 4.4.2 and the salient findings are summarized below.

Crop establishment methods influenced the grain yield significantly at all locations. At **Aduthurai**, results revealed that M_1: transplanting of rice recorded significantly higher yield attributes and grain yield (4.55 t/ha) as compared to other crop establishment methods. Similarly at **Titabar**, the grain yields were higher (4.49 t/ha) with transplanting method. Similar trend of

higher grain yield (5.67 t/ha) with transplanting was reported at **Rajendranagar** (5.67 t/ha) and **Karjat** (4.89 t/ha) also. However, at **Vadagaon**, aerobic rice method gave significantly higher grain yield (5.65 t/ha) over other methods of crop establishment. Suitability of wet seeding and Aerobic rice at **Vadagaon** location under clay loam soil. Transplanting method showed its significant superiority in minimizing the weed population and weed dry biomass at 45 and 60 DAS over wet seeding **Aduthurai**. Among the residue management practices, rice straw incorporation during *Rabi* season gave better yields over no residue at **Vadagoan** with reduced weed population and weed dry matter.

Among crop establishment methods transplanting exhibit significant differences with respect to growth and yield attributes at **Aduthurai, Titabar, Rajendranagar** and **Karjat**. However, aerobic rice method found promising over transplanting and wet seeding in puddle rice at vadagoan. The study was initiated only in Kharif 2018 at some locations and the experiment has to be continued further in rabi season 2019-20 to evaluate the effect of crop establishment methods as well as to assess the effect of retaining of rice residue for succeeding crop.

Table 4.4.1: Summary of data on grain yield and ancillary characters conservation Agriculture/system based management practices in rice and rice based cropping systems to utilise the resources and enhancing the profitability and productivity, Kharif - 2018.

Main plot	Sub plots	ADUTHURAI							TITABAR				
		Grain Yield (t/ha)	Panicle/m2 (No.)	Test weight (g)	Weed population at 30 DAS (No/m2)	Weed Dry wt at 30 DAS (g/m2)	Weed population at 60 DAS (No/m2)	Weed Dry wt at 60 DAS (g/m2)	Grain Yield (t/ha)	Panicle/m2 (No.)	Panicle weight (g)	Days 50% flowering	Weed Dry wt (g/m2)
M1- Transplanting	S1	4.49	302	17.27	10.00(3.21)	2.07	12.33(3.56)	3.87	4.96	291	3.59	106	19.36
	S2	4.51	290	17.10	10.33(3.28)	1.77	14.33(3.85)	4.17	4.59	277	4.24	108	19.33
	S3	4.65	293	17.17	12.00(3.52)	2.2	14.67(3.84)	4.3	3.91	254	3.96	112	15.85
M2- Wet seeding	S1	3.40	303	16.93	15.00(3.93)	2.97	18.00(4.30)	4.4	3.69	247	3.50	104	25.42
	S2	3.60	302	16.90	16.33(4.10)	3.13	18.33(4.31)	4.03	3.5	244	3.45	104	22.17
	S3	3.57	301	16.83	17.33(4.22)	3.3	20.67(4.54)	4.8	2.95	227	3.19	109	20.18
M3- Aerobic rice	S1	3.22	301	16.77	20.33(4.56)	3.47	25.00(5.04)	6.23	2.19	223	3.17	116	40.98
	S2	3.16	299	16.80	21.33(4.67)	3.07	23.00(4.81)	6.23	2.16	217	2.94	113	37.49
	S3	3.32	291	16.87	24.00(4.95)	2.77	25.00(5.04)	6.2	2.01	217	2.67	115	34.43
Mean of main plots													
M1		4.55	295	17.18	10.78(3.34)	2.01	13.78(3.75)	4.11	4.49	274	3.93	109	18.18
M2		3.53	302	16.89	16.22(4.08)	3.13	19.00(4.38)	4.41	3.38	239	3.38	105	22.59
M3		3.24	297	16.81	21.89(4.72)	3.10	24.33(4.97)	6.22	2.12	219	2.93	115	37.63
C.D.(0.05)		0.08	NS	0.07	0.26	0.29	0.56	0.6	0.14	10.58	0.25	0.7	2.35
C.V.(%)		2.61	1.76	0.47	7.55	12.39	15.29	14.57	4.96	5.18	8.86	0.77	10.74
Mean of Sub plots													
S1		3.70	302	16.99	15.11(3.90)	2.83	18.44(4.30)	4.83	3.61	254	3.42	109	28.59
S2		3.76	297	16.93	16.00(4.02)	2.66	18.56(4.32)	4.81	3.42	246	3.54	108	26.33
S3		3.85	295	16.96	17.78(4.23)	2.76	20.11(4.47)	5.10	2.95	232	3.27	112	23.48
C.D.(0.05)		NS	NS	NS	NS	NS	NS	NS	0.23	12.83	NS	0.88	2.87
C.V. (%)		4.15	1.85	0.98	8.81	11.59	11.01	8.84	6.74	5.12	11.91	0.79	10.68
Interaction													
N at same V		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.53	NS
V at same N		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.31	NS
Expt. Mean		**3.77**	**298**	**16.96**	**4**	**2.75**	**4.37**	**4.91**	**3.33**	**244**	**3.41**	**110**	**26.13**
Variety		-							Shraboni				
Soil type		Clay							-				
pH		7.2							-				
RDF N:P:K (kg/ha)		150:60:60							-				
Aval. N:P:K of soil (kg/ha)		28.5:72.5:132							-				

S1 - No residue
S2 - 15cm height of rice straw from ground
S3 - 30cm height of rice straw from ground

Table 4.4.1: Contd.

Main plot	Sub plots	VADGAON							Over all mean	Rank
		Grain Yield (t/ha)	Panicle/m2 (No.)	Panicle weight (g)	Test weight (g)	Days 50% flowering	Weed population at 45 DAS (No/m2)	Weed Dry wt at 45 DAS (g/m2)		
M1- Transplanting	S1	4.89	272	1.87	22.48	96	12.75(3.62)	20.32	4.78	2
	S2	5.61	309	2.13	22.27	96	5.75(2.49)	9.87	4.90	1
	S3	5.72	319	2.19	23.07	96	4.00(2.11)	6.62	4.76	3
M2- Wet seeding	S1	4.7	261	1.73	20.73	96	15.00(3.92)	24.36	3.93	6
	S2	5.78	324	2.25	23.38	96	5.00(2.34)	7.23	4.29	4
	S3	5.89	335	2.31	23.8	96	3.50(2.00)	9.27	4.14	5
M3- Aerobic rice	S1	4.91	251	1.75	20.2	96	17.00(4.17)	28.08	3.44	9
	S2	5.97	338	2.34	24.23	96	5.25(2.40)	8.5	3.76	8
	S3	6.07	348	2.4	24.88	96	3.75(2.06)	5.99	3.80	7
Mean of main plots										
M1		5.41	300	2.07	22.61	96	7.50(2.74)	12.27	4.82	1
M2		5.45	306	2.10	22.63	96	7.83(2.75)	13.62	4.12	2
M3		5.65	312	2.17	23.10	96	8.67(2.87)	14.19	3.67	3
C.D.(0.05)		0.16	1.56	0.03	0.36	NS	NS	NS		
C.V.(%)		2.85	0.51	1.89	1.59	1.38	5.04	22.99		
Mean of Sub plots										
S1		4.83	261	1.79	21.13	96	14.92(3.91)	24.25	4.05	3
S2		5.78	324	2.24	23.29	96	5.33(2.41)	8.53	4.32	1
S3		5.89	334	2.30	23.92	96	3.75(2.06)	7.29	4.23	2
C.D.(0.05)		0.19	4.96	0.06	0.35	NS	0.18	3.55		
C.V. (%)		3.93	1.89	2.91	1.78	1.02	7.64	31		
Interaction										
N at same V		NS	8.58	NS	0.6	NS	NS	NS		
V at same N		NS	7.11	NS	0.56	NS	NS	NS		
Expt. Mean		**5.50**	**306**	**2.11**	**22.78**	**96**	**3**	**13.36**	**4.20**	
Variety		Phule samruddhi								
Soil type		-								
pH		-								
RDF N:P:K (kg/ha)		100;50;50								
Aval. N:P:K of soil (kg/ha)		183:19:231								

S1 - No residue

S2 - 15cm height of rice straw from ground

S3 - 30cm height of rice straw from ground

Follow up crop : Gram

Table 4.4.1: Contd.

Main Methods	KARJAT								
	Grain Yield (t/ha)	Panicle/m2 (No.)	Panicle weight (g)	Test weight (g)	Days 50% flowering	Weed population at 30 DAS (No/m2)	Weed Dry wt at 30 DAS (g/m2)	Weed population at 60 DAS (No/m2)	Weed Dry wt at 60 DAS (g/m2)
M1- Transplanting	4.89	298	3.05	23.30	88	7.00(2.74)	1.47	5.13(2.37)	1.39
M2- Wet seeding	4.51	312	3.33	23.48	88	8.13(2.94)	1.76	6.13(2.57)	1.72
M3- Aerobic rice	4.09	287	2.84	23.94	87	9.27(3.13)	1.95	7.20(2.77)	2.05
Exp. mean	4.50	299	3.07	23.57	88	2.93	1.73	2.57	1.72
CD(0.05)	0.06	4.61	0.09	0.39	0.49	0.14	0.20	0.08	0.11
CV	0.97	1.06	2.12	1.13	0.38	3.28	8.16	2.07	4.39
res(t)	**	**	**	NS	NS	*	*	**	**
Variety	-								
Soil type	-								
pH	-								
RDF N:P:K (kg/ha)	100:50:50								
Aval. N:P:K of soil (kg/ha)	-								

Table 4.4.1: Contd.

Main Methods	RAJENDRANAGAR-ARI								
	Grain Yield (t/ha)	Panicle/m2 (No.)	Panicle weight (g)	Test weight (g)	Days 50% flowering	Weed population at 30 DAS (No/m2)	Weed Dry wt at 30 DAS (g/m2)	Weed population at 60 DAS (No/m2)	Weed Dry wt at 60 DAS (g/m2)
M1- Transplanting	5.67	221	19.21	12.97	83	12.73(3.63)	2.30	15.63(3.99)	22.40
M2- Wet seeding	5.00	243	19.75	12.27	80	11.30(3.40)	1.57	16.83(4.09)	22.31
M3- Aerobic rice	3.73	209	18.52	44.30	80	12.30(3.51)	2.43	15.63(3.85)	57.95
Exp. mean	4.80	224	19.16	23.18	81	3.51	2.10	3.98	34.22
CD(0.05)	0.57	64.28	3.57	47.85	0.48	0.81	0.63	0.90	40.86
CV	8.16	19.75	12.84	142.36	0.41	15.95	20.85	15.53	82.34
res(t)	**	NS	NS	NS	**	NS	NS	NS	NS
Variety	-								
Soil type	Loamy								
pH	7.8								
RDF N:P:K (kg/ha)	120:60:40								
Aval. N:P:K of soil (kg/ha)	213:88:750								

4.4.2. Enhancing productivity of rice-pulse system under different crop establishment methods

Among the various cropping systems being practiced in India, Rice based cropping systems is considered to be the most important because of its large area coverage and contribution to total food grain production.

On an average, 30% of area under rice production during *kharif s*eason in India remain fallow in the subsequent *rabi* due to number of biotic, abiotic and socio-economic constraints. A large area (11.6 m ha) of rice fallow under rainfed condition can be brought under pulse provided availability of land water resources.

Pulses are the ideal crops that can be grown in the areas vacated after rice, because of their property to establish with the surface seeding and suitability for relay/para cropping and resistance against soil moisture and temperature stress. The suitable pulse crops are lentil, lathyrus, urd bean, mung bean and chick pea.

Transplanting is the most dominant and traditional method of establishment in irrigated lowland rice. However, due to non-availability of irrigation water, shortage of labour during peak period of transplanting and escalating labour costs make the transplanting technique more expensive which invariably leads to delay in transplanting and resulting in reduction of yield. To mitigate this problem, alternate methods need to be evolved to substitute manual transplanting method under various agro-ecologies. Hence, this trial was initiated with a view to evaluate systems of rice crop establishment under different cropping systems (especially rice-pulse) to realize the production potential of alternate systems (inclusion of pulses) of crop establishment under different sequences.

The trial was conducted at 5 locations **Ghaghraghat**, **Kanpur**, **Titabar**, **Mandya** and **Chinsurah**) during Kharif 2017 and continued at all locations except **Mandya** in *kharif* 2018. **Ragolu** centre at Andhra Pradesh also took the experiment for first time during 2018. Main plot treatments comprised of two different crop establishment methods (M_1: Transplanting, M_2: Wet seeding (line sowing under puddled conditions). The sub plot treatments comprised of five different cropping sequences (S_1: Rice-Wheat-Pulse, S_2: Rice-Rice-Pulse, S_3: Rice-Maize-Pulse, S_4: Rice-Oilseed-Pulse and S_5: Rice-Rice). The results are summarized and presented in Table 4.4.2 and the salient findings are summarized below.

Among the crop establishment methods for rice in *kharif* 2018, transplanted method gave significantly higher grain yield at **Ghaghraghat** (3.43 t/ha), **Kanpur** (4.56 t/ha) and **Titabar** (4.99 t/ha) except at **Ragolu**, where in wet seeding in puddle field gave significantly higher grain yield (6.23 t/ha). No significant difference were found at **Chinsurah** due to different crop establishment methods. Incorporation of pluse crop in the system gave significantly higher grain yield at **Chinsurah** (2.48 to 2.63 t/ha over 2.2 t/ha), **Ragolu** (6.02 to 6.14 t/ha over 5.99 t/ha) and **Ghaghraghat** (3.04 to 3.09 t/ha over 2.57 t/ha) as compared to rice-rice system alone.

Among the cropping sequences, rice-cowpea exhibited significant differences with respect to grain yield (REY) at **Mandya** (9.05 t/ha) during 2017-18. However at **Kanpur**, Rice-Wheat-Pulse (11.00 t/ha) cropping system followed by Rice-Mustard-Pulse cropping system (7.47 t/ha) recorded higher grain yield over other cropping system. *Pre-kharif* pulse increased grain yield significantly over rice-rice system and the experiment need to be continued for assessing the long term effect of pulse in different cropping system.

The result indicated that, transplanting method found promising at most of the locations over wet seeded rice in puddle system. Incorporation of pulse in different rice based cropping systems increased grain yield significantly over rice-rice system alone.

Table 4.4.2: Summary of data on grain yield and ancillary characters Enhancing productivity of rice-pulse system under different crop establishment methods in Kharif – 2018

Main plot	Nutrient levels	CHINSURAH				RAGOLU								
		Grain Yield (t/ha)	Panicle/m2 (No.)	Panicle weight (g)	Straw Yield (t/ha)	Grain Yield (t/ha)	Panicle/m^2 (No.)	Panicle weight (g)	Test weight (g)	Days for 50% Flowering	Weed Population at 30DAS	Weed Population at 60DAS	Weed Dry wt at 30 DAS (g/m2)	Weed Dry wt at 60 DAS (g/m2)
M1- Transplanting	S1	2.26	198	2.05	2.73	5.79	157	2.66	26.49	95	33.25(5.80)	14.25(3.80)	33.65	28.35
	S2	2.16	189	1.95	2.61	5.61	157	2.66	26.52	96	36.25(6.05)	11.75(3.47)	31.75	22.98
	S3	2.59	225	2.35	3.12	5.8	115	2.72	26.53	95	43.00(6.59)	16.25(4.01)	42.00	31.40
	S4	2.68	234	2.42	3.23	5.9	121	2.78	26.74	95	42.75(6.55)	10.75(3.33)	36.79	24.18
	S5	2.24	196	2.02	2.7	5.78	150	2.78	25.98	95	36.25(5.99)	12.50(3.57)	38.50	24.70
M2- Wet seeding	S1	2.7	236	2.44	3.26	6.24	141	2.72	26.22	86	50.50(7.11)	89.50(9.46)	51.13	45.85
	S2	2.84	248	2.56	3.42	6.11	168	2.75	26.81	87	48.00(6.91)	87.50(9.35)	46.25	53.70
	S3	2.78	243	2.51	3.36	6.25	148	2.7	26.6	85	45.75(6.79)	86.50(9.27)	51.90	54.67
	S4	2.57	224	2.32	3.1	6.37	166	2.72	26.51	86	46.25(6.78)	93.25(9.63)	48.45	44.73
	S5	2.18	190	1.96	2.63	6.19	169	2.69	26.65	86	56.00(7.46)	102.25(10.13)	50.58	55.49
Interaction														
N at same V		0.32	27.93	NS	0.39	NS	NS	NS	NS	NS	NS	NS	NS	NS
V at same N		0.6	52.3	NS	0.72	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean of Main plots														
M1		2.39	208	2.16	2.88	5.78	140	2.72	26.45	95	38.30(6.20)	13.10(3.64)	36.54	26.32
M2		2.61	228	2.36	3.15	6.23	158	2.72	26.56	86	49.30(7.01)	91.80(9.57)	49.66	50.89
C.D.(0.05)		NS	NS	NS	NS	0.37	8.96	NS	NS	0.84	0.78	1.21	11.86	10.69
C.V.(%)		27.03	19.62	19.62	19.17	6.11	5.98	0.98	1.48	0.92	11.8	18.26	27.34	27.52
Mean of Sub plots														
S1		2.48	217	2.25	3.00	6.02	149	2.69	26.36	91	41.88(6.46)	51.88(6.63)	42.39	37.10
S2		2.50	218	2.26	3.02	5.86	162	2.71	26.67	91	42.13(6.48)	49.63(6.41)	39.00	38.34
S3		2.69	234	2.43	3.24	6.03	131	2.71	26.57	90	44.38(6.69)	51.38(6.64)	46.95	43.04
S4		2.63	229	2.37	3.17	6.14	144	2.75	26.63	90	44.50(6.67)	52.00(6.48)	42.62	34.46
S5		2.21	193	1.99	2.67	5.99	160	2.74	26.32	91	46.13(6.72)	57.38(6.85)	44.54	40.10
C.D.(0.05)		0.23	19.75	0.21	0.27	NS	NS	NS	NS	0.73	NS	NS	NS	NS
C.V. (%)		7.44	7.39	7.60	7.4	3.77	23.79	2.81	1.42	0.78	12.31	9.12	27.83	26.62
Expt. Mean		**2.50**	**218**	**2**	**3.02**	**6.00**	**149**	**2.72**	**26.51**	**90**	6.60	6.60	**43.10**	**38.61**
Variety		Gobindobhog				IR 64								
Soil type		Clay loam				Red sandy loam								
pH		7.01				7.23								
RDF N:P:K (kg/ha)		80:40:40:5				100:50:50:20								
Aval. N:P:K of soil (kg/ha)		410: 85:279				107:30:216								
Cropping system														
S1		S1 - Rice-wheat-pulse				S1 - Rice-wheat-pulse								
S2		S2 - Rice-rice-pulse				S2 - Rice-rice-pulse								
S3		S3 - Rice-maize-pulse				S3 - Rice-maize-pulse								
S4		S4 - Rice-Oilseed-pulse				S4 - Rice-Oilseed-pulse								
S5		S5 - Rice-rice (control)				S5 - Rice-rice (control)								

Table 4.4.2: Contd.

Main plot	Nutrient levels	GHAGHRAGHAT			KANPUR			TITABAR				Over all mean	Rank
		Grain Yield (t/ha)	Panicle/m^2 (No.)	Test weight (g)	Grain Yield (t/ha)	Panicle/m^2 (No.)	Panicle weight (g)	Grain Yield (t/ha)	Panicle/m^2 (No.)	Panicle weight (g)	Days 50% flowering		
M1- Transplanting	S1	3.46	178	2.15	4.56	279	2.68	4.99	197	4.54	128	4.21	3
	S2	3.29	163	2.13				5.13	183	4.72	130	4.05	4
	S3	3.75	194	2.22	4.64	283	2.72	4.95	193	4.74	131	4.35	2
	S4	3.54	185	2.16	4.49	276	2.65	5.14	193	4.31	132	4.35	1
	S5	3.13	157	2.07				4.75	188	4.65	130	3.98	7
M2- Wet seeding	S1	2.62	167	2.18	4.14	271	2.61	4.48	165	3.79	116	4.04	5
	S2	2.21	147	2.03				4.43	170	4.27	119	3.90	9
	S3	2.42	154	2.05	4.07	267	2.57	4.34	168	4.24	119	3.97	8
	S4	2.71	179	2.09	3.95	265	2.55	4.46	159	4.27	119	4.01	6
	S5	2.00	138	1.97				4.15	174	4.18	118	3.63	10
Interaction													
N at same V		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
V at same N		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
Mean of Main plots													
M1		3.43	175	2.15	4.56	279	2.68	4.99	191	4.59	130	4.23	1
M2		2.39	157	2.06	4.05	268	2.58	4.37	167	4.15	118	3.93	2
C.D.(0.05)		0.34	6.54	0.07	0.38	11.59	NS	NS	16.91	0.38	1.98		
C.V.(%)		11.67	3.92	3.3	4.37	2.09	2.03	13.41	9.4	8.67	1.58		
Mean of Sub plots													
S1		3.04	173	2.17	4.35	275	2.65	4.74	181	4.17	122	4.12	3
S2		2.75	155	2.08				4.78	176	4.50	124	3.97	4
S3		3.09	174	2.14	4.36	275	2.65	4.65	180	4.49	125	4.16	2
S4		3.13	182	2.13	4.22	271	2.60	4.80	176	4.29	126	4.18	1
S5		2.57	147	2.02				4.45	181	4.42	124	3.80	5
C.D.(0.05)		0.41	10.05	NS	NS	NS	NS	NS	NS	NS	1.89		
C.V. (%)		13.78	5.86	8.18	3.78	1.66	2.08	7.03	6.75	6.87	1.47		
Expt. Mean		**2.91**	**166**	**2.11**	**4.31**	**274**	**2.63**	**4.68**	**179**	**4.37**	**124**	4.08	
Variety		NDR 359			Pant 12			Swarna Sub-1					
Soil type		Sandy loam			Sandy loam			-					
pH		8.06			7.9			-					
RDF N:P:K (kg/ha)		120:60:40			120:60:60			-					
Aval. N:P:K of soil (kg/ha)		208:20:183			-			-					
Cropping system													
S1		S1 - Rice-wheat-pulse			S1 - Rice-wheat-pulse			S1 - Rice-wheat-pulse					
S2		S2 - Rice-rice-pulse			-			S2 - Rice-rice-pulse					
S3		S3 - Rice-maize-pulse			S3 - Rice-maize-pulse			S3 - Rice-maize-pulse					
S4		S4 - Rice-Oilseed-pulse			S4 - Rice-Oilseed-pulse			S4 - Rice-Oilseed-pulse					
S5		S5 - Rice-rice (control)			-			S5 - Rice-rice (control)					

Table-4.4.2(R): Summary of data on grain yield characters of rice from enhancing productivity of rice-pulse system under different establishment methods in during Rabi 2017-18.

Treatment	Croping Sequence	KANPUR				MANDYA					
		Grain yield (t/ha) Kharif 2017	Grain yield (t/ha) Rabi 2017-18	REY	Total REY (K+ R)	Grain yield (t/ha) Kharif 2017	Grain yield (t/ha) Rabi 2017-18	Germination % (R)	Plant population No.m2	REY	Total REY (K+ R)
M1- Transplanting	S1 - Rice-Wheat-Pulse	4.85	4.95	5.43	10.28	5.69	0.83	71.43	18.7	2.89	8.58
	S2 - Rice-Rice-Pulse	-				6.01	0.71	65.40	24.0	2.55	8.56
	S3 - Rice-Maize-Pulse	4.79	2.03	1.87	6.66	5.78	0.7	67.62	26.3	2.44	8.22
	S4 - Rice-oilseed-Pulse	4.81	1.57	2.96	7.77	5.53	0.75	72.38	29.4	1.48	7.01
	S5 - Rice-Rice	-				5.63	0.8	62.54	24.7	2.04	7.67
M2- Wet Seeding (line sowing under puddled condition	S1 - Rice-Wheat-Pulse	4.34	4.91	5.39	9.73	6.52	0.86	71.11	20.3	3.00	9.52
	S2 - Rice-Rice-Pulse	-				6.58	0.67	74.29	28.7	2.41	8.99
	S3 - Rice-Maize-Pulse	4.43	1.96	1.80	6.23	6.71	0.83	73.33	28.0	2.89	9.60
	S4 - Rice-oilseed-Pulse	4.26	1.54	2.91	7.17	6.84	0.7	69.84	26.7	1.38	8.22
	S5 - Rice-Rice	-				6.88	0.72	67.62	26.1	1.83	8.71
Interaction											
M and S		NS	NS	-		NS	NS	NS	NS	-	
S and M		NS	NS	-		NS	NS	NS	NS	-	
Mean of Factor-1											
M1		4.82	2.85	3.42	8.24	5.73	0.76	67.87	24.6	2.28	8.01
M2		4.34	2.8	3.36	7.71	6.71	0.76	71.24	25.9	2.30	9.01
C.D. (0.05)		0.34	NS	-		0.58	NS	NS	NS	-	
C.V. (%)		3.68	2.17	-		9.28	17.77	29.39	18.18	-	
Mean of Factor-2											
S1		4.595	4.93	5.41	10.00	6.11	0.84	71.27	19.5	2.94	9.05
S2		-				6.30	0.69	69.84	26.3	2.48	8.78
S3		4.61	1.99	1.83	6.44	6.25	0.77	70.48	27.2	2.67	8.91
S4		4.535	1.55	2.94	7.47	6.19	0.72	71.11	28.1	1.43	7.61
S5		-				6.26	0.76	65.08	25.4	1.94	8.19
CD (0.05)		NS	0.17	-	-	NS	NS	NS	2.45	-	-
C.V. (%)		2.94	4.42	-	-	5.18	20.75	8.05	7.9	-	-
Experimental Mean		**4.58**	**2.82**	**3.39**	**7.97**	**6.22**	**0.76**	**69.56**	**25.3**	**2.29**	**8.51**
Soil type		Sandy loam				Red sandy loam					
Applied fertiliser dose (N-P-K-Zn kg/ha)		100:60:40:25	0.54			100:50:50:20					
pH		7.60	7.94			7.23					
Available soil nutrient status		21-18.33-209	217:16:209			107:30:216					
Variety		-				IR 64					

S1	Wheat PBW-343 (MSP Rs.1700/Q)		Cowpea:PGCP 6 (MSP Rs.5400/Q)
S2	-		Green gram: KKM-3 (MSP Rs.5575/Q)
S3	Maize: Azad Uttam (MSP Rs.1425/Q)	Rice: IR-64	Black gram: KU-14-8 (MSP Rs.5400/Q)
S4	Mustard: T-59 (MSP Rs.2775)		Soybean: J-5-335 (MSP Rs.3050/Q)
S5	-		Avare: HA-4 (MSP Rs.3950)

4.4.3 Analysis of long term meteorological data of AICRIP centres (temp and rainfall) for identifying the reasons for yield reduction

Impact of climate change on rice production and productivity of different co-ordinated centers of rice

Introduction

Climate change is real. It impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of the high population depending on agriculture and excessive pressure on natural resources. The warming trend in India over the past 100 years (1901 to 2007) was observed to be 0.51^{o}C with accelerated warming of 0.21^{o}C per every10 years since 1970 (Kumar 2009). Very hot debate on global warming is going on (Kerr 2009), the mean global temperature has increased by 0.8^{o}C since 1880, and may increase by an additional 3 to 7^{o}C by 2100 as usual scenario (Allen et al.2009). For every one degree increase in temperature, yields of wheat, soybean, mustard, groundnut and potato are expected to decline by 3–7% (Agarwal 2009). Similarly, rice yields may decline by 6% for every one degree increase in temperature (Saseendran et al. 2000, Ilangovan et.al.). Agronomic management practices such as water requirement of crops is also likely to go up with projected warming and extreme events are likely to increase. Hence, there is a need to address the whole issue of climate change and its impacts on Indian agriculture in totality so as to cope with it through adaptation and mitigation.

Trends in Key Weather Parameters of temperature rainfall in different AICRIP Centre's

Rainfall is the key variable influencing crop productivity in agricultural crops in general and rainfed crops in particular. Intermittent and prolonged droughts are a major cause of yield reduction in most crops. Equally important weather parameters minimum and maximum temperature and number of rainy days are directly influencing the rice yield. Very particularly the minimum temperature raise is directly declining the rice yield. Total of eleven centre's (Vadagon, Coimbatore, Mandya, Gangavathy, Jagdalpur, Karjat, Khudwani, Ludhiana, Rajendranagar and Hyderabad) climate datum for 2005 to 2017 were grouped and commented critically in this program.

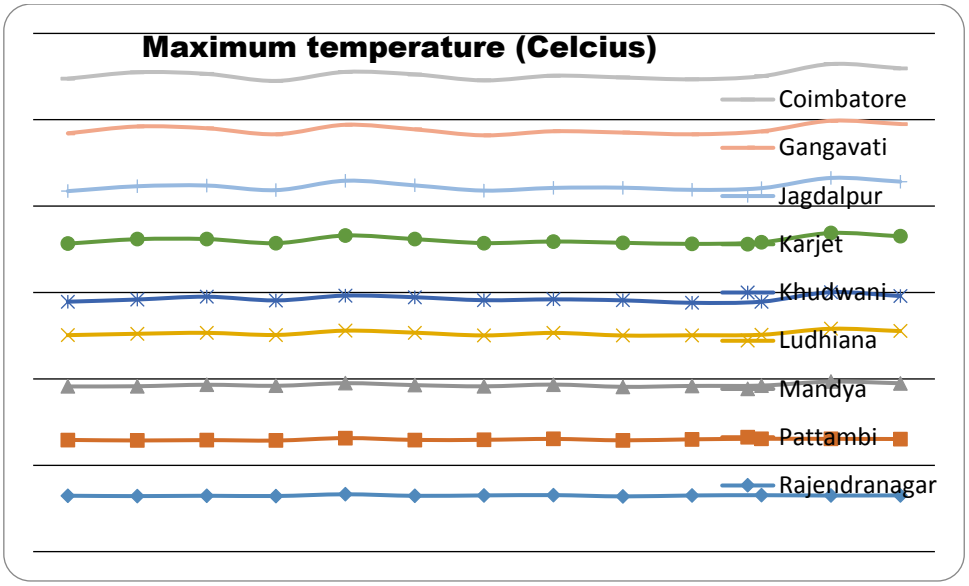
MAXIMUM & MAXIMUM TEMPERATURE

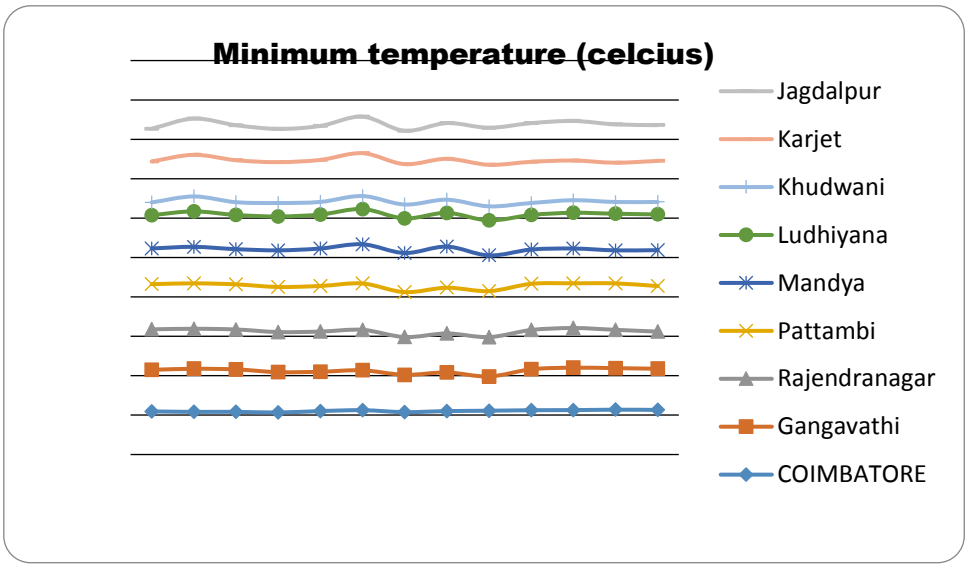
All the data recorded for standard weeks of Kharif and Rabi seasons are analysed and observed the differences with respect to 11 years (2005 - 2017) datum. Most of the centres are observed with raise in maximum temperatures when compared to the average of eleven years of 2005 to 2015. The change is very visible during the kharif seasons than Rabi. The raise in maximum temperature is very visible to the tune of 2 to 3^{o}C during Kharif season. (Table 1.) Similarly the raise of minimum temperatures particularly during the standard weeks of 45 to 52 (Rabi months) is observed in many of the centres. Raise in minimum temperatures is recorded of 0.4 to 1.9 ^{o}C in most of the centres. As per the literatures the raise in minimum temperature is not at all good sign for rice production and productivity. There are lot of variations in minimum temperatures is observed during the standard weeks of 23 to 39 in most

of the centres. Remarkably the centres viz., Gangavathy, Mandya, Ludhiana, Pattambi the raise in minimum temperature is very acute.

Table 1. Difference in Temperatures of different AICRIP Centers

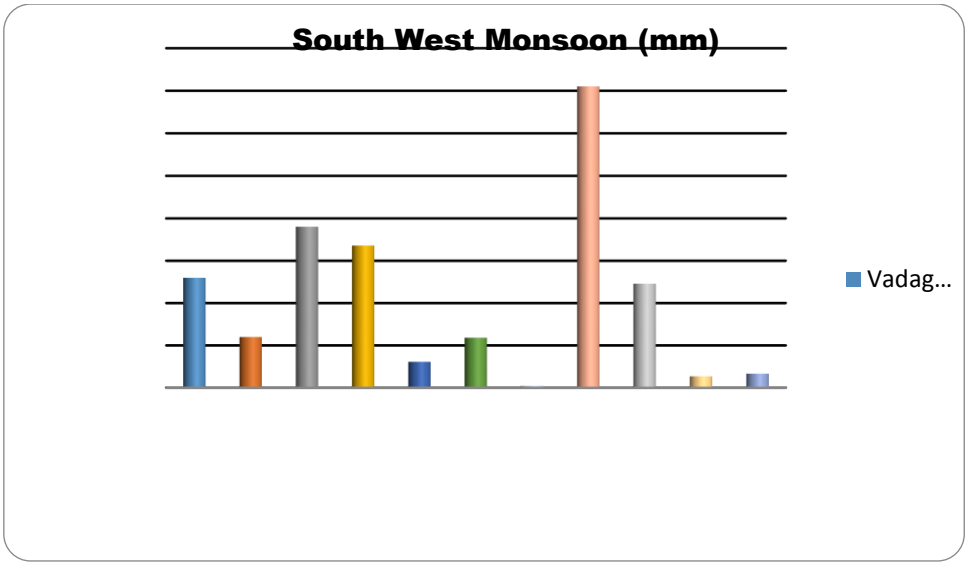
MAXIMUM (c)			MINIMUM (c)		
Pattambi			Pattambi		
Season	Kharif	Rabi	Season	Kharif	Rabi
13 Yrs	30.0	31.8	13 Yrs	23.5	22.6
2017	30.1	31.8	2017	23.6	22.4
Rajendranagar			Rajendranagar		
13 Yrs	31.3	29.8	11 Yrs	23.2	14.9
2017	30.8	29.9	2015	22.2	12.3
Karjet			Karjet		
13 Yrs	30.4	34.0	13 Yrs	24.4	18.4
2017	30.6	33.7	2017	24.3	18.3
Ludhiana			Ludhiana		
13 Yrs	34.5	26.5	13 Yrs	26.0	12.2
2017	34.6	26.4	2017	26.2	12.6
COIMBATORE			COIMBATORE		
13 Yrs	31.3	29.8	13 Yrs	23.1	21.2
2017	31.6	30.4	2017	23.5	21.9
GANGAVATI			GANGAVATI		
13 Yrs	32.0	30.3	13 Yrs	22.4	17.9
2017	32.3	29.6	2017	23.5	15.5
MANDYA			MANDYA		
13 Yrs	30.5	30.5	13 Yrs	19.8	17.8
2017	31.5	30.1	2017	19.7	18.8
Khudwani			Khudwani		
13 Yrs	28.8	16.2	13 Yrs	14.7	1.1
2017	29.0	17.4	2017	14.5	0.1
Jagdalpur			Jagdalpur		
13 Yrs	30.1	29.2	13 Yrs	22.5	15.4
2017	30.6	29.6	2017	22.9	15.5

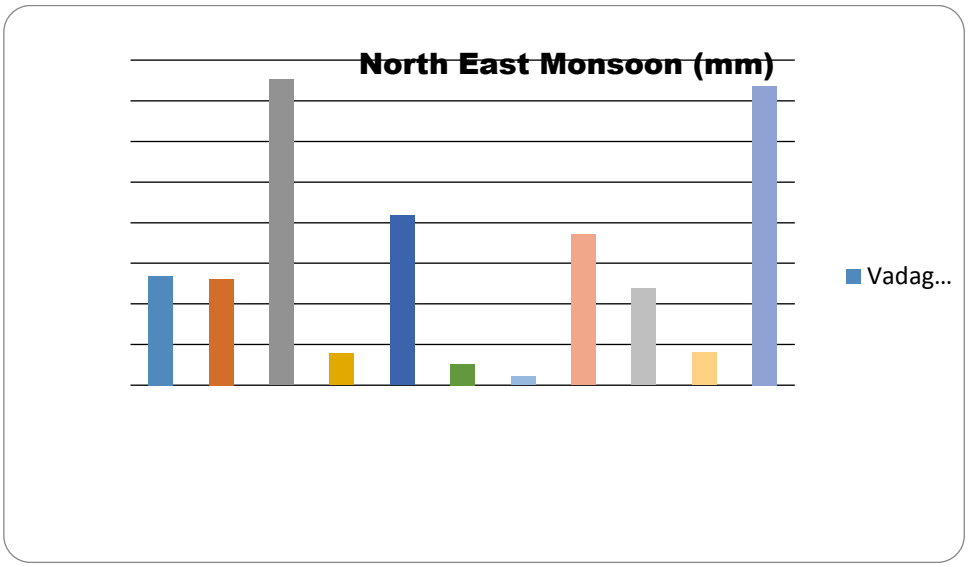




RAINFALL & YIELD of Rice

Rainfall is erratic. The quantum of rainfall and its distribution is not uniform in most of the centers. Rainfall during the vegetative phases of rice is declining and more yield when the crop received lees rain with support of irrigation. Another important climatic parameter is number of rainy days involve directly to the success of agronomic operations. For example in high rainfall zone like Kerala the number rainy days and quantum of rainfall received in few months limiting directly the rice breeding.





CONCLUSION

To conclude this is a small attempt on climatic studies of various centre's to study the variations of the climatic parameters. It may be useful to develop good agronomic package to mitigate or battle with changed climate scenario in any. Most of the weather data aberration is started from late nineties (1997 onwards in Pattambi). Hence the few more data of previous year's (Minimum of 25 years) may also be studied with respect to yield, insects and diseases in rice. Awaiting more concern about future changes in our climate and its direct or indirect effects are inevitable on society linked sectors like health, agriculture including animal husbandry, biodiversity, marine ecosystem, forestry, fisheries, water resources and sea level rise.

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ANNEXURES

Annexure - I

Major weeds observed during Kharif 2018

Grasses	Sedges	BLW
Brachiaria eruciformis	*Cyperus diffformis*	*Alternanthera philoxeroides*
Chloris barbata	*Cyperus esculentus*	*Aeschynomene indica*
Cynodon dactylon	*Cyperus iria*	*Ammania baccifera*
Dactyloctameum spp	*Cyperus rotundus*	*Celosia argentea*
Digitaria sanguinalis	*Fimbristylis litoralis*	*Caesulia axilaris*
Echinochloa colona	*Fimbristylis miliacea*	*Commelina benghalensis*
Echinochloa crusgalli		*Eclipta alba*
Eleusine indica		*Ludwigia parviflora*
Ischaemum rugosum		*Marselia quadrifolia*
Paspalum dilatatum		*Phyllanthus niruri*
Panicum dichotomiflorum		*Rotala densiflor*
Panicum repens		*Spilanthes acmela*
Setaria glauca		*Trianthema portulacastrum*

Annexure - II

WEATHER DATA – KHARIF 2018

CHINSURAH							
Latitude :	22^0 52' N		Longitude:	88^0 24' E		Elevation :	8.62 msl
Soil type:	Clay Loam		Soil pH :	7.3		Soil texture :	Alluvium
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total / Range**
No. of Rainy days	23	21	16	7	0	3	70
Total Rainfall (mm)	399.5	190.1	121.1	21.9	0	19.2	751.8
Avg. Max. Temp. ('^{0}C)	-	-	33.3	31.7	30.6	25.5	25.5-33.3
Avg. Mini. Temp. ('^{0}C)	-	-	26	22.4	17.4	11	11-26

CHIPLIMA							
Latitude :	20^{0}21'N		Longitude	80^0 55'E		Elevation :	178.8 m MSL
Soil type:	Mixed Red, Black &Lateritic		Soil pH :			Soil texture :	
	(June)	**(July)**	**(August)**	**(September)**	**October)**	**(November)**	**Total/Range**
No. of Rainy days	21	21	7	-	-	5	54
Total Rainfall (mm)	919.2	540.2	262.8	-	-	85.4	1807.6
Avg. Max. Temp. ('0C)	30.5	28.8	32.5	32.5	30.5	26.6	26.6-32.5
Avg. Mini. Temp. ('0C)	18.6	17.6	19.5	21.2	18.5	12.6	12.6-21.2

COIMBATORE							
Latitude	11^o N	Longitude:	77^o E			Elevation (m):	426.72 m
Soil type	Clay	Soil pH	7.8			Soil Texture:	Heavy
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec**	**Total / Range**
No. of Rainy days	7	6	6	7	-	-	26
Total Rainfall (mm)	54	70.8	60.4	115.7	-	-	300.9
Avg. Max. Temp. ('^{0}C)	30.3	30.3	30.2	32.8	-	-	30.2-32.8
Avg. Mini. Temp. ('^{0}C)	23.7	23.3	23.0	22.7	-	-	22.7-23.7
Solar radiation (CAL/CM^2)	298.8	305.8	295.8	362.2	-	-	315.6
Avg. Sunshine hours	4.1	4.4	4.4	7.9	-	-	3.7
Avg. wind velocity	10.5	11.5	9.9	5.6	-	-	9.3

GANGAVATI								
Latitude :	15^0 15' N			Longitude:		76^0 31' E	Elevation :	419m msl
Soil type:	Medium Black			Soil pH/EC	6.5-7.5		Soil texture :	Fine
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec**		**Total / Range**
No. of Rainy days	2	8	7	2	0	0		19
Total Rainfall (mm)	15.2	44.5	35.7	42.4	0	0		137.8
Avg. Max. Temp. ('^{0}C)	31.93	30.03	31.96	30.35	30.76	29.16		29.16-31.96
Avg. Mini. Temp. ('^{0}C)	23.48	22.80	21.86	19.83	17.29	15.96		15.96-23.48

GHAGHRAGHAT								
Latitude :	27^0 50' N			Longitude:		81^0 20' E	Elevation :	112 msl
Soil type:	Sandy loam						Soil texture :	
	May	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec**	**Total / Range**
No. of Rainy days	01	06	14	19	09	-	-	-	49
Total Rainfall (mm)	3.4	41.0	323.0	330.6	246.0	-	-	-	944
Avg. Max. Temp. ('^{0}C)	38.65	37.00	33.65	32.19	31.63	31.87	28.90	23.23	23.23-38.65
Avg. Mini. Temp. ('^{0}C)	24.35	26.27	26.42	26.52	25.73	21.71	14.60	8.84	8.84-26.52

JAGDALPUR							
Latitude :	19.05^{0}N		Longitude:	82.02^0		Elevation(m) :	
Soil type:	Alfisol		Soil pH :	6.5		Soil texture :	Alfisol
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of rainy days	11	17	20	11	01	0	60
Total Rainfall (mm)	178.1	269.4	421.4	233.9	6.2	0.0	1109
Avg. Max. Temp. ('^{0}C)	32.2	27.9	27.4	29.8	30.7	30.3	27.4-32.2
Avg. Mini. Temp. ('^{0}C)	23.4	21.9	21.2	20.7	16.4	12.6	12.6-23.4
Avg. Sunshine hours	3.7	1.0	0.9	4.5	7.7	6.7	4.0
Avg. wind velocity (km/h)	5.5	5.8	4.4	2.5	2.4	2.1	3.7

KANPUR							
Latitude :	27°24'N		Longitude:			Elevation(m) :	178msl
Soil EC:	01.43		Soil pH :	9.82		Soil texture :	Clay loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. Of rainy days	05	10	12	5	00	00	32
Total rainfall (mm)	63.4	386	365.3	143.8	00	00	958.5
Avg. Maximum Temperature (°C)	39.4	34.2	32.1	32.4	34.3	28.8	28.8-39.4
Avg. Minimum Temperature (°C)	27.5	26.3	25.0	23.5	17.2	13.1	13.1-27.5
* Avg. Sunshine Hours	5.2	4.3	2.9	6.3	9.8	7.6	6.0
* Avg. Wind velocity	5.3	3.5	4.0	5.6	2.6	2.4	3.9

KARAIKAL							
Latitude :	11^0 01' N		Longitude:	79^0 52' E		Elevation :	4 msl
Soil type:	**Fluventicustropept (surakudy soil series)**		Soil pH : Soil Ec (ds/m)	8.30 1.84		Soil texture :	Clay loam
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total / Range**
No. of Rainy days	0.0	3	2	14	16	7	42
Total Rainfall (mm)	0.0	41.0	74.10	271.6	551.30	78.10	1016.1
Avg. Max. Temp ('^{0}C)	36.9	36.0	34.7	31.3	29.6	29.3	29.3-36.9
Avg. Mini Temp ('^{0}C)	26.9	26.4	25.7	24.8	23.7	22.6	22.6-26.9
Avg. Sunshine hours	202.0	197.47	217.8	161.2	135.78	183.0	182.8
Avg. wind velocity	9.1	9.5	5.8	3.5	3.5	3.6	5.8

KARJAT							
Latitude :	18^0 55' N		Longitude:	73^0 18' E		Elevation :	51 msl
Soil type:	Medium black		Soil pH :	6.2		Soil texture :	Clay loam
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Total / Range**
No. of Rainy days	18	26	30	10	2.0	1	87
Total Rainfall (mm)	885.70	1605.4	816.7	199.7	21.8	29.0	3558.3
Avg. Max. Temp ('^{0}C)	33	28.4	28.81	31.27	35.25	32.26	28.4-35.25
Avg. Mini Temp ('^{0}C)	25	24.1	23.68	22.8	21.43	23.58	21.43-25
Avg. Sunshine hours	1.93	0.5	0.96	3.80	7.54	3.85	3.0

KHUDWANI								
Latitude :	34 ^{0}N		Longitude:	73 ^{0}E		Elevation(m) :	1560 msl	
Soil type:	Clay loam		Soil pH :	Neutral		Soil texture :	Silty Clay loam	
	April	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Total / Range**
No. of rainy days	11	8	9	15	7	6	4	60
Total Rainfall (mm)	160.3	50.8	61.6	134.2	120.6	22.8	10.5	560.8
Avg. Max. Temp. ('^{0}C)	21.4	24.6	28.3	28.8	30.7	28.0	21.7	21.4-28.8
Avg. Mini. Temp. ('^{0}C)	6.8	9.0	13.5	17.2	16.6	12.0	2.9	2.9-17.2
Avg. Sunshine hours	6.2	7.3	7.3	5.7	7.8	7.1	6.2	6.8
Avg. wind velocity (Km/h)	1.2	1.04	0.82	0.35	0.39	0.45	0.37	0.66

KAUL							
Latitude :	29^0 51' N		Longitude:	76^0 39' E		Elevation :	230.7 msl
Soil type:	Clay loam		Soil pH :	7.8		Soil texture :	Clay
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	6	8	5	7	0	0	26
Total Rainfall (mm)	168.9	281.5	207.9	185.2	0	0	843.5
Avg. Max. Temp. ('^{0}C)	36.9	33.7	32.7	31.2	30.9	27.0	27.0-36.9
Avg. Mini .Temp. ('^{0}C)	25.3	25.9	25.4	22.7	15.9	10.9	10.9-25.9
Avg. Sunshine hours	6.2	5.1	4.7	5.9	7.4	4.3	5.6
Avg. wind velocity (Km/h)	6.6	4.6	3.8	3.7	2.2	3.2	4.0

LUCKNOW							
Latitude :	26^0 47' N		Longitude:	80^0 46' E		Elevation :	120 msl
Soil type: - Typic Natrustalfs	Soil EC: 1.2		Soil pH :	9.7		Soil texture :	Sandy loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	6	16	18	8	0	0	48
Total Rainfall (mm)	351	636	823	209	0	0	2019
Avg. Max. Temp. ('^{0}C)	39.1	33	32.1	32.6	34	29.9	29.9-39.1
Avg. Mini .Temp. ('^{0}C)	23.5	22.9	22.3	21.1	16.6	8.7	8.7-23.5

LUDHIANA								
Latitude :	30^{0}54' N		Longitude:	75^0 48' E		Elevation :	247 msl	
Soil type:	Loamy Sand		Soil pH :	7.7		Soil texture :		
	May	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy Days	2	6	10	5	7	-	-	30
Total rainfall (mm)	19	147.2	376.6	74	328	-	2.6	947.4
Avg. Max. Temp. ('^{0}C)	39.19	37.65	34.26	34.10	32.07	31.31	26.80	26.80-39.19
Avg. Mini Temp. ('^{0}C)	24.29	27.16	26.97	27.28	23.96	17.15	11.80	11.80-27.28
Avg. Sunshine hours	12.35	6.78	5.51	5.40	7.14	8.30	5.76	7.32
Avg. wind velocity	6.34	6.17	4.67	4.10	3.68	2.08	2.48	4.21

MALAN							
Latitude :	32^0 1' N		Longitude:	76^0 20' E		Elevation :	950 m
Soil type:	Alfisol		Soil pH :	5.6- 5.8		Soil texture :	Silty clay loam
	June	**July**	**August**	**Sept.**	**Oct.**	**Nov**	**Total / Range**
No. of Rainy days	4	3	13	11	9	-	40
Total Rainfall (mm)	25.8	74.8	426.9	586.6	348.3	-	1462.4
Avg. Max. Temp. ('^{0}C)	34.0	37.1	32.9	31.4	30.7	28.7	28.7-34.4
Avg. Mini .Temp. ('^{0}C)	16.7	18.8	18.3	19.1	19.1	13.0	13.0-18.8

MANDYA								
Latitude	12.45^0- 13.57^0 N		Longitude	76.48^0- 78.24^0 E		Elevation (m):	695	
Soil type	Sandy Loam		Soil pH	6.5- 7.1		Soil texture:	Sandy loam	
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Jan**	**Total / Range**
No. of Rainy days	5	3	8	21	0	0	-	37
Total Rainfall (mm)	26.4	16.0	166.2	109.7	0	3.8	-	322.1
Avg. Max. Temp. ('^{0}C)	31.2	31.3	31.4	31.5	31.3	28.8	-	28.8-31.5
Avg. Mini. Temp.('^{0}C)	20.1	19.3	18.6	19.2	19.0	18.6	-	18.6-20.1
Solar Radiation (Cal/cm^2)	-	-	-	-	-	-	-	-
Avg. Sunshine hours	2.7	3.4	7.09	6.8	6.7	3.9	-	5.0
Avg. wind velocity (Km/h)	6.6	7.1	3.3	1.9	2.2	1.5	-	3.8

MARUTERU							
Latitude	16.38^o N		Longitude:	81.44^o E		Elevation (m)	
Soil type	Black alluvial clay		Soil pH:	6.5- 7.5		Soil Texture:	Delta alluvial
	July	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec**	**Total / Range**
No. of Rainy days	14	17	7	2	2	3	45
Total Rainfall (mm)	250.2	374.0	114.0	16.4	0.34	2.17	757.11
Avg. Max. Temp. ('^{0}C)	29.6	29.2	31.3	31.9	30.9	28.8	28.8-31.9
Avg. Mini. Temp. ('^{0}C)	26.1	25.7	26.4	25.4	23.2	22.1	22.1-26.4
Avg. Sunshine hours	2.5	3.2	5.3	5.8	5.7	2.26	4.12
Avg. wind velocity (Km/h)	7.4	5.0	3.1	1.9	2.4	4.6	4.0

NAWAGAM							
Latitude :	22 ^{0} 48'		Longitude:	71 ^{0} 3'		Elevation :	32.4 msl
Soil type:	Medium black		Soil pH :	7.8		Soil texture :	Sandy Clay Loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	1	9	9	3	0	0	22
Total Rainfall (mm)	25.8	140.4	186.2	35.6	0	0	388.0
Avg. Max. Temp. ('^{0}C)	38.8	32.0	30.9	32.6	36.4	33.4	30.9-38.8
Avg. Mini .Temp . ('^{0}C)	27.6	25.6	25.0	23.3	20.6	15.7	15.7-27.6
Avg. Sunshine hours	7.3	1.8	2.1	6.9	9.0	8.6	5.95
Avg. wind velocity (Km/h)	8.0	7.1	5.8	3.0	1.8	2.7	4.73

NAGINA							
Latitude :	29^0 28' N		Longitude:	78^0 32' E		Elevation :	450 msl
Soil type:	Sandy loam		Soil pH :	7.5		Soil texture :	-
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	04	19	13	8	2	0.0	46
Total Rainfall (mm)	52	379	516.6	211.2	43.2	0.0	1590.8
Avg. Max. Temp. ('^{0}C)	37.3	33.3	31.6	31.8	30.4	26.4	26.4-37.3
Avg. Mini .Temp . ('^{0}C)	25.9	25.9	24.7	23.7	14.8	9.6	9.6-25.9
Avg. Sunshine hours	7.7	4.2	2.8	5.7	8.2	7.2	5.9
Avg. wind velocity (Km/h)	5.2	4.4	2.9	3.4	1.9	1.8	3.2

PANTNAGAR							
Latitude :	29^0 N		Longitude:	79^{0}3' East		Elevation :	243.84 m
Soil type:	Clay loam		Soil pH :	8.06		Soil texture :	Clay loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of rainy days	8	15	20	11	1	1	56
Total Rainfall (mm)	172.8	649.1	616.4	224.6	2.6	4.2	1669.7
Avg. Max. Temp. ('^{0}C)	37	32.3	32	31.6	30.8	27.1	27.1-37
Avg. Mini .Temp . ('^{0}C)	25.9	26	25.3	23.7	15.3	11.7	11.7-25.9
Avg. Sunshine hours	7	4.5	1.9	5.4	8.2	7.1	5.6
Avg. wind velocity (Km/h)	6.7	4.5	2.9	5.6	3.9	2.3	4.3

FAIZABAD							
Latitude :	25.30^0 N		Longitude:	85.15° E		Elevation(m) :	52 msl
Soil type:	Alluvial		Soil pH :	7.5		Soil texture :	Clay loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	03	08	10	07	00	00	28
Total Rainfall (mm)	46.0	241.6	183.2	116.7	00	00	587.5
Avg. Max. Temp. ('^{0}C)	36.40	33.76	33.29	32.80	31.80	28.77	28.77-36.40
Avg. Mini. Temp. ('^{0}C)	27.90	27.67	26.96	26.16	20.80	15.03	15.03-27.90
Avg. Sunshine hours/day	2.96	2.97	3.60	5.67	6.45	4.70	4.3
Avg. wind velocity	8.80	10.34	5.75	5.42	2.67	1.77	5.7

PATTAMBI							
Latitude :	10^0 48' N	Longitude :	76° 12' E		Elevation :		25.36 msl
Soil type:	Sandy loam	Soil pH :	5.3		Soil texture :		-
	July	**August**	**Sep**	**Oct**	**Nov**	**Dec**	**Total / Range**
No. of Rainy days	25	24	4	16	2	1	**72**
Total Rainfall (mm)	713	670.5	38.3	185.9	10.6	1.4	**1619.7**
Avg. Max. Temp. ('^{0}C)	29.19	28.64	32.25	32.33	32.52	32.97	**28.64-32.97**
Avg. Mini. Temp. ('^{0}C)	22.13	22.05	22.07	22.15	21.86	20.89	**20.89-22.15**
Avg. Sunshine hours/day	2.76	2.95	7.65	5.62	6.97	6.48	**5.4**
Avg. Wind velocity	6.49	7.22	5.52	4.14	5.91	3.45	**5.4**

RANCHI							
Latitude :	27^0 17' N		Longitude:	88^0 19' E		Elevation :	625
Soil type:	Sandy Loam		Soil pH :			Soil texture :	
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	7	13	11	12	0	0	43
Total Rainfall (mm)	150.1	184.7	305.9	200.5	2.0	0.0	843.2
Avg. Max. Temp. ('^{0}C)	35.3	29.3	28.3	28.7	26.5	26.8	26.5-35.3
Avg. Mini. Temp. ('^{0}C)	22.0	20.4	20.5	19.3	16.3	13.6	13.6-22.0
Avg. Sunshine hours	208.7	124.9	135.6	204.6	247.0	255.9	196.1
Avg. wind velocity	3.2	2.7	2.9	2.5	2.5	2.2	2.6

RAIPUR							
Latitude :	21^0 16' N		Longitude:	80^0 36' E		Elevation :	
Soil type:	Alfisol		Soil pH :			Soil texture :	Clay Loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	9	11	15	7	0	0	42
Total Rainfall (mm)	141.50	328.0	560.2	84.8	0	0	1114.5
Avg. Max. Temp. ('^{0}C)	36.9	31.1	29.8	31.3	32.9	31.3	29.8-36.9
Avg. Mini. Temp. ('^{0}C)	26.3	25.3	24.8	24.5	21.4	16.0	16.0-26.3
Avg. Sunshine hours	6.4	1.4	1.5	4.9	8.1	8.5	5.1
Avg. wind velocity	6.7	7.5	5.6	3.7	1.5	1.3	4.3

REWA							
Latitude :	24^o 30' N		Longitude:	81^0 2' E		Elevation(m) :	360 msl
Soil type:	Clay Loam		Soil pH :	7.3		Soil texture	Silty Clay Loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	5	17	20	5	1	-	48
Total Rainfall (mm)	116.8	246.8	399.4	99.0	5.2	-	867.2
Avg. Max. Temp. ('^{0}C)	39.6	32.5	30.3	29.3	34.3	29.5	29.3-39.6
Avg. Mini. Temp. ('^{0}C)	27.1	23.3	23.6	22.0	17.1	11.8	11.8-27.1

TITABAR							
Latitude :	26^{0}35' N		Longitude:	90^0 10' E		Elevation :	99.4 msl
Soil type:	Old alluvial		Soil pH :	5.2		Soil texture :	Clay loam
	July	**Aug.**	**Sep.**	**Oct.**	**Nov**	**Dec.**	**Total / Range**
No. of Rainy days	15	15	14	16	7	2	69
Total Rainfall (mm)	275.8	160.2	317.0	248.0	39.4	14.8	1055.2
Avg. Max. Temp. ('^{0}C)	31.1	33.4	33.1	32.9	30.4	27.4	27.4-33.4
Avg. Mini. Temp. ('^{0}C)	23.8	24.6	24.4	23.3	18.9	13.0	13.0-24.6
Avg. Sunshine hours	4.1	4.2	4.1	3.9	5.3	6.0	4.6

VADGAON							
Latitude :	18^0 74'N		Longitude:	73^o 64'		Elevation :	677.9
Soil type:	Medium		Soil pH :	5.5-6.5		Soil texture :	Clay Loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	01	07	23	29	04	01	01
Total Rainfall (mm)	16.60	102.40	560.40	336.60	65.80	5.00	62.00

VARANASI							
Latitude	25^0 20' N		Longitude	23^0 03'E		Elevation (m)	75.7
Soil type	Medium		Soil pH	7.2		Soil texture	Sandy loam
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of Rainy days	06	18	16	10	00	00	50
Total Rainfall (mm)	58.4	279	238.5	131.8	00	00	707.7
Avg. Max. Temp. ('^{0}C)	39.76	34.35	32.48	33.74	34.11	30.10	30.10-39.76
Avg. Mini. Temp. ('^{0}C)	30.00	26.55	26.49	25.18	19.69	14.33	14.33-30.00
Avg. Sunshine hours	7.18	5.63	3.67	6.79	8.51	7.7	6.5
Avg. wind velocity	5.22	4.80	5.00	4.77	5.10	4.7	4.9

WANGBAL							
Latitude :	24.8^0 N		Longitude:	94^0 E		Elevation :	781 msl
Soil type:	Clay loam		Soil pH :	5.5		Soil texture :	Fine
	June	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Total / Range**
No. of rainy days	19	23	19	7	5	3	76
Total rainfall (mm)	173.0	158.4	204.2	20.8	43.6	6.5	606.5
Avg. Maximum Temperature (°C)	36 ^{0}C	36^{0}C	36^{0}C	36^{0}C	33^{0}C	23^{0}C	23-36
Avg. Minimum Temperature (°C)	19^{0}C	20 ^{0}C	20^{0}C	19 ^{0}C	13^{0}C	11^{0}C	11^{0}C-20 ^{0}C

Annexure - III

a. Details of herbicide manufacturers *Kharif* - 2018

S.No.	Name of the herbicides	Agro-Input-Agency
1	Bispyribac sodium 10% SC	PI Industries Ltd, Bayer Crop Science
2	Pretilachlor 50 %EC	Dhanuka, Nagarjuna agrichem Ltd, Crop chemicals India ltd, SWAL corporation India, Agro care , Paramount Pesticides Ltd.
3	Metsulfuronmethyl+chlorimuronehtyl-20%WP	DuPont India Ltd
4	Pyrazosulfuronethyl 10 WP	UPL

b. Details of product/material provided by private company/organization in *Rabi*- 2017-18 and *Kharif* - 2018

S.No.	Name of the product	Agro-Input-Agency
1	Iron coated seed	JFE Steel India Pvt. Ltd., 806, 8th Floor,Tower-B, Unitech Signature Towers,South City-I, NH-8, Gurgaon – 122001,Haryana, India
2	Thiobencarb 5 l/ha	India Pesticides Limited
3	Nutrient Expert®	Internationl Plant Nutrition Institute, Gurgaon, India

Annexure - IV

ABBREVIATIONS

ADT	Aduthurai	**MNC**	Moncompu
ALM	Almora (VPKAS)	**MND**	Mandya
ARD	Arundhutinagar	**MTU**	Maruteru
BNK	Bankura	**NGN**	Nagina
CBT	Coimbatore	**NLR**	Nellore
CHN	Chinsura	**NVS**	Navsari
CHP	Chiplima	**NWG**	Nawagam
CHT	Chatha	**PDG**	Phondaghat
CKD	Chakdha	**PNT**	Pantnagar
CNG	Canning (CSSRI)	**PNV**	Panvel
CTK	Cuttak (NRRI)	**POB**	Port Blair (CIARI)
FZB	Faizabad (Masodha)	**PSA**	Pusa
GER	Gerua (NRRI)	**PTB**	Pattambi
GGT	Ghaghraghat	**PTN**	Patna (Dhangain)
GNV	Gangavati	**PDC**	Puducherry
GRD	Giridih	**RCI**	Ranchi
HZB	Hazaribagh (NRRI)	**REW**	Rewa
JDP	Jagadalpur	**RGL**	Ragolu
KHD	Khudwani	**RNR**	Rajendranagar
KJT	Karjat	**RPR**	Raipur
KNP	Kanpur	**SBR**	Sabour
KRK	Karaikal	**TLJ**	Tuljapur
KRL	Karnal (CSSRI)	**TTB**	Titabar
KTA	Kota	**USG**	Upper Shillong
KUL	Kaul	**VDG**	Vadagaon
LCK	Lucknow	**VRN**	Varanasi
LDN	Ludhiana	**VTL**	Vytilla
MLN	Malan	**WBL**	Wangbal (Imphal)
MDZ	Medziphema		

Annexure - V

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SOIL SCIENCE

Progress Report of Soil Science Coordinated Program
(*Rabi* and *Kharif* 2018)

SOIL SCIENCE

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5. SOIL SCIENCE

Summary

The coordinated program in soil science addressed the issues related to sustaining productivity of soil and crop systems on long-term basis, soil quality and productivity assessment for bridging the gap in farmers' fields, germplasm screening and nutrient management in sodic and acid soils, testing/validation of computer based nutrient management tool, Nutrient Expert, developed by IPNI for site specific nutrient management in farmers' fields, residue management in organic rice based cropping systems and collaborative trials with Agronomy and Entomology in nutrient management and bio intensive pest management under organic farming. A total of 7 trials were conducted during rabi 2017-18 and kharif 2018 in 17 locations (funded as well as voluntary centres and at IIRR) representing typical soil and crop systems and important rice growing regions. But, no data was received from Moncompu centre due to crop failure on account of floods.

5.1. Long-term soil fertility management in rice-based cropping systems

In the 30th year of study on long term soil fertility management in RBCS, the treatments RDF+ FYM and RDF were at par and significantly superior to other treatments in both seasons at MTU and in *kharif* at TTB. Whereas, RDF+FYM was superior to all other treatments at MND during *kharif* and at TTB during *rabi*. FYM alone treatment was on par to RDF in *kharif* at MND and TTB. Nutrient omission and reduction to 50% resulted in yield reduction at all three centres in both seasons and response to major nutrients was more. At the end of *kharif* 2018, there was an improvement in important soil properties with INM and organics and with a significant reduction of NPK values in omission plots compared to RDF plots at all three locations. Additional dose of FYM @5t/ha along with RDF improved the productivity growth rate substantially at all three locations.

5.2. Soil quality and productivity assessment for bridging the yield gaps in farmers' Fields

Yield and Technology gap is a major problem in increasing paddy production in the irrigated ecosystems of the states. This trial in the form of a survey was conducted in selected farmer's fields at six centres – Chinsurah (33 farmers), Ghaghraghat (30 farmers), Pantnagar (50 farmers), Karaikal (24 farmers), Faizabad (50 farmers) and Maruteru (62 farmers) to assess the variability in nutrient supply, rice yields with farmers' fertilizer practices in farm sites and fine-tune the fertilizer nutrient requirement for specific target yields in a given environment and validation of fertilizer recommendations for targeted yields. Fertilizer recommendations were suggested for various target yields at these locations (being the highest yield recorded at the test sites) with reference to grain yields and average uptake of nutrients per ton of grain and nutrient requirement recorded at the test sites. The highest level of yield gap (51 %) was recorded at Chinsurah, followed by nearly 27% at Karaikal and Ghaghraghat. Yield gaps variations were comparatively low Maruteru (16 %) and Pantnagar

(18 %) This shows a wide gap of grain harvest existed. At Faizabad, yield Gap was to the tune of almost 20%. However, ample scope existed at these centre to increase yields. At Maruteru and Pantnagar, the yield gaps were not very high and yields obtained at different farmers fields almost matched superior technology yields.

5.3 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS

In the trial on management of sodic soils, gypsum application in conjunction with NPK fertilization improved rice yields at Kanpur and Mandya by 65%-127% and 7-15.0% respectively. At Kanpur, the genotypes DRR Dhan 46, CSR 23, DRR Dhan 42, DRR Dhan 45, DRR Dhan 43 produced the highest yields when supplemented with 100% GR (4.46 - 4.61 t/ha). In unamended native sodic soils of Faizabad, the genotypes that produced the highest yields were DRR Dhan 46, CSR 36, DRR Dhan 42, DRR Dhan 45 and DRR Dhan 43 (2.09 t/ha -2.21 t/ha). Among the 10 genotypes evaluated at Mandya, CSR -23, IR 30864, DRR Dhan 40 and DRR Dhan 43 recorded highest yields with 100% GR application (5.69-6.09 t/ha). CSR 23, IR 30864, DRR Dhan 41, DRR Dhan 43 and DRR Dhan 40 exhibited better tolerance to sodicity at Mandya compared to other genotypes as demonstrated by their significantly higher yields (4.67 t/ha– 5.53 t/ha) in treatment without gypsum amendment. In Faizabad, the genotypes NDRK 500051, IRSSTN 30, IRSSTN 110, and NDRK 50063 recorded highest yields (3.74-4.89 t/ha) without gypsum amendment.

5.4 Screening of rice genotypes for acid soils and related nutritional constraints

In the acid soils, liming increased grain yields by 9-19%, 15%, and 17% at Raipur, Ranchi and Titabar respectively. The genotypes responsive to liming were MS-49, Maheswari, CNN 1707, PA6444, TI 93 at Raipur, TI-93, HRI 174, KRH 4,MTP 7 at Titabar. Genotypes tolerant to native soil acidity were Maheswari, Binadhan, PA 6444, Mahamaya at Raipur and MTP 7, 3447, MSM, TI-93,US 312 and PUP -1 at Titabar. Genotypes Bina Dhan 75, KRH4, Bina Dhan 17, US 312, while exhibiting highest reponse to liming, were also observed to be tolerant to acidity at Ranchi.

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5.5 Yield maximization in farmers' fields using Nutrient Expert software (*Kharif*)

A multi-locational trial was conducted to know the response of the crop to varied degrees of edaphic factors derived from farmers' practices (T1), recommended dosages of fertilisers (T2) and recommendations emanated from Nutrient Expert software (T3). Testing centers included Chinsurah, Faizabad, Karaikal, Khudwani, Mandya, Maruteru, Pantnagar and Puducherry with varied number of test sites. Superior performance of T3 was realized T3 (Nutrient Expert based recommendations) in grain and straw production in all centers except Chinsurah and Khudwani where T2 (RDF) performed better. Since sites did vary in crop production factors, sites within each center also performed sometimes differently depending the on the combination of factors. T3 registered better numbers in yield components also in several instances of course with certain exceptions. Site variations were found in terms of total uptake of nitrogen, phosphorus and potassium even within centers and

among different treatments. The idea of better crop management could be fulfilled with site specific nutrient management resulting out of decision rules based on Nutrient Expert analysis or regional recommended fertiliser schedules, which emanated from the specific studies.

5.6 Bio - Intensive Pest Management (BIPM) in rice under Organic Farming

From the fourth year of study on "Bio-intensive pest management", it can be summarized that among four locations (CHN, IIRR, PDU and TTB), BIPM was significantly superior to FP at CHN and TTB locations during *kharif* and both treatments were on par at IIRR and PDU, in terms of grain yield. This could be attributed to the significant increase in yield components at CHN. The pest incidence was either reduced in BIPM plots or on par compared to Farmers' practice. The natural enemies were higher in BIPM plots in all locations. No significant difference was noticed in nutrient content, uptake and grain quality parameters between BIPM and FP and improvement in soil properties with BIPM was observed at CHN and TTB.

5.7 Residue management in organic rice based cropping systems

The disposal of huge quantity of paddy residues has become a big problem, particularly in North-West Indian states, resulting in farmers preferring to burn the residues *in-situ* leading to air pollution, smog and loss of appreciable amount of plant essential nutrients besides being deleterious to soil microbes. Keeping this in view, the present trial was initiated, in *Kharif* 2018 at nine centres, to study the influence of rice/wheat residue on rice crop productivity, soil health, pest dynamics and grain quality in organic rice based cropping systems. Rice productivity was highest under RDF while Control maintained the lowest grain yield values. However, crop residues at 100 & 150% N were on par and significantly superior to RDF at GHG while combined application of residues (75% N) with GM/GLM (25% N) was on par with RDF at GHG, KRK and Pusa. Nutrient uptake was highest under RDF [N (78-101 kg/ha), P (15-32 kg/ha) and K (78-220 kg/ha)]. The crop residue treatments were at par and didn't vary much in terms of nutrient uptake and maintained higher nutrient use efficiencies over RDF. This being the first year of the trial, no significant change in post-harvest soil nutrient status was observed with residue treatments.

DETAILED REPORT

5.1 Long term soil fertility management in rice-based cropping systems (RBCS)

Long-term studies with well-defined nutrient management treatments and cropping systems were initiated in 1989-90 at four selected locations representing major rice growing regions and cropping systems *viz*., Mandya (MND) in Karnataka (rice-cowpea, Deccan Plateau), Maruteru (MTU) in Andhra Pradesh (rice-rice, Delta system), Titabar (TTB) in Assam (rice-rice, Alluvial soils) and Faizabad (FZB) in Uttar Pradesh (rice – wheat, Indo Gangetic plains) to study the dynamics of soil and crop productivity in relation to management for identifying the constraints that affect the sustainability of a given production system. The trial at Faizabad was discontinued during 2007-08 for lack of manpower support and being continued at 3 centres only. Hence, the results of 30th year of cropping i.e., *rabi* 2017-18 and *Kharif* 2018 are presented in Tables 5.1.1 to 5.1.11 and Figs. 5.1.1 to 5.1.4.

Crop productivity and soil fertility during *rabi* 2017-18

Grain and straw yields of *rabi* rice at MTU and TTB are presented in Table 5.1.2. At MTU, grain yield ranged from 2.50 (control) to 6.47 t/ha (RDF+FYM) with a mean of 4.82 t/ha. RDF and RDF+FYM treatments were at par. Omission of N,P,K,Zn and S resulted in yield reduction by 4.0% in -S to 49% in -N plots. At Titabar, grain yield ranged from 1.21 t/ha in control to 4.41 t/ha in RDF+FYM which was superior to all other treatments while FYM alone treatment (4.05 t/ha) was very close to RDF (4.23 t/ha). Here also, omission of nutrients resulted in grain yield reduction by 6.0% in -P to 14% in - K plots over RDF. 50% reduction in RDF resulted in 39% yield reduction in silty clay soil of TTB compared to 23% reduction in clay loam soil of MTU. STCR recommendation was at par to 100% RDF at MTU and significantly lower than RDF at TTB with high N, low P and K recommendation at MTU and high N and K doses at TTB.

Total nutrient (NPK) uptake followed similar trend as that of grain yield with maximum uptake in RDF+ 5t FYM/ha at both centres, MTU and TTB (Table 5.1.3). With regard to soil fertility status, soil organic carbon and available nutrient status after harvest at Maruteru were higher when organic manures were added as a supplementary dose (RDF+FYM). Control treatment recorded lowest values and organic carbon content with only FYM was higher compared to RDF+FYM (Table 5.1.4). In nutrient omission plots (-N and -P), there was a significant reduction in available N and P compared to plots with RDF.

Crop productivity and soil fertility status during *kharif* 2018

At MTU, RDF and RDF+FYM recorded significantly higher grain yields (5.31-5.39 t/ha) than all other treatments and both these treatments were on par (Table 5.1.5). Omission of major nutrients resulted in maximum yield loss (1.1 to 1.7 t/ha) compared to omission of micro nutrients (0.02 to 0.7 t/ha). At TTB also, RDF and RDF+FYM (5.10 – 5.44 t/ha) were at par and and FYM alone (5.01 t/ha) treatment was on par to RDF (5.10 t/ha). Here, two INM treatments (4.98-5.14 t/ha) were on par to RDF (5.10 t/ha). Response to NPKZn and S

was significant here at TTB similar to that at MTU with maximum yield loss due to omission of major nutrients compared to micro nutrients. At MND, RDF+FYM recorded maximum yield (6.27 t/ha) which was on par to 50% NPK+25% GM-N+ 25% FYM-N (6.02 t/ha) and these two treatments were significantly superior to other treatments. Here also, omission plots recorded significantly lower yields by 7% in –Zn to 48% in –N than RDF except –Zn which was on par to RDF. Whereas, FYM alone (4.43 t/ha) was on par to RDF (4.53 t/ha). Unlike in *rabi* season, in *kharif*, STCR recommendation resulted in significant yield reduction at MTU and MND compared to RDF and on par to RDF at TTB only. With regard to straw yield, the trend was almost similar to grain yield trend at all locations. The total nutrients (NPK) uptake by the above ground biomass was almost similar to that of grain yield trend at all locations (Table 5.1.6). Soil fertility status at the end of *kharif* 2018 (Table 5.1.7 and 5.1.8 and Fig. 5.1.4) indicated an improvement in important soil properties with addition of organics and significant reduction of NPK values in omission plots compared to RDF at all 3 locations. Maximum OC values were observed with RDF+FYM and FYM alone treatments at TTB; INM treatments at MND and without any specific trend at MTU. Control recorded the lowest values at two locations (0.19 and 0.60% at MND and TTB, respectively).

Long term changes in crop productivity and soil fertility over a period of 30 years

The trends in mean grain yields over 30 years (1989-2018) of *kharif* and *rabi* rice at MND, MTU and TTB by fitting to linear and non-linear function using actual yields and the per cent change in important soil properties in some important treatments were analysed and presented below.

Linear trends in crop productivity (Tables 5.1.9 and 5.1.10 and figs.5.1.1-5.1.3)

During *kharif* 2018, the treatment, RDF+5 t FYM/ha recorded maximum mean yield at all 3 locations (MND- 5.19; MTU-5.12 and TTB- 4.90 t/ha) with an average increase of 10, 2 and 13%, respectively, at MND, MTU and TTB by this treatment over RDF. Linear trends of productivity over the years with current RDF indicated slightly positive growth in the delta soils of MTU (6.0 kg grain/ha/year) and more positive growth in the acid alluvial soils of TTB (31.7 kg/ha/year). Additional dose of FYM @5t/ha along with RDF improved the growth rate substantially with 65 kg/ha/year at MTU and 81 kg/ha/year at TTB. Whereas, at MND, RDF recorded –ve growth rate (-44 kg/ha/yr) and RDF+FYM recorded more positive growth rate (96 kg/ha/yr).

During *rabi* (Table 5.1.10) also, RDF+5t FYM recorded maximum mean grain yield both at MTU (5.99 t/ha) and TTB (4.32 t/ha) and this treatment recorded growth rate of 15 and 58 kg/ha/year at MTU and TTB, respectively. Higher growth rate was observed in *kharif* season compared to *rabi* season.

Changes in soil fertility compared to initial values (Table 5.1.11)

The Organic carbon (OC) content increased in all treatments at MTU compared to initial values. At MND, it decreased in control and RDF but increased in INM treatments. At TTB, OC decreased in control but increased in RDF and other treatments. Available N decreased in all

treatments at MTU and TTB but at MND, it decreased in control and omission plots with an increase in organic additions while maintaining the same in RDF. With regard to available P, there was a build up in all other treatments except control compared to initial value at MND and TTB except MTU where there was a build up in P in all treatments including control. In case of available K, at MTU, there was a decrease in all treatments compared to initial value. But, at MND (Table 5.1.8), decrease was observed in control and K omission plots and at TTB (Table 5.1.7), decrease was seen in control and all omission plots without much accumulation in other treatments since K addition is very less through RDF at this centre.

The per cent change in important soil fertility parameters compared to the initial values were presented in Table 5.1.11 for three locations. There was a maximum decline in OC in control treatment at MND (-43%) and TTB (-37%) and INM treatments recorded accumulation of OC with maximum value in RDF+FYM and FYM alone treatments at MTU (35%) and TTB (58%) and 50%NPK+25%GM+25%FYM at MND (71%). With regard to N, there was a decline in all treatments (-2 to -21.5%) at MTU and TTB (-9 to -66%) while at MND, decline was in control only (-33%). P accumulation was very high at all three locations in P addition treatments (63-384%). In case of K also, change was -ve in all treatments at MTU (-6 to -27 %) and in control alone at MND (-39%) and TTB (-44%) with a positive change in other treatments.

Statistical modeling analysis

Statistical modeling of rice productivity in *kharif* season over the 30 years of period was done to understand the trends in yield data of rice. Linear and Nonlinear statistical models viz., Linear Regression model, Polynomial Regression model, Exponential growth model, Gompertz growth model and Logistic growth models were used for the same.

1. **Linear models:**

a) Linear Regression
b) Polynomial Regression

2. **Nonlinear growth models:**

a) Exponential model
b) Gompertz model
c) Logistic model

The model with highest R^2 is considered as best model and the same model is further used for predicting the future yield. Among these models tried, we found that polynomial regression model with different degrees (4-10) was perfect and found to predict the future yield in an appropriate way. And polynomial regression is considered to be a special case of multiple linear regressions.

Polynomial Regression model (degree=10) $\mathbf{Y = a + b_1x + b_2x^2 + b_3x^3 + ... + b_{10}x^{10}}$

(Degree varies with the treatments and data sets)

For example, NPKSZn treatment at Maruteru was analyzed by polynomial regression model with 10 degrees was found to be best with 52% R^2 value, which explains 52% variability occurring in yield by the treatment effect and the remaining variations are may be due to extraneous factors which may not be known to statistical model (Appendix 1). Based on this model, we may predict or validate the yield for the desired year. For example,

recorded yield for the year of 2018 is 5.31 t ha^{-1} and the predicted yield of the same year through this polynomial model is 5.25 t ha^{-1} which is almost similar to the observed value (Table 5.1.12). With this we can conclude that yield data of the long term fertilizer experiments are following polynomial trend in the yield.

Summary

In the 30th year of study on long term soil fertility management in RBCS, the results indicated the significantly superior performance of RDF+FYM and RDF over other treatments at MTU in both seasons and in *kharif* at TTB. Whereas, RDF+FYM was superior to all other treatments at MND during *kharif* and at TTB during *rabi*. FYM alone treatment was on par to RDF in *kharif* at MND and TTB. Omission of major nutrients resulted in maximum yield reduction compared to micronutrients at all three locations. Response to N application was more MND and MTU and to K at TTB compared to other nutrients. In general, INM and organics alone treatments resulted in improvement of soil fertility parameters which had reflected positively in rice productivity at all locations.

Table 5.1.1: Long term soil fertility management in RBCS, 2018 Soil and crop characteristics

Cropping system	Maruteru	Titabar	Mandya
	Rice-Rice	**Rice-Rice**	**Rice-Cowpea**
Variety – *kharif*	MTU-1061	Gitesh	Thanu (KMP101)
Rabi	MTU-1010	Lachit	-
Recommended Fertilizer Dose (kg NPK /ha)			
Kharif	90:60:60:50 (Zn)	40:20:20	100:50:50:20 (Zn)
Rabi	180:90:60:50	40:20:20	-
STCR	112:60:40	-	-
Crop growth: *Kharif*	Satisfactory	Very good	Satisfactory
Rabi	Satisfactory	Good	Satisfactory
% Clay	38	42.0	11.1
% Silt	28	28.5	18.1
% Sand	34	29.5	62.8
Texture	Clay loam	Silty Clay	Sandy loam
pH (1:2)	6.10	5.4	5.87
Organic carbon (%)	1.24	1.1	0.30
CEC (cmol (p^+)/kg)	48.6	12.5	-
EC (dS/m)	0.64	0.28	0.28
Avail. N (kg/ha)	234	495	208
Avail. P_2O_5 (kg/ha)	61.2	22.4	19.7
Avail. K_2O (kg/ha)	294	112	118

Table 5.1.2: Long term soil fertility management in RBCS, *rabi* 2018
Grain and straw yields of rice

Treatments	Grain yield (kg/ha)		Straw yield (kg/ha)	
	Maruteru	**Titabar**	**Maruteru**	**Titabar**
Control	2501	1207	3251	3150
100% PK	3224	3917	3357	5875
100% NK	4457	3995	4924	5887
STCR recommendation	5890	3937	6542	5975
100% NP	4640	3662	5158	5700
100% NPKZnS	6290	4227	6854	6227
100% NPKZnS + FYM/PM @ 5t/ha	6474	4412	7302	6285
100% NPK –Zn	5940	3737	6637	5725
100% NPK – S	6040	3887	6651	5962
100%NPK-S+1tlime/ha	-	3712	-	5801
100% N+50% PK	5540	3650	6302	5752
50 % NPK	4857	2575	5433	5440
50 % NPK + Biofertilizer	5624	3287	6408	5362
50%NPK+ 50% GM-N	4774	3862	5327	5900
50% NPK + 50% FYM-N	4357	3665	4798	5812
50% NPK + 25% GM-N+25% FYM-N	4324	3775	4755	5845
FYM @ 10 t/ha	3340	4050	3506	6111
FYM @ 10 t/ha + Split application	3640	-	3887	-
Expt. Mean	**4818**	**3621**	**5356**	**5694**
CD (0.05)	**579**	**156**	**696**	**166**
CV (%)	**7.3**	**3.1**	**7.9**	**2.1**

Table 5.1.3: Long term soil fertility management in RBCS, *rabi* 2018- Total nutrient uptake (kg/ha)

Treatments	Maruteru			Titabar		
	N	P	K	N	P	K
Control	14.8	5.7	24.2	24.6	3.4	35.4
100% PK	22.4	9.7	35.3	61.7	10.8	71.1
100% NK	45.9	13.5	55.5	62.1	11.3	73.9
STCR recommendation	67.7	20.3	77.6	62.1	11.2	74.9
100% NP	51.7	16.1	61.4	56.5	10.0	69.8
100% NPKZnS	69.6	24.5	90.6	69.2	12.3	78.2
100% NPKZnS + FYM/PM @ 5t/ha	79.7	27.9	103.0	71.0	14.1	84.3
100% NPK – Zn	63.4	23.2	63.7	59.5	9.9	71.8
100% NPK – S	61.6	19.7	66.3	65.5	10.5	75.2
100%NPK-S+1tlime/ha	-	-	-	62.0	10.1	73.3
100% N+50% PK	59.4	17.1	52.9	60.1	10.0	72.3
50 % NPK	51.0	17.0	60.1	49.9	7.6	65.2
50% NPK + Biofertilizer	56.9	17.1	76.1	53.7	9.5	68.4
50% NPK+ 50% GM-N	53.0	16.6	61.0	63.3	9.9	76.3
50% NPK + 50% FYM-N	49.0	13.0	54.7	58.6	9.9	72.5
50% NPK + 25% GM-N+ 25% FYM-N	49.6	13.1	52.6	59.7	10.4	75.6
FYM @ 10 t/ha	32.3	10.0	28.6	55.9	11.2	79.5
FYM @ 10 t/ha + Split Vermi	35.8	11.1	30.8	-	-	-
Expt. Mean	**50.8**	**16.2**	**58.5**	**58.6**	**10.1**	**71.6**
LSD (0.05)	**14.8**	**2.3**	**17.4**	**7.89**	**1.7**	**4.44**
CV (%)	**17.7**	**8.4**	**18.0**	**8.16**	**10.1**	**3.76**

Table 5.1.4: Long term soil fertility management in RBCS, *rabi* 2018 - Soil fertility status at harvest

Treatments	Maruteru					
	pH	EC	Org. C (%)	Avail. N (kg/ha)	Avail. P_2O_5 (kg/ha)	Avail. K_2O (kg/ha)
Control	6.1	0.5	1.0	180	39.5	234
100% PK	5.9	0.6	1.1	193	95.2	291
100% NK	6.0	0.5	1.1	239	41.2	270
STCR recommendation	6.0	0.5	1.2	258	76.5	328
100% NP	6.0	0.6	1.1	235	96.2	302
100% NPKZnS	6.0	0.6	1.1	259	102	339
100% NPKZnS + FYM/PM @ 5t/ha	6.0	0.6	1.2	266	106	348
100% NPK – Zn	6.1	0.6	1.2	216	85.6	325
100% NPK – S	6.2	0.6	1.1	218	96.4	215
100%NPK-S+1t lime/ha	-	-	-	-	-	-
100% N+50% PK	6.1	0.5	1.2	221	79.9	332
50 % NPK	6.1	0.6	1.2	220	58.0	322
50% NPK + Biofertilizer	6.0	0.5	1.1	228	79.9	336
50% NPK+ 50% GM-N	6.0	0.6	1.2	204	63.4	300
50% NPK + 50% FYM-N	6.1	0.5	1.1	218	60.9	299
50% NPK + 25% GM-N+ 25% FYM-N	5.9	0.6	1.2	207	73.7	306
FYM @ 10 t/ha	5.8	0.6	1.3	248	70.7	288
FYM@10 t/ha + 3.0 t/ha Vermicompost +200 kg/ha oil cakes	6.0	0.5	1.1	209	66.3	257
Expt. Mean	**6.0**	**0.6**	**1.1**	**225**	**76.0**	**305**
LSD (0.05)	**NS**	**0.1**	**NS**	**35**	**12.1**	**56**
CV (%)	**2.3**	**7.2**	**6.8**	**9.5**	**9.7**	**11**

Table 5.1.5: Long term soil fertility management in RBCS, *kharif* 2018 - Yield and yield parameters of rice

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)			Panicles/m^2	
	MTU	**TTB**	**MND**	**MTU**	**TTB**	**MND**	**MTU**	**MND**
Control	3171	1775	1895	3806	3512	2138	179	224
100% PK	3599	4275	2356	4319	5405	2643	181	243
100% NK	4240	4187	2675	5087	5287	2934	188	278
STCR recommendation	4501	4775	3864	5401	5837	4016	198	428
100% NP	4171	4375	2865	5005	5500	3027	185	326
100% NPKZnS	5315	5100	4526	6379	6575	4934	203	465
100% NPKZnS + FYM/PM @ 5 t/ha	5394	5437	6270	6472	6815	6183	209	528
100% NPK –Zn	5295	4550	4216	6353	5750	4375	200	448
100% NPK – S	4574	4350	3894	5489	5475	3982	200	436
100%NPK-S+ 1timelime/ha	-	4400	-	-	5537	-	-	-
100% N+50% PK	4470	3362	3268	5364	4165	3689	197	403
50 % NPK	3928	3362	3096	4713	4550	3268	183	336
50 % NPK + Bio fertilizer	4143	2475	3784	4972	3975	4015	185	358
50% NPK+ 50% GM-N	4232	4375	5276	5079	5562	5592	188	497
50% NPK + 50% FYM-N	4398	4981	5124	5278	6235	5426	196	491
50% NPK + 25% GM-N+25% FYM-N	4351	5137	6018	5221	6075	6418	195	518
FYM @ 10 t/ha	3873	5012	4429	4648	6487	4759	181	453
FYM@10 t/ha + 3.0 t/ha Vermicompost +200 kg/ha oil cakes	4121	-	4968	4945	-	5284	184	475
Expt. Mean	**4340**	**4231**	**4030**	**5208**	**5455**	**4275**	**191**	**406**
LSD (0.05)	**368**	**351**	**346**	**442**	**495**	**225**	**23**	**32**
CV (%)	**5.2**	**5.9**	**4.1**	**5.2**	**6.4**	**2.5**	**7.3**	**3.8**

MTU-Maruteru TTB-Titabar MND -Mandya

Table 5.1.6: Long term soil fertility management in RBCS, *kharif 2018*
Nutrient uptake (kg/ha) in total dry matter

Treatments	Maruteru			Titabar			Mandya		
	N (kg /ha)	P (kg /ha)	K (kg /ha)	N (kg /ha)	P (kg /ha)	K (kg /ha)	N (kg /ha)	P (kg /ha)	K (kg /ha)
Control	50.2	12.1	40.7	27.3	4.6	42.1	27.4	5.0	31.4
100% PK	62.4	12.4	66.2	48.9	11.2	68.0	35.9	7.1	44.0
100% NK	69.8	16.8	57.9	48.9	11.4	68.5	44.2	6.8	52.4
STCR recommendation	80.1	18.3	89.3	50.1	12.3	75.4	66.5	12.5	73.4
100% NP	66.7	16.4	80.3	52.7	10.7	67.5	48.8	9.0	46.6
100% NPK + Zn + S	76.4	22.3	69.2	78.8	14.2	83.3	81.4	15.9	94.5
100% NPK + Zn + S + FYM/PM @ 5 t/ha	94.9	21.7	59.5	81.9	16.4	92.8	113.1	23.1	127.0
100% NPK –Zn	85.8	21.4	58.1	66.1	11.4	74.6	73.4	14.5	84.0
100% NPK – S	80.8	18.0	57.1	66.3	10.9	70.4	66.8	13.4	76.3
100%NPK-S+ 1timelime/ha	-	-	-	65.0	11.0	70.7	-	-	-
100% N+50% PK	76.4	16.1	68.7	47.6	8.2	51.9	56.6	10.2	61.5
50 % NPK	64.7	14.7	72.5	48.7	8.0	55.0	49.4	9.4	53.5
50 % NPK + Biofertilizer	69.3	15.5	66.6	40.4	7.1	51.4	61.4	11.6	67.2
50% NPK+ 50% GM-N	77.2	18.1	58.9	63.4	10.2	71.4	94.0	18.8	109.3
50% NPK+ 50% FYM-N	77.1	16.9	83.8	70.7	12.4	80.6	91.8	18.3	107.1
50% NPK +25% GM-N +25% FYM-N	69.1	18.5	81.6	71.3	13.0	82.1	109.9	22.8	125.8
FYM @ 10 t/ha	63.2	15.0	68.0	73.6	12.9	89.5	79.8	14.9	92.8
FYM@10t/ha +3.0 t/ha Vermicompost+200 kg/ha oil cakes	65.2	13.9	61.7	-	-	-	90.2	17.3	103.1
Expt. Mean	**72.3**	**16.9**	**67.1**	**58.9**	**10.9**	**70.3**	**70.0**	**13.6**	**79.4**
LSD (0.05)	**9.2**	**3.1**	**10.0**	**7.3**	**2.1**	**7.0**	**10.0**	**4.3**	**6.8**
CV (%)	**7.7**	**11.0**	**9.0**	**7.5**	**11.5**	**6.0**	**6.7**	**15.0**	**4.0**

Table 5.1.7: Long term soil fertility management in RBCS, K*harif* 2018

Soil fertility status at harvest

Treatments	Maruteru						Titabar					
	pH	**EC dS/m**	**Org. C (%)**	**Avail. N (kg/ha)**	**Avail P_2O_5 (kg/ha)**	**Avail. K_2O (kg/ha)**	**Soil pH**	**Org. C (%)**	**Avail. N (kg/ha)**	**Avail. S (mg/kg)**	**Avail. P_2O_5 (kg/ha)**	**Avail. K_2O (kg/ha)**
Control	5.9	0.6	1.3	237	58.6	295	5.2	0.6	167	5.9	12.3	81.7
100% PK	6.0	0.6	1.2	243	78.2	376	5.4	0.8	230	11.3	24.0	95.0
100% NK	5.9	0.6	1.2	252	70.1	262	5.5	0.9	295	12.7	28.2	111.7
STCR recommendation	6.1	0.6	1.2	280	75.8	300	5.6	1.0	327	12.2	35.2	94.3
100%NP	6.1	0.7	1.2	288	91.8	309	5.5	1.1	325	13.1	32.8	93.3
100% NPKZnS	6.1	0.5	1.1	282	98.7	346	5.5	1.3	392	21.3	38.2	151.7
100% NPKZnS + FYM/PM @ 5t/ha	6.1	0.6	1.2	292	98.6	382	5.5	1.5	450	20.0	41.2	163.3
100% NPK –Zn	6.1	0.6	1.3	325	79.6	348	5.6	1.3	397	22.5	37.2	150.0
100% NPK – S	6.1	0.6	1.3	304	83.1	371	5.5	0.8	367	19.4	38.5	150.0
100%NPK-S+ 1timelime/ha	-	-	-	-	-	-	5.5	1.3	385	18.7	35.7	153.3
100% N+50% PK	6.1	0.5	1.1	306	67.4	336	5.5	0.7	222	18.9	33.6	100.0
50 % NPK	6.2	0.6	1.1	261	78.6	329	5.5	1.3	399	20.1	26.7	86.7
50 % NPK + Biofertilizer	5.9	0.6	1.2	258	67.9	279	5.6	1.4	419	18.8	36.1	143.3
50% NPK+ 50% GM-N	6.1	0.7	1.2	200	86.1	349	5.6	1.4	422	17.9	36.8	155.0
50% NPK + 50% FYM-N	6.2	0.6	1.1	233	95.5	338	5.6	1.4	418	18.6	37.4	163.0
50% NPK + 25%GM-N+25%FYM-N	6.0	0.6	1.1	270	94.4	335	5.6	1.4	429	18.6	38.2	165.0
FYM @ 10 t/ha	6.0	0.6	1.2	234	92.5	366	5.6	1.5	448	18.5	43.7	166.7
FYM@10 t/ha +3.0 t/ha Vermicompost +200 kg/ha oil cakes	6.0	0.6	1.3	254	98.5	272	-	-	-	-	-	-
Expt. Mean	**6.1**	**0.6**	**1.2**	**266**	**83.3**	**329**	**5.5**	**1.2**	**358**	**17.0**	**33.9**	**131**
LSD (0.05)	**NS**	**NS**	**0.1**	**27.3**	**5.2**	**35**	**0.2**	**0.3**	**56**	**2.2**	**3.5**	**17**
CV (%)	**2.1**	**10.8**	**6.7**	**6.2**	**3.8**	**6.4**	**1.7**	**17.9**	**9.5**	**7.8**	**6.3**	**8.2**

Table 5.1.8: Long term soil fertility management in RBCS, K*harif* 2018
Soil fertility status at harvest (Mandya)

Treatments	Soil O.C. (%)	Avail N (kg/ha)	Avail P (kg/ha)	Avail K (kg/ha)
Control	0.2	195	10.5	108
100% PK	0.2	238	24.5	234
100% NK	0.3	224	16.8	224
100% NP	0.3	245	25.4	154
100% NPK + Zn + S	0.3	288	28.7	242
100% NPKZnS + FYM/PM	0.4	355	47.3	284
100% NPK – Zn	0.3	282	28.2	248
100% NPK – S	0.3	271	29.3	247
100% N + 50% PK	0.3	265	25.7	229
50% NPK	0.3	253	23.2	238
50% NPK + 50% GM-N	0.5	318	40.2	278
50% NPK + 50% FYM-N	0.5	323	42.4	295
50% NPK + 25% GM-N + 25% FYM-N	0.6	362	46.3	304
FYM @ 10 t/ha	0.5	326	36.2	278
Expt. Mean	**0.4**	**282**	**30.2**	**243**
LSD (0.05)	**0.1**	**15.4**	**2.6**	**9.9**
CV (%)	**7.1**	**2.6**	**4.0**	**1.9**

Table 5.1.9: Long term soil fertility management in RBCS
Linear trends of changes in *kharif* rice yields (t/ha) from 1989 to 2018

Treatments	MTU			TTB			MND		
	Mean yield (t/ha)	Slope (kg/ha/yr)	Intercept (t/ha)	Mean yield (t/ha)	Slope (kg/ha/yr)	Intercept (t/ha)	Mean yield (t/ha)	Slope (kg/ha/yr)	Intercept (t/ha)
Control	2.86	4.0	2.81	2.02	-64.2	3.04	2.26	-80.0	3.39
100% PK	3.43	35.0	2.89	3.49	35.2	2.60	2.80	-42.4	3.40
100% NK	4.08	-5.0	4.14	3.49	16.0	3.24	3.51	-95.9	4.85
100% NP	4.44	-24.0	4.81	3.71	16.7	3.45	3.93	-104.8	5.40
100% NPK + Zn + S	5.05	6.0	4.92	4.32	31.7	3.83	4.73	-44.4	5.36
100% NPKZnS + FYM/PM	5.12	65.0	4.46	4.90	81.0	4.09	5.19	96.0	4.37
100% NPK – Zn	4.72	-4.0	4.77	4.13	20.1	3.82	4.56	-67.4	5.51
100% NPK – S	4.75	3.0	4.70	4.11	0.8	4.10	4.48	-57.9	5.30
100% N + 50% PK	4.42	-6.0	4.49	3.61	-14.4	3.83	4.08	-96.0	5.43
50% NPK	4.28	-4.0	4.34	3.21	-39.2	3.82	3.80	-55.9	4.59
50% NPK + 50% GM-N	4.44	1.0	4.42	3.81	27.9	3.38	4.78	-1.0	4.81
50% NPK + 50% FYM-N	4.67	0.0	4.67	3.91	29.7	3.45	4.86	17.0	4.62
50% NPK + 25% GM-N + 25% FYM-N	4.51	7.0	4.40	3.95	24.7	3.57	5.39	18.0	5.14
FYM @ 10 t/ha	4.36	-5.0	4.44	4.01	49.9	3.23	4.15	31.1	3.70

Table 5.1.10: Long term soil fertility management in RBCS
Linear trends of changes in *rabi rice* yields (t/ha) from 1989 to 2018

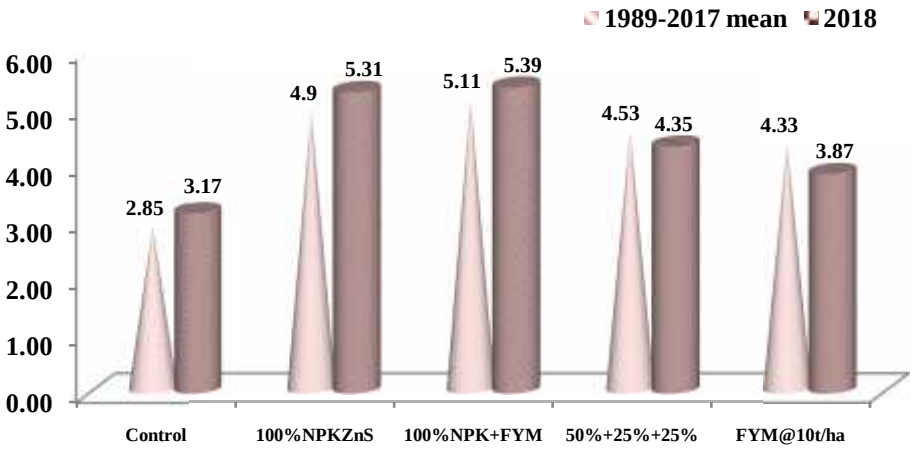
Treatments	MTU			TTB		
	Mean yield (t/ha)	Slope (kg/ha/yr)	Intercept (t/ha)	Mean yield (t/ha)	Slope (kg/ha/yr)	Intercept (t/ha)
Control	2.13	24.0	1.87	1.71	-40.0	2.27
100% PK	2.81	60.0	1.97	2.96	66.0	2.04
100% NK	4.05	30.0	3.59	3.23	30.0	2.81
100% NP	4.96	10.0	4.60	3.40	15.0	3.19
100% NPK + Zn + S	5.66	47.0	5.00	3.85	34.0	3.37
100% NPKZnS + FYM/PM	5.99	15.0	6.52	4.32	58.0	3.24
100% NPK – Zn	5.15	20.0	4.83	3.64	19.0	3.38
100% NPK – S	5.27	20.0	4.89	3.53	16.0	3.30
100% N + 50% PK	5.18	30.0	4.72	3.31	0.0	3.31
50% NPK	4.22	10.0	4.05	2.77	-15.0	2.98
50% NPK + 50% GM-N	4.84	-10.0	5.03	3.34	26.0	2.98
50% NPK + 50% FYM-N	5.10	40.0	4.52	3.43	38.0	2.91
50% NPK + 25% GM-N + 25% FYM-N	5.01	24.3	4.67	3.46	40.0	2.91
FYM @ 10 t/ha	4.02	33.4	3.53	3.46	47.0	2.84

Table 5.1.11. Long term soil fertility management in RCBS
Changes (%) in soil fertility parameters in important treatments over 1989 to 2018

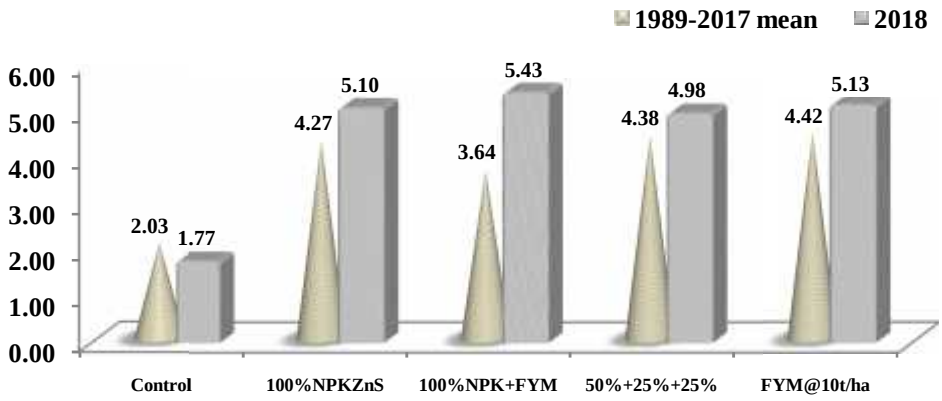
Treatments	Maruteru				Mandya				Titabar			
	Org.C.	Avail N	Avail P_2O_5	Avail K_2O	Org.C.	Avail N	Avail P_2O_5	Avail K_2O	Org.C.	Avail N	Avail P_2O_5	Avail K_2O
Control	46.1	-20.5	187	-27.3	-42.9	-32.8	-40.3	-38.6	-36.8	-66.4	-6.8	-43.8
100% NPK + Zn + S	23.6	-5.4	384	-14.8	-14.3	-0.7	63.1	37.5	36.8	-21.1	189.4	3.4
100% NPKZnS + FYM/PM	34.8	-2.0	383	-5.9	14.3	22.4	168.8	61.4	57.9	-9.5	212.1	11.6
50% NPK + 25% GM-N + 25% FYM-N	23.6	-9.4	363	-17.5	71.4	24.8	163.1	72.7	47.4	-13.7	189.4	13.0
FYM @ 10 t/ha	34.8	-21.5	353	-9.9	42.9	12.4	105.7	58.0	57.9	-9.9	231.1	14.4

Table 5.1.12 : Validation and prediction of rice yield (t ha^{-1}) through polynomial growth model

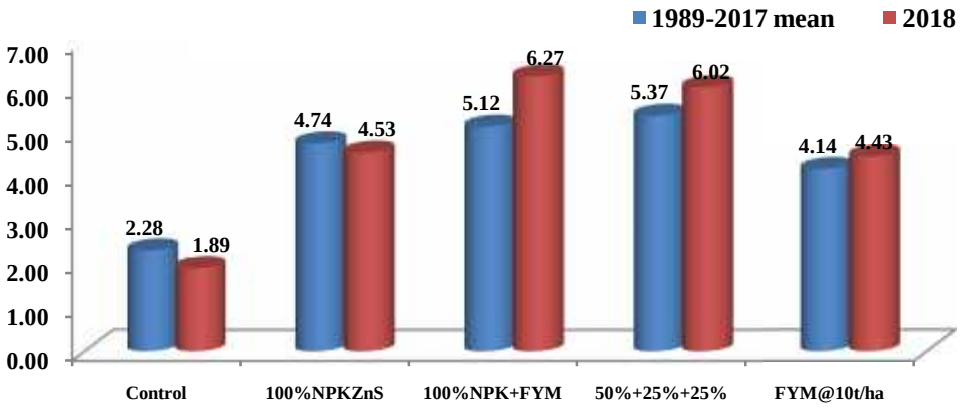
Treatments	Yield predicted through polynomial growth model			Actual yield observed		
	MND	MTU	TTB	MND	MTU	TTB
Control	1.93	3.20	1.58	1.89	3.17	1.17
RDF	4.53	5.25	5.07	4.53	5.31	5.12
RDF + FYM	6.25	5.35	5.35	6.27	5.39	5.43
FYM alone	4.29	3.67	5.29	4.43	3.87	5.01



Grain yield (t ha^{-1}) at Maruteru

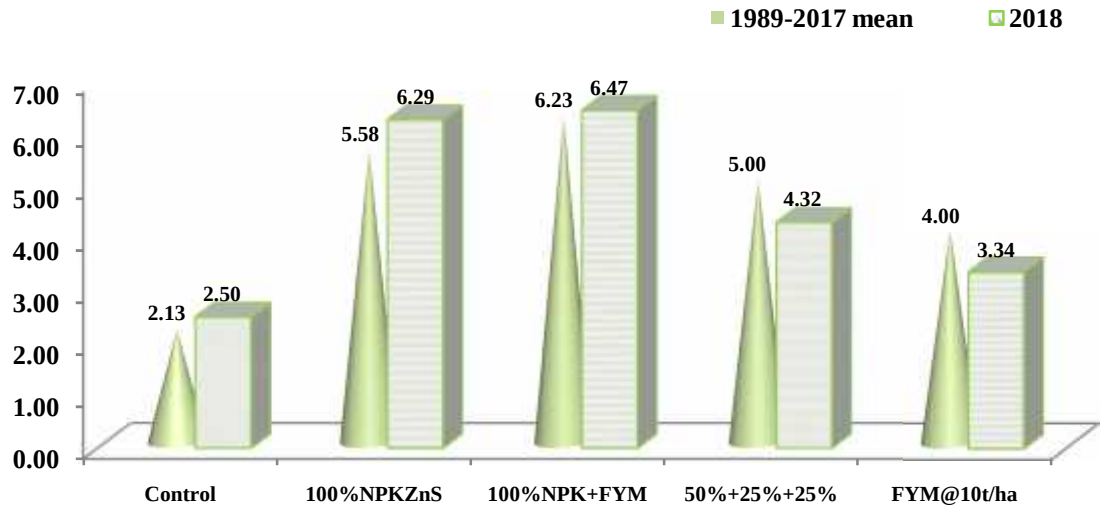


Grain yield (t ha^{-1}) at Titabar

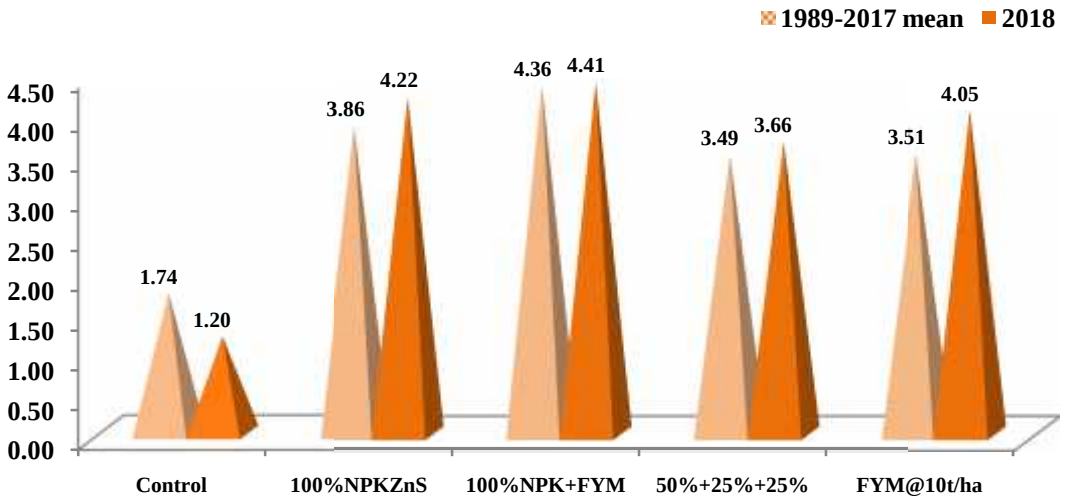


Grain yield (t ha^{-1}) at Mandya

Fig. 5.1.1. Long term effect of nutrient management on rice grain yields –*Kharif* (Mean of previous 29 years and current year grain yield)



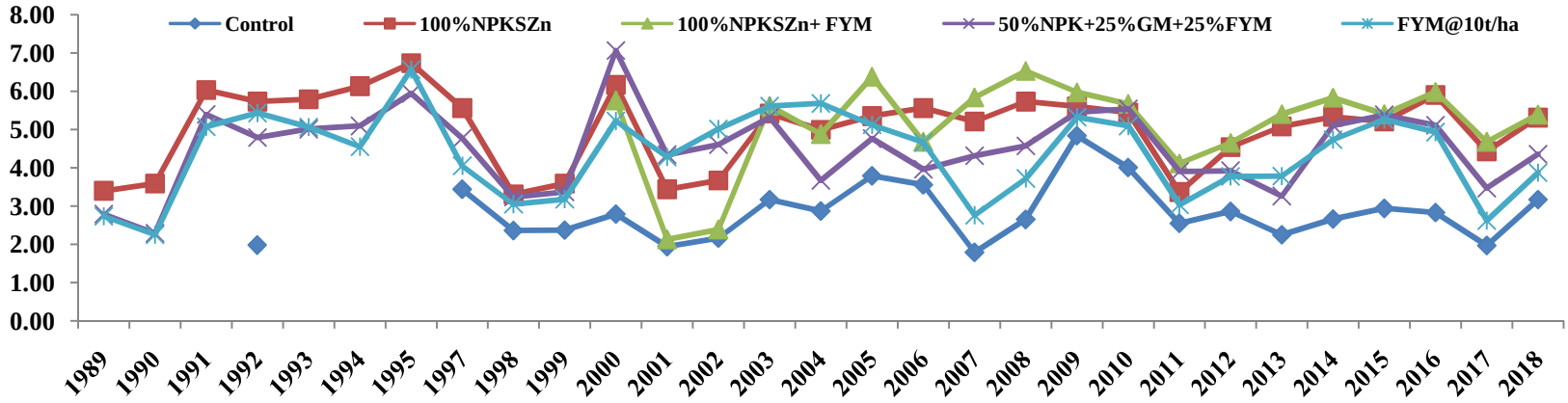
Grain yield (t ha^{-1}) at Maruteru



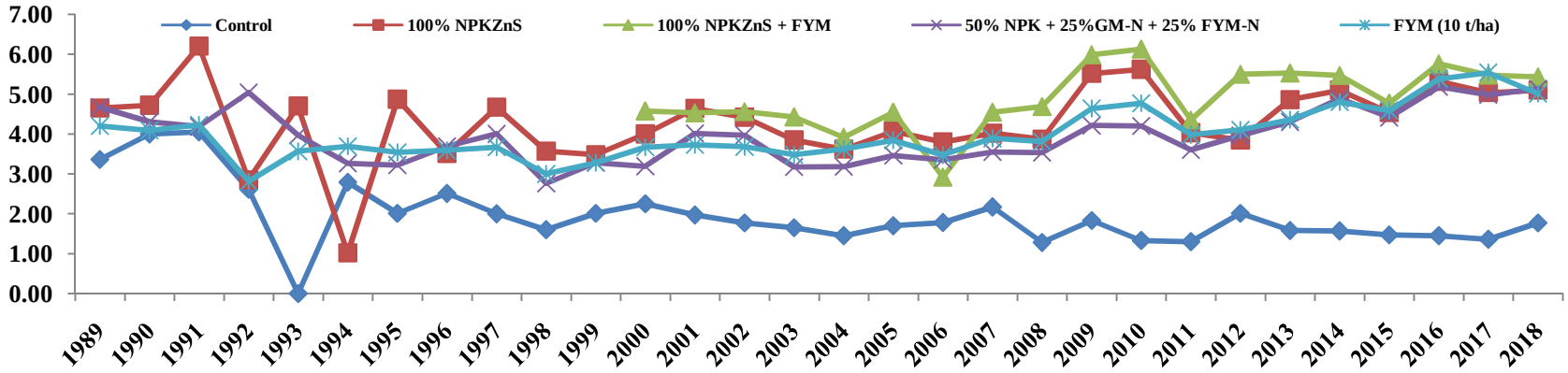
Grain yield (t ha^{-1}) at Titabar

Fig. 5.1.2. Long term effect of nutrient management on rice grain yields-*Rabi* (Mean of previous 29 years and current year grain yield)

Maruteru



Titabar



Mandya

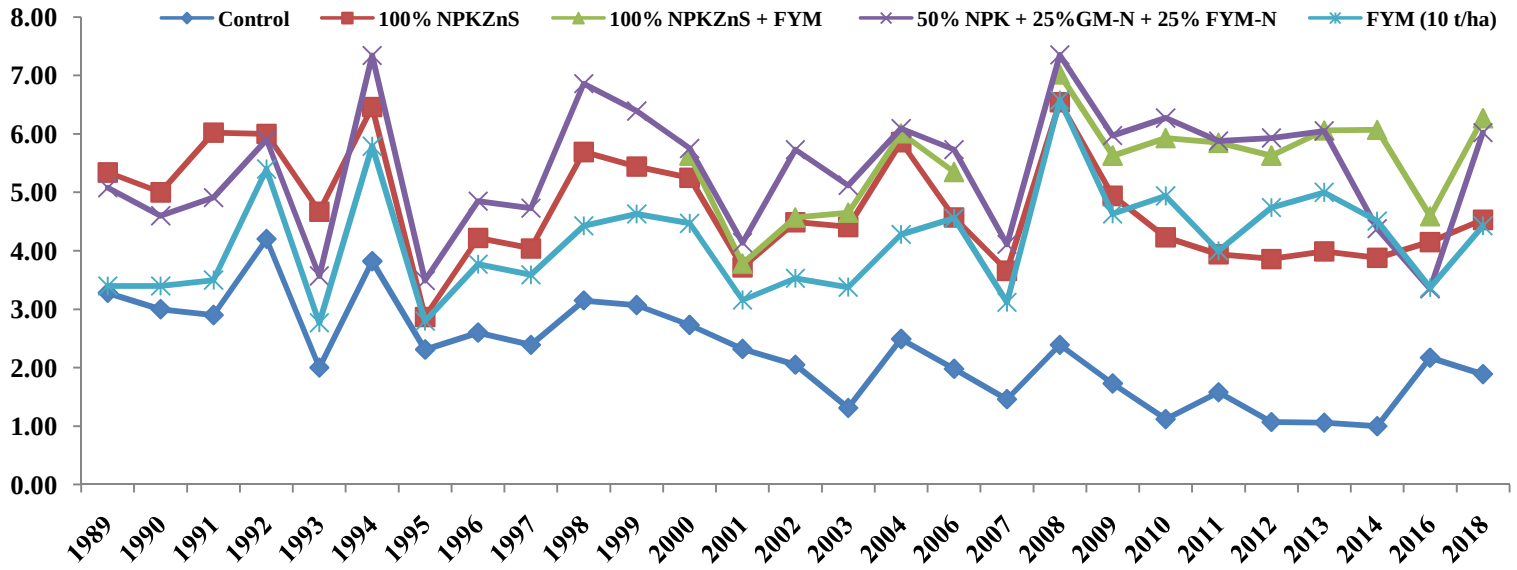
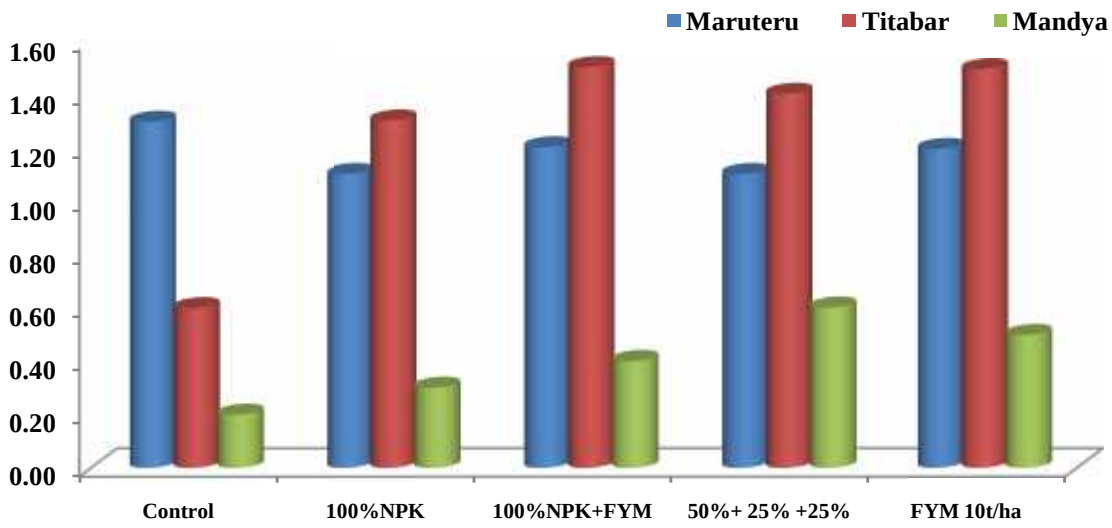
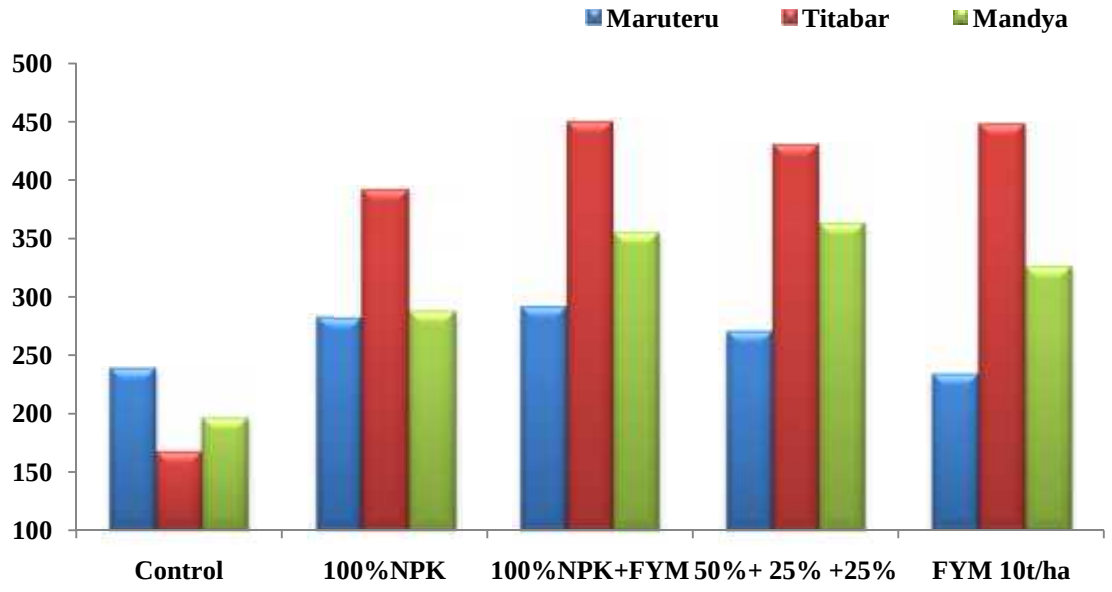


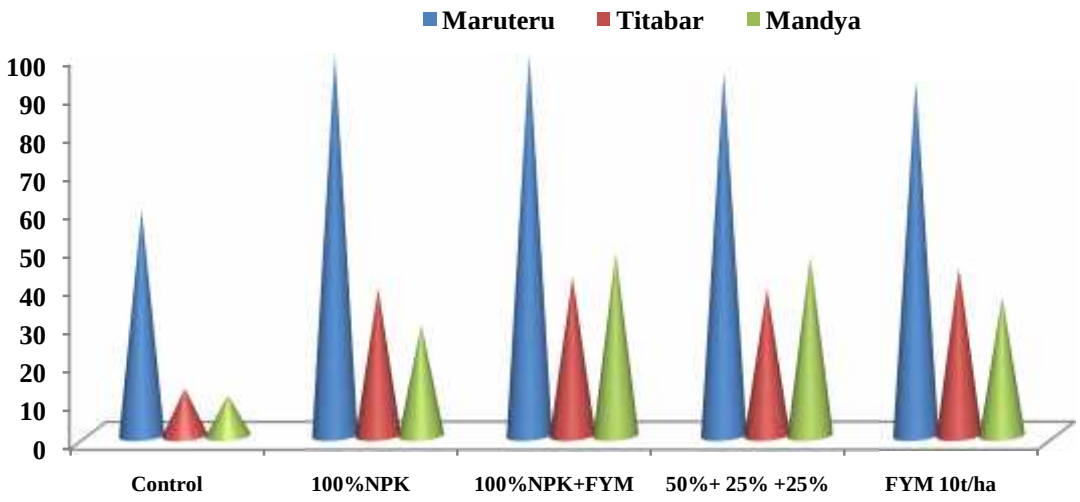
Fig 5.1.3 Long term soil fertility management in RBCS- Trends in crop productivity (t/ha) *Kharif* over 30 years (1989-2018)



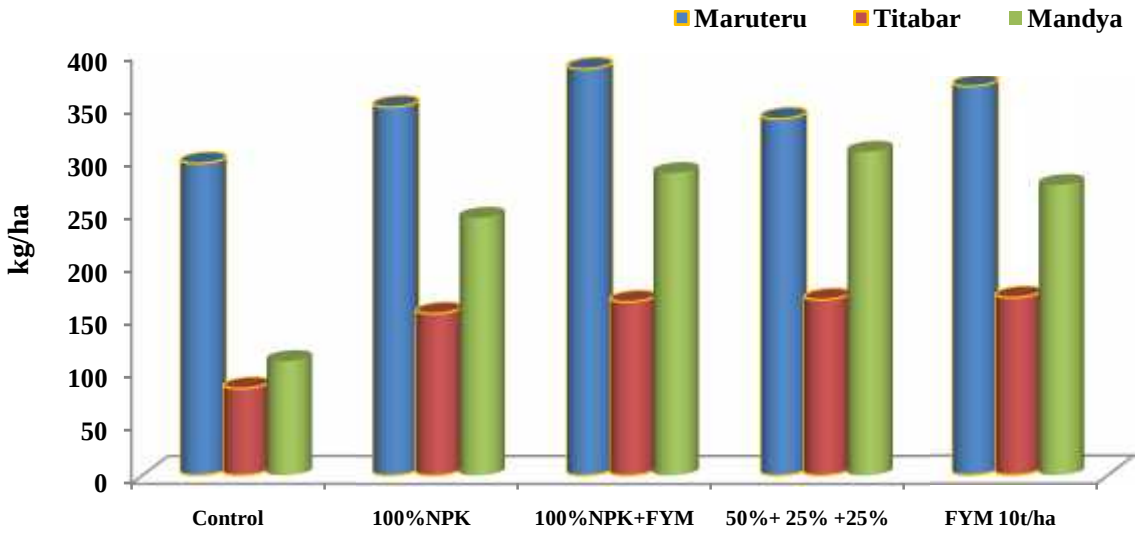
Organic carbon content (%)



Available nitrogen content (kg ha^{-1})



Available phosphorus content (kg ha^{-1})



Available K_2O content (kg ha^{-1})

Fig. 5.1.4. Long term effect of nutrient management on soil nutrient status (*Kharif 2018)*

5.2. Soil quality and productivity assessment for bridging the yield gaps in farmers' Fields

Large variations in yield are a major impending problem for rice sustainability in India. Rice production must increase to meet future food requirements amid strong competition for limited resources. The growing concern about impaired soil health, declining/decelerating productivity growth and decreasing factor productivity or efficiency of the nutrients compelling to use increasing levels of fertilizers during the last two decades has raised apprehensions on the productive capacity of the agricultural system. Yield and technology gap is a major problem in increasing paddy production in the irrigated ecosystems of the states. Yield gap analysis is useful method to examine how large the ranges are between potential, desirable rice yields and those actually realized in farmers' fields. Blanket fertilizer recommendations are still being followed in large domains with less importance being given to management induced site variations of soil nutrient supply capacities, and crop demand more so when new high yielding cultures with increasing yield potential are being regularly introduced. This has been the major reason for reported nutrient imbalances and un-sustainability in realizing yields.

This trial was, therefore, conducted in farmers' fields around six selected centres – Chinsurah (33 farmers), Ghaghraghat (30 farmers), at Pantnagar (50 farmers), Karaikal (24 farmers) ,Faizabad (50 farmers) and Maruteru (62 farmers) to assess the variability in soil nutrient supply, rice yields with farmers' fertilizer practices in some farm sites and fine-tune the fertilizer nutrient requirement for specific target yields in a given environment and validation of fertilizer recommendations for targeted yields. The *kharif* 2018 data received representing the irrigated and shallow lowland rice ecosystems are presented in Tables 5.2.1 to 5.2.4 The test varieties were Swarna , Khitish, Shatabdi at Chinsurah, 27P37 at Ghaghraghat, IET 4786 at Maruteru, CR1009, CO50, BPT5204, ADT46, IW Ponni at Pajancoa, NDR 2065, Sarjoo-52 & Sambha Sub-1 at Faizabad, PR1509,PR121,PR126,PD-10,PD-12,SARBATI,PUSA-150,PUSA-154,, HR-47,SARJOO52,HR 147 at Pantnagar. The methodology involved a survey in nearby villages during *kharif* 2018 and *rabi* 2018-19 involving data collection from around 50 farmers. The farmers were grouped into Low and high yielders categories. Soil and plant samples were collected from field after harvest and analyzed for their nutrient contents and their soil quality indices were calculated as per method given by Abassi,1999.The SQI constructed using the formula **SQI = (DpH + DOM + DP + DK + DEC)/5,**where DpH = 1, if pH > 6.5 and 0 otherwise, DOM = 1, if OM > 2 and 0 otherwise, DP = 1, if P > 20 and 0 otherwise, DK = 1, if K > 80 and 0 otherwise ,and DEC = 1, if EC < 2 and 0 otherwise, D = constant. Based on the SQI values, the soil quality scale can be rated as, Excellent (>0.9),very good (0.7-0.9),good (0.6– 0.7), average (0.5–0.6), poor (0.4–0.5) and Very poor(<0.4). For next season crop, site specific recommendations to the farmers have been generated and is being given for higher productivity and soil health improvement. The details of crop, soil and weather parameters of the experimental sites, presented in the Table 5.2.1, show variation in soil characteristics with reference to pH, organic carbon content, soil texture and available nutrient status.

Table 5.2.2 gives information collected in the new farm sites on yields obtained, nutrient uptake and Soil quality index calculated from all the soil samples collected from the farmers fields. Sharp variations in grain yields recorded varied from 2.4 t/ha among low yielders to 4.9 t/ha among high yielders at Chinsurah, from 3.4 t/ha among low yielders to 4.65 t/ha among high yielders at Ghaghraghat, varied from 4.6 t/ha among low yielders to 5.5 t/ha among high yielders at Maruteru, from 3.64 t/ha among low yielders to 5.1 t/ha among high yielders at Karaikal from 4.2 t/ha among low yielders to 5.21 t/ha among high yielders at Faizabad and from 4.50 t/ha among low yielders to 5.48 t/ha among high yielders at Pantnagar, whereas grain yield variations were not too steep at Maruteru and Pantnagar. Soil Parameters data were pooled in different categories and the resulting soil quality index generated showed variations in the quality and health of the soil across different farmers categories. The poorest soil quality index was calculated for farmers from Pantnagar, due to considerable variation among the farm sites and soil test values. The soil quality index was much superior at Chinsurah and were at par for all other centers. Very good soil quality might be one such reason as most of the farmers got very high yields. Very poor soil quality at Pantnagar observed due to low values obtained in all major nutrients tested. Large variations were obtained for nutrient uptake between low yielders and high yields across the centres. Soil nutrient uptake for major nutrients varied widely among the sites. At all these locations wide variations in grain yields and nutrient uptake were recorded (Table 5.2.3), while soil test values did not match the yields recorded with rice yield and nutrient uptake at both the locations, suggesting perhaps less suitability of current soil testing methods for flooded soils. However, some centres reported soil quality index at par with their resulting grain yield and nutrient uptake patterns. Table 5.2.3 recorded the Soil nutrient availability per ton grain yield variations obtained at all the centres.

Fertilizer prescriptions were worked out for all the farm sites and specific fertilizer recommendations were suggested for target yield Chinsurah and Ghaghraghat to be (5.6 (t/ha), Maruteru-6.8 t/ha,Pantnagar-6.6 t/ha , Pajjancoa-6.9 t/ha,Faizabaad-6.6 t/ha**.** at these three locations (being the highest yield recorded at the test sites) with reference to grain yields and average uptake of nutrients per ton of grain and average recovery efficiency and nutrient requirement recorded at the test sites. The target yields were the maximum recorded at the test sites under recommended fertilizer practice (RDF). The fertilizer recommendations presented show a range of fertilizer doses of major nutrients to achieve the targeted productivity which has already been harvested. High estimates of P and K fertilizer requirements are due to lower recovery efficiency of applied P and higher accumulation of potassium per ton of grain. The study, thus indicated ample scope for improvement in nutrient use efficiency, and an attempt has been made to refine the current blanket recommended dose of fertilizer based on site specific nutrient supply, nutrient use efficiency and crop demand. While the yields were having considerable variation with the farmers' fertilizer practices, respectively with corresponding variation in soil test values and uptake pattern followed. Wide variations in yields were recorded under recommended fertilizer practices and with all the nutrients under farmers practice indicating mismatch of the fertilizer doses. Soil nutrient availability showed steep variations for the potassium nutrient across the

centres except Faizabad where it was low. Among all the centres, high to very high status of soil available phosphorus status were recorded.

Yield Gap analysis

Yield gap analysis done for all farm fields sites. The need was assessed to ascertain the gaps of technology and compared the yield variations among low yielders and high yielders *vis* a *vis* uptake, soil quality index gaps. Yield Gap was estimated based on the existing gaps in yields which were recorded between the low yielders and the high yielders and what was the prevalent grain yield in those farmers sites prevalent across the region . The results have been enlisted in the table no.5.2.4 and Figure 1. The highest level of yield gap (51 %) was recorded at Chinsurah, followed by 26 & 29 at Ghaghraghat, respectively. Pajancoa and Ghaghraghat. Yield gap variations were comparatively low Maruteru (16%) and Pantnagar (18 %) This shows a wide gap of grain harvest existed. At Faizabad, yield Gap was to the tune of almost 20%. However, ample scope existed at these centre to increase yields. At Maruteru and Pantnagar, the yield gaps were not very high and yields obtained at different farmers fields almost matched superior technology yields.

Summary: This trial in the form of a survey conducted in farmers' fields around six selected centres – Chinsurah (33 farmers), Ghaghraghat (30 farmers), at Pantnagar (50 farmers), Karaikal (24 farmers), Faizabad (50 farmers) and Maruteru (62 farmers) to assess the variability in nutrient supply, rice yields with farmers' fertilizer practices in farm sites and fine-tune the fertilizer nutrient requirement for specific target yields in a given environment and validation of fertilizer recommendations for targeted yields. The *kharif* 2018 data received representing the irrigated and shallow lowland rice ecosystems revealed wide variations. Soil nutrient uptake varied between the sites matching with the grain yields. Sharp variations in grain yields recorded varied from 2.4 t/ha among low yielders to 4.9 t/ha among high yielders at Chinsurah, from 3.4 t/ha among low yielders to 4.65 t/ha among high yielders at Ghaghraghat, varied from 4.6 t/ha among low yielders to 5.6 t/ha among high yielders at Maruteru, from 3.64 t/ha among low yielders to 5.1 t/ha among high yielders at Karaikal from 4.2 t/ha among low yielders to 5.21 t/ha among high yielders at Faizabad and from 4.50 t/ha among low yielders to 5.48 t /ha among high yielders at Pantnagar. Grain yield variations were not too steep at Maruteru and Pantnagar. Fertilizer recommendations were suggested for target yield at Chinsurah and ghaghraghat to be (5.6 (t/ha), Maruteru-6.8 t/ha,Pantnagar-6.6 t/ha , Pajjancoa-6.9 t/ha,Faizabaad-6.6 t/ha. at these three locations (being the highest yield recorded at the test sites) based on the grain yield and average uptake of nutrients per ton of grain and nutrient requirement recorded at the test sites. The highest level of yield gap (51 %) was recorded at Chinsurah, followed by nearly 27% at Pajancoa and Ghaghraghat. Yield gaps variations were comparatively low in Maruteru (16) and Pantnagar (18 %). At Faizabad, yield Gap was to the tune of almost 20%.

Table 5.2.1 Rice productivity in relation to internal supply capacity of nutrients in farmers' fields, *kharif* 2018. Soil, crop and weather data

Parameter	Chinsurah	Ghaghraghat	Maruteru	Karaikal	Faizabad	Pantnagar
Variety	Swarna , Khitish, Shatabdi	27P37	(IET 4786)	CR1009, CO50, BPT5204, ADT46, IW Ponni	NDR 2065, Sarjoo-52 & Sambha Sub-1	PR1509,PR121,PR126,PD 10, PD-12, SARBATI, PUSA-150, PUSA-154,, HR-47, SARJOO52, HR 147
Crop growth	Good	Good	Good	Good	Good	Good
RFD (kg NPK/ha)	Varying- 70-35-35, 60-30-30, 80-40-40, 90-45-45, 50-25-25, 48-24-24, 50-25-25	Varying -60:30:00, 80:40:00, 120:60:40	80-40-40		Varying- RFD (kg NPK/ha)150:50:50	Varying-180,60,40, 150,60,40, 200,60,40, 200,60,50, 200,60,40, 200,50,40, 200,60,30
% Clay	-	15.8	-		23	-
% Silt	-	32	-		21	-
% Sand	-	50.8	-		56	-
Soil Texture	-	Sandy Loam		Sandy Loam, Loamy sand, Sandy Clay Loam	Sandy Loam	
pH	6.49-7.46	7.6-8.7	5.53-6.13	6.96-8.61	7.3-7.6	7.0-8.0
Org. carbon (%)	0.85-1.1	0.4-0.58	1.24-1.54	0.059-0.56	0.37 – 0.45	0.25-0.75
Avail. N (kg/ha)	341-461	110-230	152-219	34.5-203.8	175-210	120-215
Avail. P_2O_5 (kg/ha)	81-99	11-25	11-29	32.6-83.2	19-27	5.5-16.2
Avail. K_2O (kg/ha)	255-296	135-240	321-532	184-830	200-230	105-230

Table 5.2.2 Rice productivity in relation to internal supply capacity of nutrients in farmers' fields, *kharif* 2018 - Soil nutrient supply potential assessed in different farmers categories

Categories/ Nutrient	**Chinsurah (total of 46 sites,** 12 low yielders and 34 high yielder sites)			**Ghaghraghat** (30 sites, low yielders 10 and 20 high yielder sites)		
	Minimum	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
Grain yield (t/ha)						
Low Yielders	1.8	3.1	2.4	2.46	4.38	3.44
High Yielders	4.1	5.6	4.9	4.02	5.4	4.65
Nutrient uptake (kg/ha)						
	Low Yielders					
N	-	-	-	43.4	117.9	70.5
P	-	-	-	13.8	32.4	22.8
K	-	-	-	81.5	150.6	110.0
High Yielders						
N	-	-	-	77	147	108
P	-	-	-	23.9	39.6	31.2
K	-	-	-	105.8	181.2	142.5
Soil Quality Index						
Low Yielders	0.8 (High)	1.0 (High)	0.9 (High)	0.4 (Poor)	0.5 (Average)	0.45 (Poor)
High Yielders	0.8 (High)	1.0(High)	0.9 (High)	0.5(Average)	0.6 (Average)	0.55 (Average)

Categories/ Nutrient	**Maruteru** (27 low yielders,20 high yielders)			**Karaikal** (16 high yielders, 4 low yielders**)**		
	Minimum	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
Grain yield (t/ha)						
Low Yielders	4.0	4.96	4.6	3.4	3.8	3.64
High Yielders	5.0	7.8	5.5	4.0	6.9	5.1
Nutrient uptake (kg/ha)						
Low Yielders						
N	-	-	-	34.6	76.5	54.4
P	-	-	-	20.2	52.7	39.1
K	-	-	-	97.7	162.5	126.1
High Yielders						
N	-	-	-	**32.49**	**132.17**	**61.81**
P	-	-	-	**4.14**	**112.67**	**39.97**
K	-	-	-	**57.1**	**373.1**	165.1
Soil Quality Index						
Low Yielders	0.4 (Poor)	0.5 (Average)	0.45 (Poor)	0.4 (Poor)	0.5 (Average)	0.45 (Poor)
High Yielders	0.5 (Average)	0.6 (Average)	0.55 (Average)	0.5 (Average)	0.6 (Average)	0.55 (Average)

Categories/ Nutrient	**Faizabad** (9 low yielders, 41 high yielders)			**Pantnagar** (20 low yielders,30 high yielders)		
	Minimum	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
Grain yield (t/ha)						
Low Yielders	4.0	4.5	4.2	4.0	5.0	4.5
High Yielders	4.15	6.65	5.21	5.5	6.5	5.5
Nutrient uptake (kg/ha)						
Low Yielders						
N	42.1	85.1	58.5	53	87	65.9
P	16.0	26.6	20.1	7.5	18	13.7
K	20.8	29.7	25.1	38	91	67
High Yielders						
N	84.8	187.6	130.2	65.3	108	85.9
P	34.6	90.4	56.4	12.03	22.75	17.3
K	65.6	125.6	86.0	54.4	116.9	77.9
Soil Quality Index						
Low Yielders	0.3(Poor)	0.4(Poor)	0.35(Poor)	0.2(Very Poor)	0.3(Poor)	0.25(Very Poor)
High Yielders	0.4 (Poor)	0.5 (Average)	0.45 (Poor)	0.5 (Average)	0.6(Average)	0.55(Average)

Table 5.2.3 Rice productivity in relation to internal supply capacity of nutrients in farmers' fields, *kharif* 2018 - Nutrient Requirement per ton grain yield

Farmers categories	Chinsurah			Ghaghraghat		
	Mean yield (t/ha)	Mean uptake (kg/ha)	Nutrient Requirement (kg/t grain)	Mean yield (t/ha)	Mean uptake (kg/ha)	Nutrient Requirement (kg/t grain)
Low Yielders (12 sites)						
N	2.4	-	-	3.44	70.5	23.3
P		-	-		22.8	5.7
K		-	-		110.0	36.7
High Yielders (34 sites)						
N	4.9	-	-	4.65	108	21.6
P		-	-		31.2	6.2
K		-	-		142.5	28.4
Farmers categories	**Maruteru**			**Karaikal**		
	Mean yield (t/ha)	**Mean uptake (kg/ha)**	**Nutrient Requirement (kg/t grain)**	**Mean yield (t/ha)**	**Mean uptake (kg/ha)**	**Nutrient Requirement (kg/t grain)**
Low yielders						
N	4.6	-	-	3.64	54.4	14.94
P		-	-		39.1	10.74
K		-	-		126.1	34.64
High yielders						
N	5.5	-	-	5.1	61.81	12.11
P		-	-		39.97	7.83
K		-	-		165.1	32.37
Farmers categories	**Faizabad**			**Pantnagar**		
	Mean yield (t/ha)	**Mean uptake (kg/ha)**	**Nutrient Requirement (kg/t grain)**	**Mean yield (t/ha)**	**Mean uptake (kg/ha)**	**Nutrient Requirement (kg/t grain)**
Low yielders						
N	4.2	58.5	14.94	4.5	65.9	14.6
P		20.1	4.78		13.7	3.04
K		25.1	5.97		67	14.8
High yielders						
N	5.21	130.2	24.91	5.5	85.9	15.6
P		56.4	10.63		17.3	3.14
K		86.0	16.5		77.9	14.1

Table 5.2.4 Rice productivity in relation to internal supply capacity of nutrients in farmers' fields, *Kharif* 2018 Site-specific fertilizer recommendation (kg/ha) for a target yield

Site /centres.	Current yield low yielders group (kg/ha)	Current yield High Yielders group (kg/ha)	Per cent increase in yield over low yielders groups	Fertilizer recommendation for the target yield (t/ha) Chinsurah, 5.6 ghaghraghat-5.4 Maruteru-6.8,Pantnagar-6.5 Karaikal -6.9,Faizabad-6.6		
				N	P_2O_5	K_2O
Chinsurah	2.4	4.9	51.02	112	28	56
Ghaghraghat	3.44	4.65	26.02	108	27	54
Maruteru	4.6	5.5	16.36	136	34	74.8
Karaikal	3.64	5.1	28.63	138	35	69
Faizabad	4.2	5.21	19.39	132	33	66
Pantnagar	4.5	5.5	18.18	130	32	65

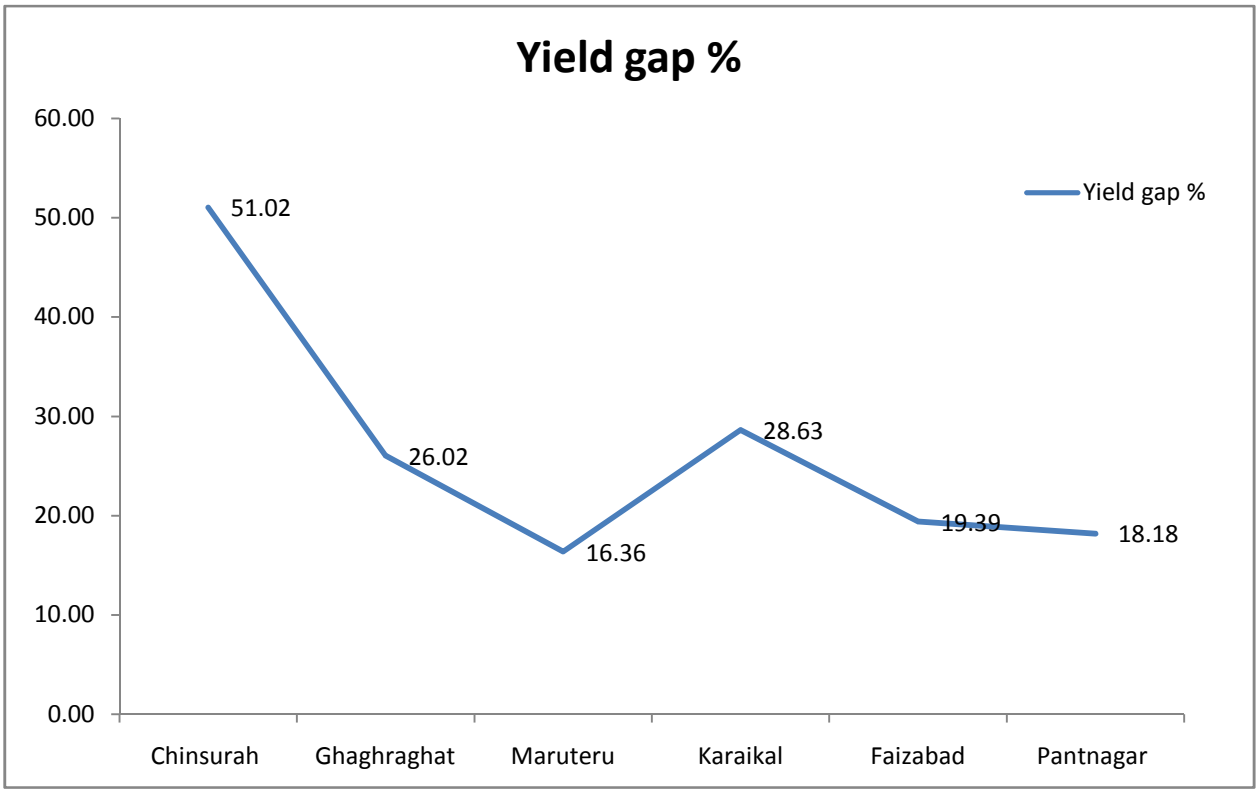


Figure1 : Yield gaps existing between low and yielders at selected farmers sites across different rice ecosystems

5.3 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS

Sodic soils have high soil pH (8.5 - 11.0) and exchangeable sodium percentage (ESP) of greater or equal to 15, low organic matter content and a preponderance of carbonates and bicarbonates of sodium or excess salt content which strongly modify the availability of micronutrients and thereby crop productivity. Such soils can be managed in two ways viz. either by growing a crop variety suitable for a particular soil or by ameliorating the soil through the application of soil amendments. Keeping these points in view, a trial was initiated in *kharif* 2014 to screen germplasm for tolerance to sodicity and higher rice productivity under three levels of ameliorative gypsum application {(0, 50 and 100% gypsum recommendation (GR)] in addition to the recommended dose of NPK. The results of the trial conducted in *rabi* 2017-18 and *kharif* 2018 at Faizabad, Kanpur and Mandya are presented in Tables 5.3.1 to 5.3.14.

Wheat yields (*Rabi* 2017-18)

Gypsum application increased rabi wheat yields at Kanpur (Table 5.3.2). The highest grain and straw yields were observed in 100% GR (4.17 and 4.91 t/ha) followed by 50% GR (3.18 and 3.78 t/ha). The lowest grain and straw yields were observed in the treatment without gypsum (1.58 t/ha and 1.89 t/ha, respectively).

Yield parameters (Kharif 2018)

Significant differences were observed among rice genotypes for all the yield parameters when cultivated under natural sodic conditions at Faizabad (Table 5.3.3). Highest tillers/m^2 (301-297) and panicles /m^2 (293-288) were produced by genotypes IRSSTN 24, NDRK 50054 and NDRK 50063 whereas the lowest number of tillers/m^2 (186) and panicles/m^2 (179) was observed for the genotype IRSSTN 151. The number of filled grains/panicle ranged from a low of 146 (NDRK 50060) to a high of 250 (NDRK 50051). The highest 1000 grain weight was observed in IRSSTN 24 (25.63 g), while the genotype NDRK 50071 produced grains with the lowest 1000 grain weight (19.87 g).

Gypsum application at 50% GR and 100% GR increased the panicles/m^2 and panicle weight of the genotypes evaluated at Kanpur compared to the treatment without gypsum (Table 5.3.4). Gypsum application increased panicle production by 31%-65% and panicle weight by 26% - 42%. The highest number of panicles (554/m^2) was produced CSAR 1604 after application of gypsum at 100 % GR and the genotype DRR Dhan 40 produced panicles with the highest weight (1.90 g)

The yield parameters assessed at Mandya were significantly influenced by both gypsum application and varietal differences, though no interactive effects were observed for tillers/m^2 and panicles/m^2 (Table 5.3.5). Tillers/m^2 and panicles/m^2 increased due to amendments with 50% GR (512 and 429 respectively) and 100% GR application (575 and 492 respectively) in comparison (450 and 364 respectively) to the non amended control treatment without gypsum. Due to the interaction effects between gypsum application and genotypes displayed for the yield parameters viz., filled grains/panicle and thousand grain

weight, the genotypes DRR Dhan 44 and DRR Dhan 46 recorded the highest filled grains/panicle (181) and thousand grain weight (27.77 g) respectively at 100 GR application.

Grain and Straw yields (*Kharif* 2018)

Grain and straw yields of the genotypes were significantly influenced by the sodic conditions at Faizabad (Table 5.3.6). NDRK 500051 recorded the highest grain and straw yields (4.89 t/ha and 6.55 t/ha respectively), followed by IRSSTN 30 (4.30 t/ha and 5.83 t/ha respectively), IRSSTN 110 (4.09 t/ha and 5.68 t/ha respectively), and NDRK 50063(3.74 t/ha and 5.39 t/ha respectively).

Application of gypsum in conjunction with recommended dose of NPK significantly influenced yields of *kharif* rice at Kanpur (Table 5.3.7). Grain and straw yields at 50% GR and 100% GR increased over control (without gypsum amendment) by 65%-127% respectively. The highest grain yields of 4.61 t/ha, 4.58 t/ha, 4.54 t/ha, 4.47 t/ha and 4.46 t/ha was observed with DRR Dhan 46, CSR 23, DRR Dhan 42, DRR Dhan 45, DRR Dhan 43, respectively under recommended NPK + 100% GR fertilization. Straw yield (5.25 -5.44 t/ha) also followed similar trends as grain yields. Significant interaction effects between genotypes and gypsum application was observed as both grain and straw yields of genotypes were highest with recommended dose of NPK with 100% GR application. The genotypes with highest yields in unamended sodic soils of Kanpur are DRR Dhan 46 (2.21 t/ha), CSR 36 (2.19 t/ha), DRR Dhan 42 (2.18 t/ha), DRR Dhan 45 (2.14 t/ha) and DRR Dhan 43 (2.09 t/ha).

Significantly higher grain and straw yield of rice was observed at Mandya due to gypsum application compared to control which did not receive gypsum (Table 5.3.8). Grain yields increased by 7% with 50% GR and by 15% with application of 100% GR. Straw yields at 50% GR and 100% GR increased over control (without gypsum amendment) by 8% and 19%, respectively. Among the ten genotypes evaluated, CSR -23 and IR 30864 recorded comparable highest yields at 0% GR (5.53 and 5.47 t/ha respectively), 50% GR (5.92 and 5.67 t/ha respectively) and 100% GR (6.09 and 5.77 t/ha respectively). The other genotypes that recorded higher yields at 100% GR are DRR Dhan 40 (5.70 t/ha) and DRR Dhan 43 (5.69 t/ha). In the treatment without gypsum amendment, CSR 23 (5.53 t/ha), IR 30864 (5.47 t/ha), DRR Dhan 41 (5.14 t/ha), DRR Dhan 43 (4.93 t/ha) and DRR Dhan 40 (4.67 t/ha), produced the highest yields.

Nutrient uptakes (Kharif 2018)

Nutrient uptake varied significantly between genotypes at Faizabad (Table 5.3.9). The genotypes NDRK 50051, IRSSTN 30 and IRSTN 110 recorded similar, comparable higher N (105.03, 96.14 and 95.41 respectively), P (39.45, 40.07 and 41.17 respectively) and K (80.00, 70.47 and 70.09 respectively) uptake compared to the other genotypes evaluated.

Gypsum application and varietal differences contributed to the differences in nutrient uptake observed at Kanpur (Table 5.3.10). Gypsum applied at 50% GR and 100% GR rates in addition to the recommended doses of NPK increased nitrogen uptake (69.38 and 96.03 kg/ha respectively), phosphorus uptake (16.78 and 23.89 kg/ha respectively) potassium uptake

(69.94and 96.89 kg/ha respectively) and zinc uptake (134.92 and 189.12 g/ha respectively) compared to the control that received only NPK fertilization (N, P, K and Zn uptake of 41.22, 9.38 and 41.48 kg/ha and 80.56 g/ha respectively). The genotype DRR Dhan 46 at 100% GR application, exhibited the highest N, P and K uptake with values of 111.27 kg N/ha, 28.10 kg P/ha, 110.18 kg K/ha and 215.41 g Zn/ha.

At Mandya, significant increment in N, P and K uptake was observed due to application of gypsum at 50% GR (increase of 8.34, 2.88 and 10.23 kg/ha respectively) and 100% GR (increase of 22.18, 5.81 and 24.72 kg/ha respectively) rates compared to application of recommended doses of NPK (Table 5.3.11) without amendment.

Post harvest soil characteristics

No changes in OC%, available N (kg/ha), available P (kg/ha), available K (kg/ha), pH and EC were observed at Faizabad after cultivation of 20 genotypes at Faizabad (Table 5.3.12). Available N, P and K status of the soils at Mandya improved by 9-23%, 6-17% and 5-11% due to the application of gypsum at 50% and 100% GR, compared to the treatment without gypsum application (Table 5.3.13). Soil OC% increased to 0.46% (initial value 0.37%), pH decreased to 8.60 (initial value 9.06) and EC and ESP reduced to 0.38 dS/m and 13.03 % (initial value 0.58 dS/m and 22.58 % respectively) post harvest at Mandya (Table 5.3.14).

To summarize, gypsum application in conjunction with NPK fertilization improved rice yields at Kanpur and Mandya by 65%-127% and 7-15.0% respectively. At Kanpur, the genotypes DRR Dhan 46, CSR 23, DRR Dhan 42, DRR Dhan 45, DRR Dhan 43 produced the highest yields when supplemented with 100% GR (4.46 - 4.61 t/ha). In unamended native sodic soils of Faizabad, the genotypes that produced the highest yields were DRR Dhan 46, CSR 36, DRR Dhan 42, DRR Dhan 45 and DRR Dhan 43 (2.09 t/ha - 2.21 t/ha). Among the 10 genotypes evaluated at Mandya, CSR -23, IR 30864, DRR Dhan 40 and DRR Dhan 43 recorded highest yields with 100% GR application (5.69-6.09 t/ha). CSR 23, IR 30864, DRR Dhan 41, DRR Dhan 43 and DRR Dhan 40 exhibited better tolerance to sodicity at Mandya compared to other genotypes as demonstrated by their significantly higher yields (4.67 t/ha– 5.53 t/ha) in treatment without gypsum amendment. In Faizabad, the genotypes NDRK 500051, IRSSTN 30, IRSSTN 110, and NDRK 50063 recorded highest yields (3.74-4.89 t/ha) without gypsum amendment.

Table 5.3.1 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS
Soil and Crop Characteristics

Parameter	Faizabad	Kanpur	Mandya
Cropping system	**Rice- Wheat**	**Rice - Wheat**	**Rice**
Variety			
Kharif (Rice)	20	24	10
Rabi (Wheat)	-	PBW-343	-
Kharif RFD (Kg NPKZn/ ha)	120:60:60:25	150:60:40:50	125:50:50:40
Gypsum requirement	-	16.0 t ha-1	
% Clay	21	17	46.52
% Silt	55	34	35.24
% Sand	24	49	18.24
Soil Texture	Silty Clay	Clay Loam	Clay
pH (1:1)	9.5	10.0	9.063
Organic carbon (%)	0.39	0.20	0.368
CEC [c mol(p^+)/kg]		12.45	34.7
EC (dS/m)	2.86	0.96	0.583
ESP (%)			22.58
Available N (kg/ha)	215	146.4	156.8
Available P_2O_5 (kg/ha)	23.5	28.9	27.4
Available K_2O (kg/ha)	235.5	244.2	194.6
Bulk density	-	1.45 mg m^{-3}	

Table 5.3.2 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS,
(*Kanpur- *Rabi 2017-18)

Grain and Straw Yield of Rabi Wheat

Gypsum Req.	Grain yield (t/ha)	Straw yield (t/ha)
T1-No amendment	1.58	1.89
T2- 50% GR	3.18	3.78
T3- 100% GR	4.17	4.91

***T1-No amendment;T2- 50% GR; T3- 100% GR**

Table 5.3.3 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Faizabad- *Kharif 2018)*

Yield Parameters

Variety/ Gypsum requirement	Tillers/m²	Panicles/m²	Filled grains/panicle	1000 grain weight(g)
	T1	T1	T1	T1
NDRK 50051	295	286	250	23.40
NDRK 50053	284	276	212	21.07
NDRK 50054	300	293	223	23.07
NDRK 50055	286	277	180	22.77
NDRK 50058	264	254	153	20.43
NDRK 50060	225	216	146	21.20
NDRK 50063	297	287	248	23.43
NDRK 50070	225	219	212	23.47
NDRK 50071	208	202	192	19.87
IRSSTN 151	186	179	155	23.13
IRSSTN 142	204	198	164	23.10
IRSSTN 133	256	247	202	22.53
IRSSTN 15	199	193	210	23.23
IRSSTN 123	246	238	215	23.60
IRSSTN 110	286	280	240	22.23
IRSSTN 18	291	284	241	20.53
IRSSTN 32	290	280	152	21.10
IRSSTN 30	278	270	227	22.90
IRSSTN 36	266	259	226	22.83
IRSSTN 24	301	288	188	25.63
Mean	**259**	**251**	**202**	**22.48**
CD (0.05)	**27.9**	**28.5**	**17.1**	**0.73**
CV %	**6.51**	**6.85**	**5.12**	**1.95**

***T1-No amendment**

Table 5.3.4 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(Kanpur- Kharif 2018)*

Yield Parameters

	Panicles m^2				Panicle wt (g)			
Variety/ Gypsum requirement	**T1***	**T2**	**T3**	**Mean**	**T1***	**T2**	**T3**	**Mean**
DRR Dhan-40	334	436	533	434	1.28	1.62	2.79	1.90
DRR Dhan-41	326	422	529	426	1.28	1.60	1.78	1.55
DRR Dhan-42	353	453	541	449	1.33	1.65	1.82	1.60
DRR Dhan-43	346	440	533	439	1.30	1.64	1.81	1.58
DRR Dhan-44	333	428	528	430	1.29	1.63	1.80	1.58
DRR Dhan-45	351	446	534	444	1.31	1.64	1.81	1.59
DRR Dhan-46	351	450	546	449	1.35	1.66	1.83	1.61
HRI-196	275	387	466	376	1.22	1.54	1.69	1.48
HRI-197	297	390	508	398	1.22	1.57	1.70	1.50
27 P 36	304	392	479	392	1.22	1.57	1.70	1.50
27 P 63	312	406	533	417	1.25	1.59	1.73	1.52
27 P 22	264	416	533	404	1.28	1.60	1.76	1.55
28 P 09	309	398	528	411	1.24	1.58	1.72	1.51
TI-93	292	387	489	389	1.22	1.55	1.70	1.49
BV-243	304	399	528	410	1.23	1.58	1.71	1.51
BV-344	261	360	452	358	1.21	1.53	1.69	1.48
CSR-43	312	413	533	419	1.27	1.60	1.75	1.54
CSR-23	326	420	529	425	1.28	1.60	1.77	1.55
CSR-36	369	449	544	454	1.28	1.65	1.81	1.58
CSAR-17817	343	409	515	422	1.30	1.60	1.80	1.56
CSAR-1604	303	392	554	416	1.22	1.58	1.69	1.50
CSAR-1628	296	391	505	397	1.22	1.56	1.68	1.49
CSAR-17135	299	383	489	390	1.22	1.55	1.68	1.48
CSAR-1611	274	386	465	375	1.22	1.54	1.68	1.48
Mean	313.92	410.53	516.39	413.61	1.26	1.59	1.79	1.55
CD (0.05)								
Main	4.61				0.09			
Sub	6.13				0.19			
Main x Sub	10.62				NS			
Sub x Main	11.31				NS			
CV %								
Main	2.41				13.26			
Sub	1.59				13.19			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.5 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Mandya- *Kharif 2018)*

Yield Parameters

	Tillers/m²				Panicles/m²				Filled grains/panicle				1000 grain weight(g)			
Variety/ Gypsum requirement	**T1***	**T2**	**T3**	**Mean**	**T1***	**T2**	**T3**	**Mean**	**T1***	**T2**	**T3**	**Mean**	**T1***	**T2**	**T3**	**Mean**
DRR-DHAN-40	442	493	554	496	348	415	469	411	131	150	159	147	18.62	19.43	19.90	19.32
DRR-DHAN-41	483	546	611	547	377	436	498	437	101	115	121	112	22.98	24.88	25.20	24.36
DRR-DHAN-42	369	438	498	435	282	356	418	352	118	120	126	121	24.07	24.89	26.22	25.06
DRR-DHAN-43	427	494	555	492	343	411	474	409	103	113	116	111	23.35	24.74	26.08	24.72
DRR-DHAN-44	385	443	501	443	295	359	416	356	151	171	181	168	22.90	24.24	25.71	24.28
DRR-DHAN-45	472	531	603	535	369	444	513	442	114	118	126	119	23.79	24.90	26.63	25.11
DRR-DHAN-46	464	521	578	521	401	466	526	464	133	138	152	141	22.99	25.22	27.77	25.33
CSR-10	508	577	637	574	423	492	552	489	45	51	55	50	20.78	21.64	23.49	21.97
CSR-23	494	552	614	554	413	468	534	472	121	138	149	136	19.54	20.92	22.26	20.90
IR-30864	460	527	595	527	384	446	518	449	119	125	135	126	21.29	22.92	24.87	23.03
Mean	450	512	575	512	364	429	492	428	114	124	132	123	22.03	23.38	24.81	23.41
CD (0.05)																
Main	2.61				1.18				2.35				0.44			
Sub	24.19				22.18				5.06				0.42			
Main x Sub	NS				NS				8.77				0.73			
Sub x Main	NS				NS				8.62				0.81			
CV %																
Main	0.71				0.38				2.66				2.65			
Sub	5.00				5.48				4.35				1.90			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.6 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Faizabad- *Kharif 2018)*

Grain and Straw Yields

Variety/ Gypsum requirement	Grain yield (t/ha)	Straw yield (t/ha)
	T1	**T1**
NDRK 50051	4.89	6.55
NDRK 50053	3.52	4.66
NDRK 50054	3.21	4.56
NDRK 50055	3.28	4.23
NDRK 50058	2.85	4.00
NDRK 50060	2.75	3.74
NDRK 50063	3.74	5.39
NDRK 50070	3.29	4.63
NDRK 50071	3.29	4.55
IRSSTN 151	2.88	4.13
IRSSTN 142	2.99	4.58
IRSSTN 133	3.38	4.79
IRSSTN 15	2.44	3.41
IRSSTN 123	3.13	4.15
IRSSTN 110	4.09	5.68
IRSSTN 18	3.26	4.59
IRSSTN 32	2.78	4.03
IRSSTN 30	4.30	5.83
IRSSTN 36	3.57	4.86
IRSSTN 24	3.33	4.99
Mean	**3.35**	**4.67**
CD (0.05)	**0.49**	**0.77**
CV %	**8.84**	**10.02**

***T1-No amendment**

Table 5.3.7 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(Kanpur- Kharif 2018)*

Grain and Straw Yield

Variety/ Gypsum requirement	Grain yield (t/ha)				Straw Yield (t/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean
DRR Dhan-40	1.98	3.28	4.41	3.22	2.33	3.85	5.21	3.79
DRR Dhan-41	1.94	3.15	4.36	3.15	2.28	3.66	5.14	3.69
DRR Dhan-42	2.18	3.46	4.54	3.40	2.56	4.08	5.36	4.00
DRR Dhan-43	2.09	3.35	4.46	3.30	2.46	3.94	5.25	3.88
DRR Dhan-44	2.00	3.28	4.41	3.23	2.35	3.79	5.20	3.78
DRR Dhan-45	2.14	3.40	4.47	3.34	2.53	4.00	5.28	3.94
DRR Dhan-46	2.21	3.47	4.61	3.43	2.58	4.09	5.44	4.04
HRI-196	1.56	2.79	3.65	2.67	1.84	3.26	4.31	3.14
HRI-197	1.69	2.59	4.00	2.76	1.99	3.34	4.71	3.35
27 P 36	1.72	2.88	3.77	2.79	2.03	3.38	4.47	3.30
27 P 63	1.81	3.01	4.27	3.03	2.13	3.54	5.04	3.57
27 P 22	1.56	3.10	4.35	3.01	1.84	3.64	5.13	3.54
28 P 09	1.78	2.95	4.20	2.97	2.10	3.46	4.94	3.50
TI-93	1.65	2.80	3.86	2.77	1.94	3.29	4.55	3.26
BV-243	1.74	2.95	4.18	2.96	2.05	3.47	4.92	3.48
BV-344	1.48	2.57	4.32	2.53	1.74	3.02	4.18	2.98
CSR-43	1.84	3.07	4.32	3.08	2.17	3.61	5.08	3.62
CSR-23	1.93	3.13	4.58	3.13	2.28	3.68	5.10	3.68
CSR-36	2.19	3.45	4.29	3.41	2.55	4.05	5.38	3.99
CSAR-17817	2.07	3.04	4.15	3.14	2.44	3.58	5.06	3.69
CSAR-1604	1.73	2.89	3.96	2.92	2.04	3.40	4.89	3.44
CSAR-1628	1.68	2.85	3.80	2.83	1.99	3.35	4.67	3.34
CSAR-17135	1.64	2.77	3.64	2.74	1.94	3.26	4.50	3.23
CSAR-1611	1.55	2.78	3.54	2.66	1.83	3.27	4.28	3.13
Mean	1.84	3.04	4.17	3.02	2.17	3.58	4.92	3.56
CD (0.05)								
Main	0.03				0.03			
Sub	0.06				0.04			
Main x Sub	0.10				0.07			
Sub x Main	0.10				0.07			
CV %								
Main	2.15				1.57			
Sub	2.08				1.12			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.8 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Mandya- *Kharif 2018)*

Grain and Straw yields

Variety/ Gypsum requirement	Grain yield (t/ha)				Straw yield (t/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean
DRR-DHAN-40	4.67	5.21	5.70	5.19	5.74	6.22	7.05	6.34
DRR-DHAN-41	5.14	5.43	5.59	5.39	6.08	6.65	6.69	6.47
DRR-DHAN-42	4.35	4.80	5.63	4.93	5.30	5.99	7.16	6.15
DRR-DHAN-43	4.93	5.19	5.69	5.27	5.86	6.27	7.03	6.38
DRR-DHAN-44	4.14	4.33	4.99	4.49	4.83	5.14	5.96	5.31
DRR-DHAN-45	4.81	5.23	5.06	5.04	5.73	6.19	6.03	5.99
DRR-DHAN-46	3.92	4.24	4.82	4.33	4.65	5.01	5.74	5.14
CSR-10	2.68	2.78	3.36	2.94	3.18	3.32	4.09	3.53
CSR-23	5.53	5.92	6.09	5.85	6.57	7.03	7.59	7.06
IR-30864	5.47	5.67	5.77	5.63	6.44	6.82	7.11	6.79
Mean	4.57	4.88	5.27	4.91	5.44	5.86	6.45	5.92
CD (0.05)								
Main	0.09				0.08			
Sub	0.33				0.27			
Main x Sub	NS				0.47			
Sub x Main	NS				0.49			
CV %								
Main	2.62				5.17			
Sub	7.14				4.86			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.9 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Faizabad- *Kharif 2018)*

N, P, K Uptake

Variety/ Gypsum requirement	N uptake (kg/ha)	P uptake (kg/ha	K uptake (kg/ha)
	T1	T1	T1
NDRK 50051	105.03	39.45	80.00
NDRK 50053	73.45	33.45	58.16
NDRK 50054	61.81	25.92	48.19
NDRK 50055	69.11	24.76	46.49
NDRK 50058	54.86	20.95	37.23
NDRK 50060	53.45	20.74	36.80
NDRK 50063	94.44	36.40	56.63
NDRK 50070	68.51	26.28	44.32
NDRK 50071	76.14	30.63	54.32
IRSSTN 151	66.34	22.92	41.87
IRSSTN 142	74.1	26.90	51.96
IRSSTN 133	82.58	32.60	59.44
IRSSTN 15	48.09	19.09	31.69
IRSSTN 123	67.6	27.04	48.74
IRSSTN 110	95.41	41.17	70.09
IRSSTN 18	74.06	26.52	45.58
IRSSTN 32	63.88	23.66	45.20
IRSSTN 30	96.14	40.07	70.47
IRSSTN 36	80.56	29.26	51.99
IRSSTN 24	77.56	30.16	51.69
Mean	**74.16**	**28.90**	**51.54**
CD (0.05)	**16.9**	**8.5**	**11.6**
CV %	**13.77**	**17.71**	**13.69**

***T1-No amendment**

Table 5.3.10 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS – *(Kanpur Kharif 2018)*
N, P, K Uptake

VARIETY/ GR	N uptake (kg/ha)				P uptake (kg/ha)				K uptake (kg/ha)				Zn uptake (g/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
DRR Dhan-40	44.91	75.60	102.91	74.47	12.11	18.49	26.05	18.28	45.13	75.97	103.65	74.91	88.00	148.21	202.33	146.18
DRR Dhan-41	43.76	71.98	101.06	72.27	11.84	17.50	25.27	17.58	43.93	72.17	101.93	72.68	85.65	141.13	199.46	142.08
DRR Dhan-42	50.60	82.04	108.69	80.44	11.76	20.28	27.61	19.88	50.28	81.62	108.20	80.03	97.89	158.84	211.48	156.07
DRR Dhan-43	47.95	78.37	105.24	77.18	11.49	19.29	26.62	18.99	47.94	78.35	105.29	77.19	93.25	152.55	205.88	150.56
DRR Dhan-44	45.54	75.63	103.57	74.91	11.06	18.59	26.14	18.40	45.71	75.45	103.83	75.00	88.77	147.50	203.06	146.44
DRR Dhan-45	49.56	80.01	110.82	80.13	11.00	19.71	26.92	19.37	49.54	79.81	106.20	78.52	96.12	155.34	207.51	152.99
DRR Dhan-46	51.61	82.89	111.27	81.92	10.48	20.36	28.10	20.19	50.94	82.00	110.18	81.04	99.35	159.58	215.41	158.11
HRI-196	34.33	62.16	82.53	59.67	10.30	14.63	20.02	14.07	34.52	62.38	83.03	59.98	66.93	121.42	162.08	116.81
HRI-197	36.95	60.08	89.89	62.31	9.97	14.17	22.09	14.84	37.48	63.00	91.38	63.95	72.80	118.63	178.19	123.2
27 P 36	37.75	64.25	85.29	62.43	9.91	15.32	20.96	14.92	38.43	65.16	86.82	63.47	74.45	126.71	169.13	123.43
27 P 63	40.18	68.16	97.68	68.68	9.33	16.40	24.22	16.56	40.67	68.78	98.82	69.42	79.13	134.17	193.55	135.62
27 P 22	34.77	70.21	99.64	68.21	9.07	17.17	24.56	16.57	35.19	71.43	101.38	69.34	68.94	139.26	198.49	135.57
28 P 09	39.40	66.30	95.47	67.06	8.88	15.96	23.63	16.16	39.95	67.25	96.82	68.01	77.96	130.71	189.20	132.63
TI-93	35.66	61.73	86.04	61.14	8.57	14.81	21.21	14.68	36.26	62.82	87.49	62.19	69.95	121.11	169.73	120.26
BVV-243	38.30	66.20	94.76	66.42	8.48	15.81	23.31	15.90	38.86	67.11	96.06	67.34	75.62	130.52	187.74	131.29
BVV-344	31.98	56.51	78.71	55.73	8.47	13.41	19.26	13.25	32.54	57.44	80.06	56.68	62.60	110.68	159.02	110.77
CSR-43	41.00	69.63	98.97	69.87	8.25	16.83	24.64	16.93	41.55	70.45	100.22	70.74	80.85	137.41	196.30	138.19
CSR-23	43.33	71.39	99.78	71.50	8.15	17.33	24.91	17.38	43.82	72.07	100.74	72.21	85.27	140.53	197.47	141.09
CSR-36	50.40	81.89	109.69	80.66	8.00	20.01	27.56	19.80	49.60	80.93	108.97	79.83	98.02	157.99	212.64	156.22
CSAR-17817	46.71	69.77	99.36	71.95	7.99	17.39	25.47	17.95	47.43	70.80	100.91	73.05	90.75	135.73	194.42	140.3
CSAR-1604	38.72	64.52	88.70	63.98	7.92	15.31	22.86	15.54	38.47	65.49	94.99	66.32	74.56	107.30	185.64	122.5
CSAR-1628	36.53	62.97	88.57	62.69	7.56	15.03	21.73	14.97	37.19	64.22	90.09	63.83	72.16	124.66	175.84	124.22
CSAR-17135	35.42	60.99	84.54	60.31	7.37	14.44	20.68	14.35	36.06	61.90	86.08	61.35	69.22	119.20	166.23	118.22
CSAR-1611	33.92	61.75	81.60	59.09	7.10	14.46	19.62	13.82	34.07	62.07	82.13	59.43	65.26	118.97	158.05	114.09
Mean	41.22	69.38	96.03	68.88	9.38	16.78	23.89	16.68	41.48	69.94	96.89	69.44	80.56	134.92	189.12	134.87
CD (0.05) Main	0.96				0.10				0.41				2.68			
Sub	1.60				0.27				0.73				4.37			
Main x Sub	2.77				0.47				1.27				7.57			
Sub x Main	2.86				0.46				1.30				7.84			
CV % Main	3.01				1.31				1.27				4.29			
Sub	2.49				1.73				1.13				3.48			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.11 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Mandya- *Kharif 2018)*
Nutrient Uptake (kg/ha)

Variety/ Gypsum requirement	Nitrogen uptake				Phosphorus uptake				Potassium uptake			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
DRR-DHAN-40	97.00	108.69	127.02	110.90	16.13	19.77	23.20	19.70	119.05	130.99	150.48	133.51
DRR-DHAN-41	105.81	114.71	122.13	114.21	17.58	21.04	22.36	20.32	126.21	139.39	142.44	136.01
DRR-DHAN-42	89.90	102.48	126.11	106.16	14.86	18.24	23.64	18.91	109.39	125.36	151.69	128.81
DRR-DHAN-43	100.97	108.48	125.53	111.66	16.19	18.67	22.48	19.11	121.69	132.61	149.73	134.68
DRR-DHAN-44	84.16	90.03	109.16	94.45	13.95	16.59	20.78	17.11	100.09	108.24	126.98	111.77
DRR-DHAN-45	100.35	109.03	110.01	106.46	16.06	19.32	19.95	18.44	118.64	131.15	129.69	126.49
DRR-DHAN-46	80.20	89.03	105.43	91.56	13.83	15.83	19.13	16.26	96.61	104.8	122.49	107.97
CSR-10	54.81	58.14	73.72	62.23	9.05	10.43	13.61	11.03	66.12	70.14	87.93	74.73
CSR-23	112.92	122.87	134.7	123.49	19.12	22.76	25.11	22.33	136.76	148.83	161.98	149.19
IR-30864	112.06	118.17	127.13	119.12	18.03	21.00	22.58	20.54	133.12	143.81	151.48	142.80
Mean	93.82	102.16	116.09	104.02	15.48	18.36	21.29	18.38	112.77	123.53	137.49	124.60
CD (0.05)												
Main	2.36				0.84				3.48			
Sub	4.99				1.14				5.54			
Main x Sub	8.65				NS				9.60			
Sub x Main	8.52				NS				9.71			
CV %												
Main	3.17				6.39				3.90			
Sub	5.08				6.55				4.71			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.12 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Faizabad- *Kharif 2018)*

Post harvest soil characteristics

Variety/ Gypsum requirement	OC (%)	Avail. N (kg/ha)	Avail P (kg/ha)	Avail K (kg/ha)	pH	EC (dS/m)
	T1	T1	T1	T1	T1	T1
NDRK 50051	0.39	215	23.5	235.5	9.5	2.86
NDRK 50053	0.39	215	23.5	235.5	9.5	2.86
NDRK 50054	0.39	215	23.5	235.5	9.5	2.86
NDRK 50055	0.39	215	23.5	235.5	9.5	2.86
NDRK 50058	0.39	215	23.5	235.5	9.5	2.86
NDRK 50060	0.39	215	23.5	235.5	9.5	2.86
NDRK 50063	0.39	215	23.5	235.5	9.5	2.86
NDRK 50070	0.39	215	23.5	235.5	9.5	2.86
NDRK 50071	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 151	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 142	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 133	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 15	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 123	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 110	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 18	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 32	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 30	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 36	0.39	215	23.5	235.5	9.5	2.86
IRSSTN 24	0.39	215	23.5	235.5	9.5	2.86
Mean	0.39	215	23.5	235.5	9.5	2.86

***T1-No amendment**

Table 5.3.13 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Mandya- *Kharif 2018)*

Post Harvest Nutrient Availability (kg/ha)

Variety/ Gypsum requirement	Available Nitrogen				Available Phosphorus				Available Potassium			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
DRR-DHAN-40	180.30	195.03	220.23	198.52	35.20	37.77	39.90	37.62	223.67	235.93	247.93	235.84
DRR-DHAN-41	182.40	190.23	224.07	198.90	35.97	37.77	41.47	38.40	226.90	239.53	252.47	239.63
DRR-DHAN-42	190.93	213.83	234.57	213.11	38.50	39.53	43.80	40.61	226.93	241.60	251.73	240.09
DRR-DHAN-43	186.30	200.73	234.37	207.13	36.37	39.53	43.03	39.64	226.83	233.70	250.17	236.9
DRR-DHAN-44	176.20	192.20	225.97	198.12	36.37	38.97	43.07	39.47	226.30	238.00	253.17	239.16
DRR-DHAN-45	182.60	201.23	224.30	202.71	36.63	39.90	43.87	40.13	225.50	239.67	252.43	239.2
DRR-DHAN-46	192.73	219.40	235.30	215.81	35.33	37.30	41.80	38.14	225.63	241.53	251.87	239.68
CSR-10	180.00	189.73	213.33	194.36	37.43	39.57	44.20	40.40	224.80	238.20	252.13	238.38
CSR-23	192.57	212.47	234.00	213.01	36.30	37.77	42.43	38.83	226.93	233.93	250.40	237.09
IR-30864	188.97	201.60	233.13	207.90	38.43	40.03	44.13	40.87	225.53	240.10	252.73	239.46
Mean	185.30	201.65	227.93	204.96	36.65	38.81	42.77	39.41	225.90	238.22	251.50	238.54
CD (0.05)												
Main	6.71				1.05				4.24			
Sub	7.42				1.31				NS			
Main x Sub	NS				NS				NS			
Sub x Main	NS				NS				NS			
CV %												
Main	4.57				3.71				2.48			
Sub	3.83				3.52				2.48			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

Table 5.3.14 Screening of Germplasm for Sodicity and Management of Sodic Soils in RBCS - *(*Mandya- *Kharif 2018)*

Post Harvest Soil Characteristics

Variety/ Gypsum requirement	OC(%)				pH				EC(dS/m)				ESP (%)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
DRR-DHAN-40	0.41	0.45	0.52	0.46	8.61	8.49	8.33	8.47	0.45	0.44	0.25	0.38	17.25	15.64	9.18	14.02
DRR-DHAN-41	0.41	0.49	0.52	0.47	8.71	8.63	8.44	8.59	0.50	0.44	0.27	0.41	18.63	16.37	8.12	14.37
DRR-DHAN-42	0.41	0.45	0.55	0.47	8.84	8.76	8.52	8.71	0.44	0.37	0.24	0.35	18.75	17.98	10.75	15.83
DRR-DHAN-43	0.41	0.49	0.53	0.48	8.74	8.52	8.47	8.58	0.52	0.44	0.28	0.41	16.25	9.65	7.29	11.06
DRR-DHAN-44	0.41	0.43	0.51	0.45	8.91	8.71	8.50	8.71	0.46	0.42	0.27	0.38	18.2	14.07	9.13	13.80
DRR-DHAN-45	0.43	0.49	0.54	0.48	8.80	8.51	8.41	8.57	0.48	0.40	0.23	0.37	16.54	9.24	7.42	11.07
DRR-DHAN-46	0.41	0.45	0.53	0.46	8.90	8.81	8.49	8.74	0.39	0.33	0.22	0.31	18.94	16.84	8.31	14.70
CSR-10	0.40	0.42	0.47	0.43	8.84	8.57	8.40	8.60	0.52	0.44	0.27	0.41	17.34	10.06	7.12	11.51
CSR-23	0.41	0.48	0.53	0.47	8.60	8.49	8.31	8.47	0.46	0.42	0.26	0.38	16.18	8.47	7.38	10.68
IR-30864	0.41	0.44	0.52	0.45	8.77	8.52	8.48	8.59	0.49	0.38	0.24	0.37	16.97	15.18	7.58	13.24
Mean	0.41	0.46	0.52	0.46	8.77	8.60	8.43	8.60	0.47	0.41	0.25	0.38	17.51	13.35	8.23	13.03
CD (0.05)																
Main	0.02				0.07				0.04				0.92			
Sub	0.01				0.09				0.03				0.47			
Main x Sub	0.02				NS				NS				0.82			
Sub x Main	0.03				NS				NS				1.19			
CV %																
Main	4.96				1.09				15.38				9.81			
Sub	2.70				1.07				8.13				3.85			

***T1-No amendment, T2- 50% GR , T3- 100% GR**

5.4 Screening of rice genotypes for acid soils and related nutritional constraints

Acid soils are wide spread in Eastern, North Eastern and coastal regions of the Indian Peninsula. These soils are poor in soil fertility and are associated with toxicity of iron in lowlands, aluminum in the uplands, with depletion of Ca, Mg and K, deficiency of B, Mo and Si. The soils also fix large quantities of soluble P which lead to sub optimal productivity of crops. Management options include using amendments such as lime or other basic materials to correct soil acidity, balanced application of P, K, silicates and organic manuring. In addition, growing tolerant cultures helps stabilize rice productivity for which identification of suitable genotypes with high yield potential is required. The trial was, therefore, conducted at five centres *viz.,* Moncompu (Kuttanad, Kerala, soil pH 5.3), Ranchi (Dumka, Jharkhand, soil pH 5.2), Raipur (Jagdalpur, Chhattisgarh, Soil pH 5.5), and Titabar (Assam, soil pH 5.2) under low land conditions and at Hazaribagh (Jharkhand, soil pH 5.5), under upland conditions during *kharif* 2018, screening between 14-24 genotypes at different centers. The genotypes were evaluated at 2 or 3 set of nutrient management treatments viz., NPK(RD) and NPK (RD)+Lime at Ranchi; and NPK(RD), NPK (RD)+Lime and N (RD)+double PK at Hazaribagh and Moncompu, NPK(RD), NPK (RD)+Lime and N (RD)+double PK + slag at Titabar, and NPK(RD), NPK (RD) + Lime (2 different doses) and N at Raipur. Lime was applied as per the location specific estimates of lime requirement. The NPK doses applied were: 90-45-45 at Moncompu, 100-50-25 at Ranchi 100-60-40 at Raipur, and 40-20-20 at Titabar.The experiment at Moncompu was affected by floods and hence the results are not presented. The results are presented in Tables 5.4.1 – 5.4.11. The results of Hazaribagh are not discussed as the crop at this centre was severely affected by low rainfall.

Yield Parameters

Liming significantly influenced filled grains/panicle and 1000 grain weight at Raipur but not tillers/m^2 and panicles/m^2 (Table 5.4.3). The genotype CSR 43 produced the highest number of tillers/m^2(330) and panicles/m^2(300). JKRH 3333 produced the highest number of filled grains/panicle (176) whilst Mahamaya recorded the highest 1000 grain weight (30.24 g).

Grain and straw yields

Grain yields at all the locations were influenced by genotype and liming (Table 5.4.5-5.4.7). Supplementation of recommended NPK with lime at 2.5 t/ha and 5t/ha increased grain yields by 9% and 19% respectively and straw yields by 7% and 13% respectively at Raipur (Table 5.4.5). The highest grain yields (7.28-6.78 t/ha) were recorded with genotypes MS-49, Maheswari, CNN 1707, PA6444 and TI 93 at recommended NPK+ 5 t/ha liming. The genotypes tolerant to acidity at Raipur were Maheswari (6.66 t/ha), Binadhan 8 (6.55 t/ha) PA 6444 (6.43 t/ha) and Mahamaya (6.2 t/ha). At Ranchi, significant increases in grain and straw yields (15% and 16% respectively) were recorded due to the application recommended NPK + lime when compared to unlimed control (Table 5.4.6). Among the 14 genotypes evaluated, US 312 (7.19 t/ha), Bina Dhan 75 (7.11 t/ha), KRH4 (6.39 t/ha), Bina

Dhan 17 (6.13 t/ha) and PUP 221 (6.11 t/ha) produced highest yields both with recommended NPK + Lime application and with non limed treatment (6.28 t/ha-5.43 t/ha) at Ranchi. Recommended NPK + lime treatment at Titabar resulted in highest yields (3.65 t/ha), followed by recommended NPK alone (3.12 t/ha), compared to recommended N+double PK+ slag which produced a lower yield of 3.07 t/ha (Table 5.4.7). Straw yields followed the same trends as grain yields at Titabar. Binadhan 8 (5.08 t/ha), HRI 174 (4.62 t/ha), KRH 4 (4.40 t/ha) and MTP 7 (4.52 t/ha) were the highest yielding genotypes under recommended NPK + liming treatment while the acid tolerant genotypes at Titabar were MTP 7 (4.46 t/ha), 3447 (4.09 t/ha), MSM (3.55 t/ha)US 312 and PUP -1 (3.47 t/ha).

Nutrient uptakes

A 13% increase in P uptake was observed at Ranchi (Table 5.4.8) due to supplementation of lime along with recommended NPK. Among the genotypes, US 312 had the highest P uptake of 20.73 kg/ha for the recommended NPK treatment and 24.47 kg/ha when recommended NPK was supplemented with lime. At Raipur, liming significantly influenced the uptake (Table 5.4.9) of macronutirents viz., N (9-15%), P (16-21%) K (8-14%) and S (5-14%) and also of micronutrients (Table 5.4.10) such as Zn (3-10%), Mn (7-13%), Fe (7-14%) and Cu (7-14%). Recommended NPK supplemented with liming increased N, P, K and Fe uptake by 25%, 36%, 24% and 6% respectively at Titabar (Table 5.4.11). Application of recommended N + double PK + lime was observed to reduce the uptake of K and Fe (in grain).

Post harvest soil characteristics

Soil availability of NPK and S were significantly influenced by liming and genotypes at Raipur (Table 5.4.12). Application of lime at 2.5 t/ha and 5 t/ha along with RDF increased soil available N, P K and S by 5, 11, 5, 14% and 8, 22, 8 and 23% respectively at Raipur. Soil availability of micronutrients Zn and Fe were not influenced by liming (Table 5.4.13) though genotypic differenes were observed. No influence of the treatments were observed for post harvest soil EC, whereas pH (increase in pH by 4-9%) and OC (decrease by 5-19%) were affected by both liming and genotypes at Raipur (5.4.14).

Summary

Liming increased grain yields by 9-19%, 15%, and 17% at Raipur, Ranchi and Titabar respectively. The genotypes responsive to liming were MS-49, Maheswari, CNN 1707, PA6444, TI 93 at Raipur, TI-93, HRI 174, KRH 4,MTP 7 at Titabar. Genotypes tolerant to native soil acidity were Maheswari, Binadhan, PA 6444, Mahamaya at Raipur and MTP 7, 3447, MSM, TI-93,US 312 and PUP -1 at Titabar. Genotypes Bina Dhan 75, KRH4, Bina Dhan 17, US 312, while exhibiting highest reponse to liming, were also observed to be tolerant to acidity at Ranchi.

Table 5.4.1 Screening of rice genotypes for soil acidity and related nutritional constraints (*kharif* 2018)

Soil and Crop data

Parameters	**Hazaribagh**	**Raipur (Jagadalpur)**	**Ranchi (Dumka)**	**Titabar**
Number of varieties evaluated	19	24	14	20
Treatments followed	• NPK (RD) • NPK (RD) + LIME@---- kg/ha N (RD) + double PK	• NPK (RD) • NPK (RD) + LIME@ 2.5t /ha • NPK (RD) + LIME@ 5t /ha	• NPK (RD) • NPK (RD) + LIME @ 4 Q/ha	• NPK (RD) • NPK (RD) + Lime @ 1t/ha • N (RD) + double PK+slag
Rec. fert. Dose (kg N,P_2O_5 and K_2O/ha)	60-30-30	100-60-40	100-50-25	40-20-40
Soil				
% Clay		27	23	42
% Silt		21	34	28.5
% Sand		52	43	29.5
Soil texture		Sandy Clay Loam	-	Silty clay
pH	5.5	5.5	5.2	5.2
Org.carbon (%)	0.4	0.52	0.65	1.1
CEC (me/100g)		15.3	16	12.8
EC ds/m		0.18	-	-
Avail.N (kg/ha)		224	320	485
Avail. P_2O_5 (kg/ha)		12.4	28.4	22.30
Avail. K_2O (kg/ha)		187	185	142
Avail.S (mg/kg)		18.2		
DTPA –Zn (mg/kg)		0.89		
DTPA –Fe (mg/kg)		42.3		
DTPA –Mn (mg/kg)		32.4		
DTPA –Cu (mg/kg)		1.24		

Table 5.4.2. Screening of rice genotypes for soil acidity and related nutritional constraints (Hazaribagh- *kharif* 2018)

Yield Parameters

Variety	Tillers/m²				Panicles/m²				Filled grains/panicle			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS 49	183	193	198	191	0	1	1	74	0	2	5	3
MSM	123	147	137	136	7	0	1	54	4	0	4	3
MTP 3	171	157	153	160	27	4	17	49	29	6	8	14
MTP 5	201	200	195	199	8	38	53	45	35	7	17	20
MTP 7	150	141	220	170	66	13	57	33	3	16	22	14
3447	206	140	147	164	63	61	39	23	38	14	9	21
TI 93	235	166	163	188	4	13	3	16	10	12	0	8
Binadhan 8	185	159	183	176	3	17	20	14	17	8	11	12
Binadhan 17	203	157	189	183	71	3	73	12	16	1	47	21
BRRI-Dhan 75	213	199	198	203	83	51	87	9	4	4	12	7
CSR 43	233	203	240	226	2	3	0	8	1	1	0	1
PA 6444	211	198	155	188	3	1	3	7	2	1	1	2
US 312	140	232	118	163	16	45	7	6	10	6	7	8
KRH 4	190	217	201	203	23	7	4	4	1	13	1	5
HRI 174	200	217	207	208	11	4	9	3	4	8	13	9
JKRH 3333	221	215	197	211	4	5	3	2	1	6	1	3
PUP 1	267	182	177	208	6	5	5	2	8	12	16	12
CNN1707	257	193	152	201	1	13	14	1	6	19	8	11
BPTCTM 1	267	212	205	228	0	0	0	0	0	0	0	0
Mean	203	186	181	190	21	15	21	19	10	7	10	9
CD (0.05)												
Main	NS				4.48				NS			
Sub	42.39				9.53				9.33			
Main x Sub	NS				16.5				16.15			
Sub x Main	NS				16.63				15.99			
CV%												
Main	54.64				45.50				64.25			
Sub	23.90				53.74				110.91			

T1=Recommended NPK, T2= Recommended NPK + Lime, T3= Recommended N + double PK

Table 5.4.3. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur - *kharif* 2018) Yield Parameters

Variety	Tillers/m²				Panicles/m²				Filled grains/panicle				1000 grain wt (g)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	260	237	225	240	253	232	216	234	138	174	168	160	15.97	16.73	24.57	19.09
MSM	261	247	263	257	251	241	257	250	110	104	129	114	19.60	27.80	22.23	23.21
MTP-3	214	269	247	243	206	256	248	237	124	113	128	122	21.37	24.53	23.50	23.13
MTP-5	247	273	248	256	239	268	243	250	120	131	137	129	18.73	20.73	23.27	20.91
MTP-7	241	207	263	237	235	200	256	230	119	133	106	119	20.60	22.53	22.27	21.80
3447	234	255	210	233	226	249	203	226	119	113	142	125	25.37	25.43	25.47	25.42
TI-93	281	259	256	265	276	253	242	257	130	178	154	154	16.63	13.43	21.43	17.17
Binadhan-8	245	232	217	231	227	223	212	221	122	131	124	126	27.83	26.67	30.43	28.31
Binadhan-17	247	232	258	246	237	227	250	238	113	138	137	129	24.70	22.43	20.77	22.63
BRRI-Dhan-75	259	251	294	268	247	245	280	257	108	109	107	108	22.53	23.50	23.77	23.27
CSR-43	284	307	330	307	278	299	324	300	81	78	79	79	27.13	26.73	24.87	26.24
PA 6444	259	243	235	246	253	237	232	241	108	112	114	111	22.07	23.23	23.73	23.01
US-312	242	232	247	240	231	220	243	231	131	140	125	132	20.47	20.37	21.30	20.71
KRH-4	237	247	248	244	232	237	242	237	114	142	150	135	19.53	20.20	20.83	20.19
HRI-174	233	262	246	247	224	254	238	239	118	119	129	122	24.63	22.57	23.33	23.51
JKRH-3333	218	242	240	233	212	236	228	225	166	175	186	176	16.63	17.40	20.70	18.24
PUP-1	228	216	265	236	222	211	256	230	107	116	115	112	28.20	28.10	26.27	27.52
CNN-1707	280	232	232	248	270	228	227	242	109	123	152	128	23.20	24.80	24.63	24.21
BPTCTM-1	261	273	331	288	255	268	324	282	110	107	113	110	14.53	15.57	15.83	15.31
HTM-18-1	248	282	291	274	243	270	286	266	122	128	130	127	14.23	14.60	13.83	14.22
Maheshwari	255	248	245	249	249	242	238	243	104	107	115	109	31.30	31.07	30.50	30.96
Bamleshwari	197	236	222	218	193	228	217	213	137	121	131	130	25.53	25.50	25.20	25.41
Mahamaya	215	226	255	232	209	222	249	226	112	108	104	108	29.40	30.80	30.53	30.24
Swarna	256	270	300	275	251	267	295	271	114	134	121	123	19.67	20.40	21.40	20.49
Mean	246	249	257	251	238	242	250	244	118	126	129	124	22.08	22.71	23.36	22.72
CD (0.05)																
Main	NS				NS				6.77				0.41			
Sub	11.35				10.97				6.63				0.60			
Main x Sub	19.65				19.00				11.48				1.04			
Sub x Main	25.06				25.34				13.00				1.09			
CV%																
Main	14.28				15.72				11.76				3.91			
Sub	4.86				4.83				5.71				2.83			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5t/ha, T3= Recommended NPK + Lime 5t/ha

Table 5.4.4. Screening of rice genotypes for soil acidity and related nutritional constraints (Hazaribagh- *kharif* 2018)

Grain and straw yields

Variety	Grain yield (t/ha)				Straw yield (t/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS 49	0.000	0.001	0.004	0.002	1.33	1.67	2.00	1.67
MSM	0.009	0.000	0.003	0.004	1.00	1.33	1.00	1.11
MTP 3	0.150	0.008	0.050	0.069	3.67	2.00	3.67	3.11
MTP 5	0.073	0.066	0.169	0.103	4.00	3.33	2.33	3.22
MTP 7	0.036	0.035	0.267	0.112	3.33	1.67	2.33	2.44
3447	0.400	0.160	0.067	0.209	3.00	3.00	4.67	3.56
TI 93	0.015	0.046	0.001	0.020	3.67	2.00	2.67	2.78
Binadhan 8	0.030	0.034	0.058	0.041	2.67	3.33	2.00	2.67
Binadhan 17	0.219	0.001	0.527	0.249	4.00	2.00	3.67	3.22
BRRI-Dhan 75	0.067	0.045	0.213	0.108	2.00	2.67	4.00	2.89
CSR 43	0.001	0.001	0.000	0.001	1.00	1.33	1.00	1.11
PA 6444	0.003	0.001	0.003	0.002	3.67	3.00	2.33	3.00
US 312	0.021	0.075	0.022	0.039	5.00	2.67	4.00	3.89
KRH 4	0.006	0.022	0.001	0.010	2.67	3.33	4.33	3.44
HRI 174	0.008	0.014	0.040	0.021	3.33	2.00	3.67	3.00
JKRH 3333	0.001	0.009	0.001	0.004	3.67	4.00	4.00	3.89
PUP 1	0.023	0.017	0.029	0.023	6.33	0.67	1.67	2.89
CNN1707	0.003	0.056	0.013	0.024	2.00	3.00	2.67	2.56
BPTCTM 1	0.000	0.000	0.000	0.000	1.67	1.33	1.33	1.44
Mean	0.06	0.03	0.08	0.05	3.05	2.33	2.81	2.73
CD (0.05)								
Main	0.02				NS			
Sub	0.071				0.68			
Main x Sub	0.123				1.18			
Sub x Main	0.122				1.37			
CV%								
Main	82.23				55.26			
Sub	138.47				26.63			

T1=Recommended NPK, T2= Recommended NPK + Lime, T3= Recommended N + double PK

Table 5.4.5. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur- *kharif* 2018)

Grain and straw yields

Variety	Grain yield (t/ha)				Straw yield (t/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	4.33	5.46	7.28	5.69	4.45	5.65	7.51	5.87
MSM	4.30	5.73	6.17	5.40	5.58	5.89	6.32	5.93
MTP-3	4.32	5.88	6.11	5.43	4.53	6.08	6.21	5.61
MTP-5	4.27	5.95	6.19	5.47	6.12	6.30	6.31	6.24
MTP-7	4.53	4.77	4.80	4.70	4.62	4.93	5.12	4.89
3447	5.56	5.81	5.91	5.76	5.58	5.95	5.98	5.84
TI-93	4.78	5.03	6.78	5.53	4.81	5.52	6.86	5.73
Binadhan-8	6.55	6.60	6.63	6.59	6.61	6.68	6.79	6.70
Binadhan-17	5.50	5.63	5.76	5.63	5.83	5.93	5.93	5.90
BRRI-Dhan-75	4.85	5.08	5.69	5.21	4.90	5.19	5.80	5.30
CSR-43	4.97	5.18	5.27	5.14	6.17	6.34	5.55	6.02
PA 6444	6.43	6.52	6.62	6.52	6.73	6.68	6.80	6.74
US-312	5.06	5.13	5.24	5.14	5.55	5.60	5.43	5.53
KRH-4	4.12	5.63	5.92	5.23	4.40	5.87	6.06	5.44
HRI-174	5.30	5.67	5.89	5.62	5.43	5.95	6.02	5.80
JKRH-3333	4.63	5.97	6.53	5.71	5.22	6.23	6.62	6.02
PUP-1	5.51	5.68	6.30	5.83	5.69	5.85	6.63	6.06
CNN-1707	5.23	5.70	6.83	5.92	5.26	5.84	6.90	6.00
BPTCTM-1	4.11	3.32	4.33	3.92	4.37	4.61	4.59	4.45
HTM-18-1	4.26	3.87	3.98	4.04	4.50	6.93	4.17	4.43
Maheshwari	6.66	6.83	7.02	6.84	6.72	5.92	7.18	6.94
Bamleshwari	5.59	5.82	5.97	5.79	5.82	6.81	6.13	5.96
Mahamaya	6.29	6.38	6.56	6.41	6.83	5.09	6.60	6.75
Swarna	4.07	4.43	6.55	5.02	5.34	4.39	6.73	5.72
Mean	5.05	5.50	6.01	5.52	5.46	5.84	6.18	5.83
CD (0.05)								
Main	0.26				0.13			
Sub	0.32				0.31			
Main x Sub	0.55				0.55			
Sub x Main	0.59				0.55			
CV%								
Main	10.13				4.80			
Sub	6.14				5.80			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5t/ha, T3= Recommended NPK + Lime 5t/ha

Table 5.4.6. Screening of rice genotypes for soil acidity and related nutritional constraints
(Ranchi -*kharif* 2018)

Grain and Straw Yield

Variety	Grain yield (t/ha)			Straw yield (t/ha)		
	T1*	T2	Mean	T1*	T2	Mean
MTP-3	4.07	4.57	4.32	4.67	5.19	4.93
MTP-7	4.34	5.26	4.80	4.44	5.49	4.96
HRI -174	4.50	4.71	4.61	4.75	4.87	4.81
JKRH-3333	4.62	5.85	5.24	4.78	6.04	5.41
KRH-4	5.43	6.39	5.91	5.84	6.70	6.27
BINADHAN-8	4.12	4.72	4.42	4.40	5.20	4.80
BINADHAN-17	5.67	6.13	5.90	8.64	9.73	9.19
BINADHAN-75	5.70	7.11	6.41	10.61	12.39	11.50
TI-93	3.41	3.79	3.60	4.90	6.09	5.50
US-312	6.28	7.19	6.74	7.10	8.08	7.59
PUP-217	3.51	4.07	3.79	3.76	4.35	4.05
PUP-221	5.55	6.11	5.83	5.82	6.42	6.12
PUP-223	5.16	6.05	5.60	5.42	6.47	5.95
MTU 7029	4.46	4.94	4.70	4.59	5.19	4.89
Mean	4.77	5.49	5.13	5.69	6.59	6.14
CD (0.05) Main	0.46			0.45		
Sub	0.61			0.72		
Main x Sub	NS			NS		
Sub x Main	NS			NS		
CV% Main	9.51			7.87		
Sub	10.29			10.14		

T1=Recommended NPK, T2= Recommended NPK + Lime

Table 5.4.7. Screening of rice genotypes for soil acidity and related nutritional constraints (Titabar- *kharif* 2018)

Grain and straw yields

Variety	Grain yield (t/ha)				Straw yield (t/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS 47	3.05	3.43	2.68	3.06	4.54	5.03	3.91	4.49
MSM	3.55	4.05	2.83	3.48	5.19	5.94	3.77	4.97
MTP 3	2.57	3.22	2.86	2.88	3.81	4.64	4.04	4.16
MTP 5	2.98	4.03	3.10	3.37	4.41	5.84	4.24	4.83
MTP 7	4.46	4.52	3.13	4.04	6.43	6.45	4.28	5.72
3447	4.09	3.95	2.94	3.66	5.92	5.65	3.87	5.15
TI 93	3.47	5.08	3.13	3.89	5.07	7.36	4.05	5.49
Bina Dhan 8	2.54	2.98	3.02	2.84	3.76	4.31	3.90	3.99
Bina Dhan 17	3.02	3.68	3.27	3.32	4.70	5.33	4.12	4.72
BRRI Dhan 75	1.69	3.02	3.10	2.60	2.45	4.37	3.87	3.56
CSR 43	3.12	3.60	3.03	3.25	4.52	5.21	3.76	4.50
PA6444	2.63	3.12	3.20	2.99	3.85	4.54	3.91	4.10
US 312	3.47	4.04	3.18	3.56	5.03	5.81	3.90	4.91
KRH 4	3.11	4.40	3.05	3.52	4.49	6.28	3.68	4.82
HRI174	3.16	4.62	3.51	3.76	4.60	6.64	4.26	5.16
JKRH 3333	3.02	3.80	3.33	3.38	4.37	5.30	4.05	4.58
PUP-1	3.47	3.56	3.42	3.48	5.03	5.13	4.14	4.77
CNN-1707	3.13	2.91	2.65	2.90	4.53	4.15	4.04	4.24
BPTCTM-1	3.23	2.58	3.27	3.03	4.66	3.70	5.18	4.51
M. Sali	2.55	2.45	2.66	2.55	3.78	3.49	4.18	3.82
Mean	3.12	3.65	3.07	3.28	4.56	5.26	4.06	4.62
CD (0.05)								
Main	0.33				0.47			
Sub	0.28				0.42			
Main x Sub	0.48				0.73			
Sub x Main	0.57				0.84			
CV%								
Main	19.96				19.94			
Sub	9.12				9.71			

T1=Recommended NPK, T2= Recommended NPK + Lime, T3= Recommended N + double PK+ slag

Table 5.4.8. Screening of rice genotypes for soil acidity and related nutritional constraints (Ranchi -*kharif* 2018)

P uptake

Variety	P uptake (kg/ha)		
	T1*	T2	Mean
MTP-3	11.53	12.80	12.17
MTP-7	12.30	14.13	13.22
HRI -174	12.23	12.80	12.52
JKRH-3333	14.43	16.30	15.37
KRH-4	18.47	20.57	19.52
BINADHAN-8	12.97	15.43	14.20
BINADHAN-17	19.30	20.33	19.82
BINADHAN-75	19.63	22.10	20.87
TI-93	11.40	12.37	11.88
US-312	20.73	24.47	22.60
PUP-217	12.10	14.27	13.18
PUP-221	17.70	20.27	18.98
PUP-223	17.50	19.90	18.70
MTU 7029	12.97	15.20	14.08
Mean	15.23	17.21	16.22
CD (0.05)			
Main	1.27		
Sub	1.93		
Main x Sub	NS		
Sub x Main	NS		
CV%			
Main	8.34		
Sub	10.26		

T1=Recommended NPK, T2= Recommended NPK + Lime

Table 5.4.9. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur- *kharif* 2018)
Uptake of N, P K and S (kg/ha)

Variety	N				P				K				S			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	67.81	82.70	105.80	85.44	10.92	12.25	15.72	12.96	120	158	204	161	10.78	12.54	17.18	13.50
MSM	70.22	84.93	90.72	81.96	12.27	11.14	14.66	12.69	150	163	171	161	10.70	14.66	13.16	12.84
MTP-3	67.54	87.67	88.95	81.39	11.66	13.02	11.82	12.17	124	167	170	153	10.81	13.49	14.39	12.90
MTP-5	72.97	88.15	90.11	83.75	12.21	13.62	13.25	13.03	165	173	174	171	11.72	14.96	13.80	13.49
MTP-7	69.10	69.43	71.42	69.98	11.53	9.75	10.23	10.50	127	134	138	133	10.80	11.58	10.95	11.11
3447	84.97	86.83	85.72	85.84	15.20	13.22	13.45	13.96	153	166	166	162	13.15	13.25	12.99	13.13
TI-93	72.65	77.48	97.79	82.64	13.08	11.62	14.94	13.21	131	152	189	157	12.30	12.81	16.21	13.77
Binadhan-8	101.10	97.54	97.49	98.71	17.72	15.22	15.33	16.09	181	185	188	185	15.99	16.11	16.03	16.04
Binadhan-17	86.33	83.81	84.88	85.01	14.30	12.28	12.32	12.96	159	162	161	161	13.44	13.04	13.27	13.25
BRRI-Dhan-75	74.37	75.47	83.79	77.88	12.64	11.42	12.05	12.04	133	143	161	146	11.68	12.29	13.12	12.36
CSR-43	81.16	81.38	77.20	79.91	14.65	13.43	11.79	13.29	165	172	153	163	12.69	13.58	13.27	13.18
PA 6444	100.00	105.71	102.5	102.7	9.28	14.84	12.66	12.26	190	192	194	192	17.42	15.35	19.11	17.29
US-312	79.41	82.89	79.33	80.55	7.72	12.89	10.55	10.39	155	159	152	155	13.94	13.07	13.37	13.46
KRH-4	62.70	89.08	92.85	81.54	6.62	12.88	9.41	9.64	124	168	173	155	10.78	14.10	15.73	13.54
HRI-174	81.17	92.15	93.83	89.05	8.86	10.72	11.06	10.21	153	170	170	164	13.01	13.44	14.90	13.78
JKRH-3333	71.96	93.23	101.9	89.05	6.42	12.21	13.74	10.79	145	176	185	169	11.96	13.97	15.40	13.78
PUP-1	85.64	93.21	99.72	92.86	9.23	12.57	11.29	11.03	161	168	185	171	13.93	13.41	16.06	14.47
CNN-1707	78.85	91.67	1039	91.46	8.57	11.46	16.21	12.08	148	167	196	170	12.75	14.55	17.45	14.91
BPTCTM-1	62.75	58.28	68.15	63.06	6.34	7.99	9.27	7.86	124	123	131	126	10.89	8.98	11.16	10.34
HTM-18-1	65.60	66.00	63.04	64.88	7.42	15.30	9.42	8.27	126	130	203	124	10.99	9.80	9.59	10.13
Maheshwari	102.79	110.93	110.2	107.9	10.67	13.23	15.82	13.93	190	198	173	197	16.94	16.71	17.79	17.15
Bamleshwari	86.62	94.58	93.03	91.41	8.26	14.40	13.25	11.58	164	170	182	169	13.40	13.66	15.28	14.11
Mahamaya	98.14	98.31	98.86	98.44	10.18	9.46	13.37	12.65	191	192	184	188	15.80	15.03	13.95	14.93
Swarna	65.97	69.20	95.88	77.02	6.01	9.50	14.04	9.84	144	144	118	157	11.17	11.18	15.23	12.53
Mean	78.74	85.86	90.71	85.11	10.49	12.20	12.73	11.81	151	164	172	162	12.79	13.40	14.56	13.58
CD (0.05)																
Main	3.39				0.32				2.87				0.49			
Sub	4.86				1.49				8.91				1.15			
Main x Sub	8.43				2.58				15.43				2.00			
Sub x Main	8.87				2.55				15.36				2.02			
CV%																
Main	8.61				5.83				3.83				7.95			
Sub	6.13				13.54				5.90				9.14			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5t/ha, T3= Recommended NPK + Lime 5t/ha

Table 5.4.10. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur *kharif* 2018)
Zn, Mn, Fe and Cu uptake

Variety	Zn uptake (g/ha)				Mn uptake (g/ha)				Fe uptake (g/ha)				Cu uptake (g/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	0.27	0.31	0.42	0.33	1.67	2.05	2.61	2.11	1.23	1.46	1.97	1.55	50.3	66.0	86.2	67.5
MSM	0.30	0.32	0.34	0.32	1.87	2.08	2.31	2.09	1.39	1.51	1.66	1.52	55.4	70.2	72.8	66.2
MTP-3	0.28	0.34	0.34	0.32	1.67	2.26	2.26	2.06	1.13	1.54	1.60	1.42	50.8	72.1	70.8	64.6
MTP-5	0.32	0.33	0.35	0.33	2.16	2.38	2.34	2.29	1.49	1.68	1.64	1.60	62.9	72.0	75.8	70.2
MTP-7	0.28	0.26	0.28	0.27	1.70	1.81	1.91	1.81	1.14	1.22	1.37	1.24	55.8	57.9	57.9	57.2
3447	0.35	0.33	0.34	0.34	2.11	2.12	2.28	2.17	1.45	1.42	1.48	1.45	67.2	71.2	68.3	68.9
TI-93	0.31	0.29	0.38	0.33	1.83	2.00	2.55	2.13	1.28	1.41	1.75	1.48	58.6	64.4	82.1	68.4
Binadhan-8	0.43	0.39	0.36	0.39	2.45	2.55	2.51	2.50	1.72	1.76	1.84	1.77	82.2	81.6	79.5	81.1
Binadhan-17	0.36	0.33	0.34	0.34	2.18	2.22	2.26	2.22	1.51	1.54	1.58	1.55	69.6	70.8	69.5	70.0
BRRI-Dhan-75	0.30	0.29	0.31	0.30	1.79	1.97	2.17	1.98	1.33	1.36	1.58	1.42	59.9	62.1	67.3	63.1
CSR-43	0.37	0.34	0.30	0.33	2.28	2.33	2.06	2.22	1.63	1.58	1.50	1.57	67.6	69.3	63.4	66.8
PA 6444	0.37	0.37	0.38	0.37	2.43	2.49	2.39	2.44	1.71	1.77	1.78	1.75	76.1	77.4	78.8	77.4
US-312	0.29	0.31	0.30	0.30	2.04	2.07	1.95	2.02	1.39	1.39	1.44	1.41	64.6	64.2	58.6	62.5
KRH-4	0.23	0.32	0.35	0.30	1.58	2.15	2.10	1.95	1.14	1.49	1.52	1.38	50.1	66.8	68.7	61.9
HRI-174	0.31	0.34	0.34	0.33	2.01	2.19	2.34	2.18	1.40	1.52	1.57	1.50	64.9	68.5	73.1	68.8
JKRH-3333	0.27	0.33	0.35	0.32	1.92	2.20	2.48	2.20	1.36	1.54	1.66	1.52	57.9	70.8	79.5	69.4
PUP-1	0.31	0.32	0.36	0.33	2.10	2.17	2.50	2.26	1.48	1.49	1.69	1.55	66.8	68.3	78.8	71.3
CNN-1707	0.29	0.33	0.38	0.33	2.02	2.10	2.60	2.24	1.37	1.50	1.81	1.56	62.9	66.5	81.5	70.3
BPTCTM-1	0.23	0.22	0.25	0.23	1.59	1.62	1.69	1.63	1.15	1.09	1.20	1.15	51.3	44.8	53.8	50.0
HTM-18-1	0.24	0.24	0.23	0.24	1.70	1.74	1.54	1.66	1.17	1.20	1.09	1.15	53.7	49.4	50.7	51.3
Maheshwari	0.39	0.38	0.40	0.39	2.51	2.59	2.73	2.61	1.77	1.80	1.85	1.81	81.1	80.3	88.2	83.2
Bamleshwari	0.31	0.33	0.34	0.33	2.16	2.18	2.28	2.21	1.53	1.50	1.61	1.55	68.1	68.1	74.0	70.1
Mahamaya	0.42	0.38	0.39	0.40	2.46	2.53	2.49	2.49	1.70	1.70	1.77	1.72	81.1	80.2	75.5	78.9
Swarna	0.30	0.26	0.36	0.31	1.99	1.82	2.40	2.07	1.31	1.26	1.71	1.43	57.4	55.6	86.2	64.6
Mean	0.31	0.32	0.34	0.32	2.01	2.15	2.28	2.15	1.41	1.49	1.61	1.50	63.2	67.4	72.3	67.7
CD (0.05)																
Main	0.02				0.078				0.046				2.07			
Sub	0.02				0.142				0.102				3.74			
Main x Sub	0.04				0.246				0.176				6.47			
Sub x Main	0.04				0.252				0.178				6.64			
CV%																
Main	11.51				7.84				6.67				6.61			
Sub	7.08				7.09				7.26				5.93			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5t/ha, T3= Recommended NPK + Lime 5t/ha

Table 5.4.11. Screening of rice genotypes for soil acidity and related nutritional constraints (Titabar- *kharif* 2018)

Uptake of N, P, K and Fe

Variety	Total N uptake (kg/ha)				Total P uptake (kg/ha)				Total Kuptake (kg/ha)				Fe uptake in grain (g/ha)			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS 47	40.32	51.31	39.16	43.60	6.70	7.68	5.78	6.72	57.40	65.29	47.42	56.70	356	377	323	493
MSM	41.81	56.33	40.06	46.07	6.32	7.78	5.99	6.69	55.63	71.79	49.67	59.03	406	508	325	482
MTP 3	37.51	49.74	43.19	43.48	4.97	7.89	6.20	6.35	50.44	64.20	50.44	55.03	291	435	349	475
MTP 5	47.63	61.15	45.00	51.26	6.24	8.35	6.27	6.95	62.11	79.65	57.67	66.47	398	505	385	448
MTP 7	60.05	64.04	41.85	55.31	7.69	8.77	6.60	7.69	76.03	83.91	50.41	70.12	576	526	378	444
3447	54.02	63.73	44.44	54.06	7.14	10.26	5.82	7.74	68.91	86.21	48.98	68.03	528	429	370	443
TI 93	41.33	63.68	42.26	49.09	5.56	8.46	6.44	6.82	53.36	78.80	48.24	60.13	434	604	410	442
Bina Dhan 8	38.06	49.22	43.67	43.65	4.91	7.14	5.96	6.00	52.31	61.06	50.28	54.55	333	358	361	430
Bina Dhan 17	36.68	49.02	44.41	43.37	5.02	6.99	6.20	6.07	47.87	64.26	48.90	53.67	395	424	418	429
BRRI Dhan 75	27.48	49.96	43.29	40.24	3.80	7.38	6.61	5.93	35.86	63.19	49.53	49.53	231	353	373	413
CSR 43	42.42	49.22	43.05	44.90	5.74	6.70	6.15	6.20	53.14	65.51	48.36	55.67	414	401	390	412
PA6444	38.53	50.58	44.02	44.38	5.32	8.14	6.60	6.69	50.00	65.08	48.78	54.62	351	365	407	402
US 312	48.34	65.36	42.97	52.23	5.80	9.62	6.56	7.33	61.42	82.73	46.93	63.69	468	474	403	383
KRH 4	45.87	67.03	46.44	53.11	5.82	9.49	6.20	7.17	58.87	83.77	50.73	64.46	422	533	374	374
HRI174	39.02	58.49	44.02	47.18	5.47	9.51	7.10	7.36	50.72	77.59	53.32	60.54	413	557	456	367
JKRH 3333	43.58	57.27	43.70	48.19	5.72	8.53	6.36	6.87	56.67	73.07	52.48	60.74	393	456	440	358
PUP-1	47.88	50.08	45.78	47.91	6.23	7.94	6.13	6.77	59.51	65.65	52.29	59.15	447	447	438	352
CNN-1707	48.41	43.92	44.71	45.68	6.11	6.85	6.21	6.39	59.17	52.70	54.24	55.37	419	344	337	350
BPTCTM-1	40.21	39.56	47.13	42.30	6.08	5.52	6.40	6.00	49.30	47.09	60.75	52.38	436	294	418	323
M. Sali	42.91	37.83	38.96	39.90	6.02	5.54	4.95	5.51	53.68	48.50	52.45	51.54	353	283	334	319
Mean	43.10	53.88	43.41	46.79	5.83	7.93	6.23	6.66	55.62	69.00	51.09	58.57	403	434	384	407
CD (0.05)																
Main	4.76				0.63				5.75				NS			
Sub	6.66				1.05				8.33				35.46			
Main x Sub	11.53				1.82				14.42				61.43			
Sub x Main	12.14				1.88				15.10				74.66			
CV%																
Main	20.06				18.53				19.36				22.33			
Sub	15.24				16.93				15.22				9.33			

T1=Recommended NPK, T2= Recommended NPK + Lime, T3= Recommended N + double PK+ slag

Table 5.4.12. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur -*kharif* 2018)
Avail N, P K and S status after harvest

Variety	N				P				K				S			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	225.67	237.67	245.67	236.33	10.73	12.13	13.53	12.13	187.00	196.00	203.00	195.33	19.13	21.63	24.033	21.60
MSM	222.67	234.67	242.67	233.33	9.90	11.30	12.70	11.30	195.33	204.33	211.33	203.67	16.47	18.97	21.367	18.93
MTP-3	228.00	240.00	248.00	238.67	10.27	11.67	13.07	11.67	201.67	210.67	217.67	210.00	19.57	22.07	24.467	22.03
MTP-5	222.67	234.67	242.67	233.33	11.33	12.73	14.13	12.73	184.00	193.00	200.00	192.33	24.03	26.53	28.933	26.50
MTP-7	223.00	235.00	243.00	233.67	10.60	12.00	13.40	12.00	197.33	206.33	213.33	205.67	21.80	24.30	26.7	24.27
3447	222.67	234.67	242.67	233.33	11.87	13.27	14.67	13.27	190.67	199.67	206.67	199.00	19.13	21.63	24.033	21.60
TI-93	232.33	244.33	252.33	243.00	12.97	14.37	15.77	14.37	187.33	196.33	203.33	195.67	15.97	18.47	20.867	18.43
Binadhan-8	228.67	240.67	248.67	239.33	11.97	13.37	14.77	13.37	194.67	203.67	210.67	203.00	16.53	19.03	21.433	19.00
Binadhan-17	226.33	238.33	246.33	237.00	12.40	13.80	15.20	13.80	197.67	206.67	213.67	206.00	17.47	19.97	22.367	19.93
BRRI-Dhan-75	225.00	237.00	245.00	235.67	11.93	13.33	14.73	13.33	182.67	191.67	198.67	191.00	15.77	18.27	20.667	18.23
CSR-43	237.67	249.67	257.67	248.33	10.77	12.17	13.57	12.17	176.33	185.33	192.33	184.67	16.63	19.13	21.533	19.10
PA 6444	219.00	231.00	239.00	229.67	10.83	12.23	13.63	12.23	182.00	191.00	198.00	190.33	18.77	21.27	23.667	21.23
US-312	231.00	243.00	251.00	241.67	10.43	11.83	13.23	11.83	186.33	195.33	202.33	194.67	19.43	21.93	24.333	21.90
KRH-4	213.33	234.33	233.33	224.00	11.87	13.27	14.67	13.27	188.67	197.67	204.67	197.00	19.57	22.07	24.467	22.03
HRI-174	222.33	230.67	242.33	233.00	39.43	40.83	42.23	40.83	190.67	199.67	206.67	199.00	17.60	20.10	22.5	20.07
JKRH-3333	218.67	228.00	238.67	229.33	12.33	13.73	15.13	13.73	186.67	195.67	202.67	195.00	19.23	21.73	24.133	21.70
PUP-1	216.00	235.33	236.00	226.67	11.90	13.30	14.70	13.30	186.00	195.00	202.00	194.33	19.87	22.37	24.767	22.33
CNN-1707	223.33	233.33	243.33	234.00	11.03	12.43	13.83	12.43	199.00	208.00	215.00	207.33	20.33	22.83	25.233	22.80
BPTCTM-1	221.33	231.67	241.33	232.00	11.20	12.60	14.00	12.60	188.67	197.67	204.67	197.00	18.87	21.37	23.767	21.33
HTM-18-1	219.67	231.67	239.67	230.33	11.67	13.07	14.47	13.07	183.67	192.67	199.67	192.00	15.90	18.40	20.8	18.37
Maheshwari	219.67	234.67	239.67	230.33	11.93	13.33	14.73	13.33	192.33	201.33	208.33	200.67	17.43	19.93	22.333	19.90
Bamleshwari	222.67	229.67	242.67	233.33	10.60	12.00	13.40	12.00	182.67	191.67	198.67	191.00	20.27	22.77	25.167	22.73
Mahamaya	217.67	234.67	237.67	228.33	11.17	12.57	13.97	12.57	187.67	196.67	203.67	196.00	15.23	20.30	17.733	17.70
Swarna	222.67	242.67	242.67	233.33	11.43	12.83	14.23	12.83	187.67	196.67	203.67	196.00	17.80	20.30	20.133	20.27
Mean	223.42	235.42	243.42	234.08	12.52	13.92	15.32	13.924	189.03	198.03	205.03	197.36	18.45	20.95	22.7	20.92
CD (0.05)																
Main	0.001				0.001				0.001				0.001			
Sub	5.95				9.27				5.99				2.39			
Main x Sub	NS				NS				NS				NS			
Sub x Main	NS				NS				NS				NS			
CV%																
Main	0.001				0.001				0.001				0.001			
Sub	2.73				71.41				3.26				12.30			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5t/ha, T3= Recommended NPK + Lime 5t/ha

Table 5.4.13. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur -*kharif* 2018)
Available Zn, Mn, Fe, and Cu in soil after harvest (ppm)

Variety	Zn				Mn				Fe				Cu			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	0.99	0.86	0.85	0.90	38.00	33.07	30.73	33.93	37.15	54.67	38.83	43.55	1.29	1.50	1.48	1.42
MSM	0.88	1.40	0.84	1.04	35.32	24.31	32.96	30.87	31.82	38.75	36.90	35.83	1.38	1.51	1.62	1.50
MTP-3	1.27	0.77	0.88	0.97	32.49	28.50	27.47	29.49	43.03	34.43	43.70	40.39	1.24	1.47	1.97	1.56
MTP-5	0.70	0.77	0.88	0.78	30.63	30.40	26.23	29.09	41.53	42.87	38.23	40.88	1.26	1.71	1.70	1.56
MTP-7	0.73	0.88	0.89	0.83	37.67	29.40	31.02	32.70	50.88	36.78	29.32	38.99	1.19	1.51	1.52	1.41
3447	0.33	0.74	1.02	0.70	33.09	32.11	28.44	31.21	69.94	62.01	52.51	61.48	1.17	1.51	1.55	1.41
TI-93	1.28	1.06	1.15	1.16	29.71	31.16	28.53	29.80	50.32	72.29	61.24	61.28	1.18	1.64	1.50	1.44
Binadhan-8	0.87	1.05	1.63	1.18	39.44	29.17	34.14	34.25	72.42	67.24	64.02	67.89	1.29	1.45	1.55	1.43
Binadhan-17	0.96	1.42	1.05	1.24	36.49	34.04	24.66	31.73	56.70	43.00	34.76	44.68	1.25	1.53	1.52	1.43
BRRI-Dhan-75	0.94	0.82	1.70	1.31	34.60	31.74	31.99	32.78	55.86	43.89	35.42	44.76	1.28	1.51	1.54	1.44
CSR-43	0.67	1.21	1.56	0.81	31.39	28.57	27.35	29.10	47.78	37.42	44.25	45.31	1.48	1.55	1.49	1.51
PA 6444	0.52	0.91	0.94	0.97	34.19	28.24	28.33	30.25	45.11	36.65	32.53	38.35	1.19	1.69	1.51	1.46
US-312	0.78	0.63	1.19	0.87	31.24	28.70	31.81	30.58	46.35	30.52	24.58	35.86	1.21	1.34	1.64	1.40
KRH-4	1.13	1.63	0.91	1.01	35.96	31.42	26.75	31.38	44.26	36.37	22.69	32.49	1.26	1.48	1.62	1.45
HRI-174	1.30	1.04	1.26	1.64	33.88	29.05	28.28	30.40	40.24	39.42	24.43	33.68	1.43	1.58	1.65	1.55
JKRH-3333	0.74	0.83	1.99	1.15	34.53	29.11	24.53	29.39	42.45	31.49	29.54	37.14	1.39	1.64	1.61	1.55
PUP-1	1.63	1.29	1.68	1.18	36.38	32.80	34.04	34.41	41.28	53.34	31.19	34.65	1.27	1.44	1.68	1.46
CNN-1707	1.91	0.77	1.07	1.46	33.76	33.26	31.34	32.79	44.62	66.72	55.06	51.01	1.27	1.44	1.65	1.45
BPTCTM-1	0.57	1.51	1.19	0.75	30.56	30.32	24.30	28.39	70.97	72.66	62.21	66.64	1.47	1.44	1.57	1.49
HTM-18-1	0.61	1.11	0.92	1.26	34.58	29.26	28.95	30.93	75.60	36.53	68.29	72.18	1.48	1.49	1.68	1.55
Maheshwari	0.99	1.33	1.66	1.12	33.19	29.31	29.21	30.57	48.86	36.77	36.46	40.62	1.36	1.44	1.69	1.50
Bamleshwari	1.09	0.92	1.25	1.25	34.48	30.25	29.18	31.31	51.63	41.67	37.10	41.83	1.34	1.36	1.59	1.43
Mahamaya	0.63	1.02	1.32	0.91	33.05	27.86	28.35	29.75	61.72	33.01	41.77	48.39	1.39	1.41	1.72	1.51
Swarna	1.16	1.05	1.19	1.14	33.27	29.91	28.77	30.65	59.72	42.60	32.80	41.84	1.63	1.51	1.74	1.63
Mean	0.94	1.04	1.23	1.07	34.08	30.08	29.06	31.07	51.26	45.46	40.74	45.82	1.32	1.51	1.62	1.48
CD (0.05)																
Main	NS				1.69				NS				0.09			
Sub	0.33				3.21				11.43				NS			
Main x Sub	0.57				NS				19.80				0.23			
Sub x Main	0.62				NS				19.67				0.24			
CV%																
Main	55.52				11.78				16.66				13.24			
Sub	32.94				11.08				26.76				9.66			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5t/ha, T3= Recommended NPK + Lime 5t/ha

Table 5.4.14. Screening of rice genotypes for soil acidity and related nutritional constraints (Raipur- *kharif* 2018)
Post harvest soil EC, pH and Organic Carbon

Variety	EC				pH				OC%			
	T1*	T2	T3	Mean	T1*	T2	T3	Mean	T1*	T2	T3	Mean
MS-49	0.18	0.19	0.20	0.19	5.37	5.57	5.87	5.60	0.56	0.53	0.45	0.51
MSM	0.16	0.19	0.20	0.18	5.53	5.73	6.03	5.77	0.59	0.56	0.48	0.55
MTP-3	0.22	0.23	0.23	0.22	5.17	5.37	5.67	5.40	0.55	0.52	0.44	0.50
MTP-5	0.18	0.20	0.37	0.25	5.30	5.50	5.80	5.53	0.58	0.55	0.47	0.53
MTP-7	0.16	0.21	0.19	0.19	5.57	5.77	6.07	5.80	0.55	0.52	0.44	0.50
3447	0.23	0.17	0.18	0.20	5.60	5.80	6.10	5.83	0.58	0.55	0.47	0.54
TI-93	0.24	0.18	0.22	0.21	5.30	5.50	5.80	5.53	0.55	0.52	0.44	0.51
Binadhan-8	0.23	0.18	0.34	0.25	5.53	5.73	6.03	5.77	0.57	0.54	0.46	0.53
Binadhan-17	0.19	0.34	0.18	0.24	5.47	5.67	5.97	5.70	0.57	0.54	0.46	0.53
BRRI-Dhan-75	0.31	0.51	0.19	0.34	5.33	5.53	5.83	5.57	0.64	0.61	0.53	0.59
CSR-43	0.34	0.20	0.21	0.25	5.30	5.50	5.80	5.53	0.57	0.54	0.46	0.52
PA 6444	0.41	0.19	0.25	0.28	5.60	5.80	6.10	5.83	0.62	0.59	0.51	0.57
US-312	0.19	0.22	0.21	0.21	5.43	5.63	5.93	5.67	0.63	0.60	0.52	0.58
KRH-4	0.20	0.21	0.17	0.20	5.23	5.43	5.73	5.47	0.60	0.57	0.49	0.55
HRI-174	0.20	0.21	0.21	0.21	5.23	5.43	5.73	5.47	0.56	0.53	0.45	0.51
JKRH-3333	0.20	0.20	0.23	0.21	5.53	5.73	6.03	5.77	0.61	0.58	0.50	0.56
PUP-1	0.25	0.21	0.23	0.23	5.33	5.53	5.83	5.57	0.61	0.58	0.50	0.56
CNN-1707	0.23	0.19	0.22	0.21	5.47	5.67	5.97	5.70	0.56	0.53	0.45	0.51
BPTCTM-1	0.24	0.33	0.24	0.27	5.43	5.63	5.93	5.67	0.54	0.51	0.43	0.50
HTM-18-1	0.23	0.20	0.21	0.22	5.43	5.63	5.93	5.67	0.53	0.50	0.42	0.49
Maheshwari	0.22	0.17	0.23	0.21	5.43	5.63	5.93	5.67	0.55	0.52	0.44	0.50
Bamleshwari	0.21	0.19	0.21	0.21	5.47	5.67	5.97	5.70	0.59	0.56	0.48	0.54
Mahamaya	0.18	0.21	0.22	0.21	5.30	5.50	5.80	5.53	0.60	0.57	0.49	0.55
Swarna	0.25	0.38	0.20	0.27	5.47	5.67	5.97	5.70	0.58	0.55	0.47	0.54
Mean	0.23	0.23	0.22	0.23	5.41	5.61	5.91	5.6	0.58	0.55	0.47	0.53
CD (0.05)												
Main	NS				0.001				0.001			
Sub	NS				0.18				0.031			
Main x Sub	NS				NS				NS			
Sub x Main	NS				NS				NS			
CV%												
Main	18.68				0.01				0.01			
Sub	45.31				3.42				6.19			

T1=Recommended NPK, T2= Recommended NPK + Lime 2.5 t/ha, T3= Recommended NPK + Lime 5 t/ha

5.5 Yield maximization in farmers' fields using Nutrient Expert software (*Kharif*)

The conventional blanket fertilizer recommendation causes low fertilizer use efficiency and imbalanced use of fertilizers where both deficit and excess nutrients pose problems. Estimation of field specific fertilizer requirements needs site-specific knowledge of crop nutrient requirements, indigenous nutrient supply, and the efficiency to recover the applied fertilizer. The site-specific nutrient management (SSNM) approach emphasizes 'feeding' rice with nutrients as and when needed and to enable the farmers to optimally fill the deficit between the nutrient needs of a high-yielding crop and the nutrient supply from naturally occurring indigenous sources such as soil, organic amendments, crop residues, manures, and irrigation water. The SSNM approach does not specifically aim to either reduce or increase fertilizer use. Instead, it aims to apply nutrients at optimal rate and time to achieve high yield and high efficiency of nutrient use by the rice crop, leading to high cash value of the harvest per unit of fertilizer invested. Many still perceive SSNM is complex, requiring an understanding of concepts and methods outside their experience and this slowed the wide-scale promotion and adoption of SSNM by the farmers. For more rapid adoption of SSNM technology by farmers, efforts were made in the consolidation of SSNM research conducted over the last decade across Asia into a simple delivery system by International Plant Nutrition Institute (IPNI) in the form of Nutrient Expert (NE), an easy to use interactive computer-based decision tool that can rapidly provide nutrient recommendations for farmers in the presence or absence of soil testing data. Hence, to validate this tool, this collaborative (Soil Science & Agronomy) trial was constituted in along with IPNI during *Kharif 2018* at different centers namely, Chinsurah (CHN), Faizabad (FZB), Karaikal (KRK), Khudwani (KHD), Maruteru (MTU), Mandya (MND), Pantnagar (PNT) and Pudhcherry (PDU) with three treatments in a randomized block design with three replications at different sites which are assumed to vary in the crop production factors. There was only one site in Mandya, while fives sites were tested in Faizabad, Marteru, Pathnagar, Puduchery, six sites in Chinsurah, ten sites in Khudwani and twenty sites in Karaikal. The treatments included Farmer's practice (T1), recommended dose of fertilizer (RDF) (T2) and SSNM based on Nutrient expert, which varies with each location (T3) and the results were presented in tables 5.5.1 to 5.5.3.

Initial soil properties

The available experimental soil conditions prior to cropping as observed in six centers were presented in Table 5.5.1 to characterize the soils along with plant varieties grown. The attempt to describe the soil properties of different sites and centers is to highlight the inherent problems and potentials of the soils to produce the best. Various sites under Chinsurah center including the Experimental farm of the Station, varied in soil pH from 6.6 to 7.51, which determines the solubility of nutrient elements for plant uptake. There were twenty sites selected for conducting trials under Karaikal center, which varied in soil pH from 6.96 to as high as 8.59 representing the variability. The lone site under Mandya Center had soil pH of 7.30 while the range of variability in soil pH was narrow found in ten different sites under Pantnagar center from 7.0 to 7.73. Puducherry KVK also recorded a neutral pH of 7.10. Likewise differences were noticed in other soil properties also as presented in Table 5.5.1.

The message is that the resolution was high with the selection of different sites under each Center to study the variability among sites and centers as well. It is required because the net expression of plant yield is influenced by the permutations and combinations of all edaphic factors, besides other biotic and abiotic factors. The table also showed different rice varieties grown in these sites with different production potentials through their responses to crop production factors.

Grain yield

In this description, the mean minimum and maximum of different sites tested under each center in relevant yield and yield attributes are given. It was seen that site and treatment variabilities did exist in all the attributes. For example, in Chinsurah the grain yield (kg ha^{-1}) (Table 5.5.2) varied from 5333 to 5468 in T1, while it ranged from 5490 to 5692 in T2 and 5041 to 5238 $kgha^{-1}$, which showed that sites and treatments realized differential yields. In all the test sites under Chinsurah, there were significant differences from general mean (at 5% level) with respect to grain yield. Among different treatments, T2 registered the highest grain yields in all test sites under this center. Table 5.5.2 presented the grain yields realized from different other sites and centers to understand the crop responses. Among the centers namely, CHN, FZB, MND, MTU, PNT (except one site), KRK (only seven sites showed significant difference out of 20 test sites), and PDU, T3 exhibited its supremacy over other treatments. In case of KHD, T2 (RDF) performed better that the other two treatments. It was evident from the analysis that the crops responded to resultant situation due to soil, plant and crop production factors specific to the test sites. A point of interest was that there were different responses to treatments namely, T2 and T3 which required attention to find out the additional parameters which made RDF superior over NE based recommendation.

Straw yield

Like in grain yield, differential responses were noticed in straw yield too in sites and treatments as well high lighting the site-specific responses due to inherent differences in sites and treatments. The mean minimum ($kgha^{-1}$) in Chinsurah for instance varied from 6322 to 6610 in T1 realised in five test sites while 6172 to 6825 kg ha^{-1} were obtained from T2 and 5690 to 6519 from T3 from same sites. T2 recorded the highest straw yield in majority test sites except 1 and 2 where T1 showed the highest response. In all centers similar occurrences were found in other experimental centers also (Table 5.5.2). T3 out yielded other treatments in CHN, FZB, KRK (two out of seven proved the supremacy of T2), MND, MTU, PNT and PDU while T2 did well in KHD. Like in grain yield, straw yield also was different in response to variability due to site specific characteristics, plant factors and management aspects.

Yield components

With regard to tillers/m^2, which is one of the yield components, it was seen that both sites under each treatment and among treatments there were differences like for example, in Chinsurah where the mean minimum was 356 while mean maximum was 379 tillers/m^2 in T1. There was a mean minimum tillers/m^2 of 390 and mean maximum of 409 in T2 while in T3, the mean minimum was 324 and the mean maximum was 366 tillers/m^2. Such differential responses to site specific production factors and induced variability through treatments were seen in other centers also. Likewise, with reference to other attribute, panicles/m^2 too responses to site variability and treatments were seen. Again, for instance, in Chinsurah, the range of mean minimum to mean maximum was 308-346, 335-357 and 280-331 in T1, T2 and T3, respectively (Table 5.5.2). T3 was better in all centers namely, CHN, FZB, KRK, MND, MTU (except in one site where T1 was good), PNT and PDU while in KHD T2 was better. With reference to other yield attribute, 1000 grain weight, T3 was good in FZB, KHD, KRK (only in three sites while in three sites T2 and in one site T1 was good) and PNT (except one site where T2 was good). The other attribute, panicle weight had a range of mean minimum to mean maximum of 3.09 to 3.36 g in T1, 3.15-3.51 in T2 and 2.81 to 3.10 in T3 as measured only in Chinsurah.

Nutrients Uptake

Total N, P and K uptake from six centers is presented in Table 5.5.3. One could see the dominance of some treatments in certain centers while within each center too some sites did vary in uptake. With reference to total uptake of nitrogen (kg ha^{-1}), treatment T3 higher dominance in FZB, KRK (T3 was superior in all the four sites which registered significant difference), MND, PNT (T3 was dominant in all three sites recording significant differences) and PDU (only one significant site and with T3). MTU indicated the better total nitrogen uptake in T2 (in all sites except one which had insignificant effect) in relation to others. In case of total phosphorus uptake, T3 was good in FZB, KRK (only 3 out of 20 sites showed significant difference and indicated T3 as dominant treatment), MND, PNT, PDU (only one site with T3, out of two sites with significant differences while other one was with T1). In case of phosphorus also, MTU indicated the superiority of T2 in total uptake of P. With regards to total uptake of potassium, all centers proved that T3 was better when compared to other treatments, however with minor exceptions.

The learning

The analysis of multi-location trial data and inferences drawn highlighted certain points for consideration. It is a fact that when the supply potential of the soil in relation to plant requirement is understood, better management is a possibility. In general, it is expected that a soil-based crop management is followed, but when the situation warrants crop-based soil management, we ought to know more to do more. It is in this direction; site specific nutrient management is expected to help realization of the uniform best from crop plants from all sites with their specific characteristics. Data analysis indicated the superiority of RDF over Nutrient Expert (NE) based recommendations in one instance (KHD) necessitating

further probing as to what additional parameters were involved in RDF to have out yielded NE based recommendations. It is possibly because Nutrient Expert based recommendations are limited to only application of refined quantities of N, P and K while it is a fact that a plant requires some more nutrients. It is not known whether RDF took care of these other requirements. Although, NE based recommendations were based on plant requirement and soil supply potential, the other management aspects were not included thereby RDF might be doing better. Probably, a greater number of soil parameters may be added to Nutrient Expert to help improving the decision rules for precise soil nutrient management.

Summary

A multi-location trial was conducted in Chinsurah (six sites), Faizabad (five sites), Karaikal (twenty sites), Khudwani (ten sites), Mandya (one site), Maruteru (five sites), Pantnagar (five sites) and Puducherry (five sites) with three treatments namely, Farmers' practices (T1), Recommended dosage of fertilisers (RDF) (T2) and Nutrient Expert based fertilizer recommendations (NE) (T3) to identify the better performing treatment. Analysis indicated the superiority of T3 (Nutrient Expert based recommendations) in grain and straw production in all centers except Chinsurah and Khudwani where T2 (RDF) performed better. Sites within each center also performed sometimes differently depending the on the combination of known and unknown crop production factors. In terms of yield components also T3 was better in several instances with of course with certain exceptions. Site variations were evident with regards to total uptake of nitrogen, phosphorus and potassium even within centers and among different treatments which depended on the soil supply potentials and plant requirements. In general, T3 appeared to be a promising performer in all sites with some exceptions. Thus idea of better crop-based soil management could be fulfilled with site specific nutrient management resulting out of decision rules based on Nutrient Expert analysis or regional recommended fertiliser schedules, which emanated from the specific studies.

Table 5.5.1: Yield maximization of rice through site specific Nutrient Management *(kharif 2018)*: Soil and crop characteristics

CHINSURAH							
Site No	**pH**	**EC**	**OC**	**AvN**	**AvP**	**AvK**	**Texture**
Site 1	6.6	0.22	1.05	510	44	304	Sandy loam
Site 2	6.9	0.35	1.08	510	49	299	Sandy loam
Site 3	6.9	0.39	1.2	502	43	266	Clay loam
Site 4	6.7	0.43	1.06	430	24	224	Sandy loam
Site 5	7.1	0.27	1.17	498	34	250	Clay loam
Expt Station	7.51	0.4	1.2	521	48	321	Clay loam
KARAIKAL							
Site	pH	EC	OC	AvN	AvP	AvK	Variety
Site 1	8.06	0.41	0.33	91	59	224	CR1009
Site 2	8.52	0.44	0.36	72	77	335	CR 50
Site 3	8.59	0.43	0.12	94	41	435	BPT 5204
Site 4	8.24	1.15	0.54	151	43	479	CR 1009
Site 5	7.19	0.7	0.33	163	72	212	CR 1009
Site 6	7.88	0.48	0.48	72	76	417	CR 1009
Site 7	7.23	0.55	0.51	160	49	377	CR 1009
Site 8	7.31	0.47	0.51	169	47	607	CR 1009
Site 9	7.71	0.39	0.56	94	51	422	ADT 46
Site 10	8.14	1.36	0.56	204	38	572	BPT 5204
Site 11	8.03	0.94	0.56	135	44	698	CR 1009
Site 12	7.19	0.99	0.3	132	33	327	CR 1009
Site 13	7.39	1.27	0.11	35	41	389	CR 1009
Site 14	8.44	1.16	0.39	116	49	685	BPT 5204
Site 15	8.61	0.58	0.33	135	58	184	ADT 46
Site 16	7.45	0.43	0.06	113	63	579	BPT 5204
Site 17	7.07	0.58	0.45	132	56	342	ADT 46
Site 18	7.07	0.58	0.39	100	54	753	White Ponni
Site 19	6.96	0.64	0.54	169	55	774	BPT 5204
Site 20	7.77	0.63	0.54	95	83	830	BPT 5204

PANTNAGAR									
Site	**Treatment**	**pH**	**EC**	**OC**	**AvN**	**AvP**	**AvK**	**Zn ppm**	**Fe ppm**
Site 1	T1	7.67	0.28	0.20	178	9	173	0.76	125
	T2	7.73	0.31	0.23	167	10	168	0.82	142
	T3	7.53	0.31	0.33	173	10	197	0.87	150
Site 2	T1	7.40	0.31	0.43	167	9	183	0.55	120
	T2	7.67	0.29	0.50	193	10	177	0.72	121
	T3	7.47	0.34	0.62	202	10	203	0.78	127
Site 3	T1	7.40	0.36	0.37	165	10	175	0.53	143
	T2	7.63	0.30	0.46	170	10	167	0.68	150
	T3	7.50	0.28	0.58	182	11	162	0.65	157
Site 4	T1	7.73	0.34	0.37	153	10	142	0.55	121
	T2	7.47	0.43	0.40	153	11	161	0.63	125
	T3	7.63	0.62	0.48	170	12	180	0.63	142
Site 5	T1	7.00	0.62	0.56	144	10	177	0.58	117
	T2	7.50	0.38	0.54	163	11	198	0.72	118
	T3	7.43	0.39	0.54	177	13	216	0.78	125

MANDYA							
Site	**pH**	**EC**	**OC**	**AvN**	**AvP**	**AvK**	**Variety**
Site 1	7.30	0.19	0.57	296	29	316	MTU 1061

PUDUCHERRY (KVK)							
Site No.	**pH**	**EC**	**OC**	**AvN**	**AvP**	**AvK**	**Variety**
KVK	7.10	0.13	0.39	157	40	126	CO-52

KHUDWANI					
Site No.	**Treatment**	**AvN**	**AvP**	**AvK**	**Variety**
Site 1	T1	258	18	266	Shalimar Rice 4
	T2	252	17	276	
	T3	250	17	272	
Site 2	T1	234	13	258	
	T2	228	12	226	
	T3	232	13	230	
Site 3	T1	250	17	278	
	T2	242	15	274	
	T3	248	16	278	
Site 4	T1	232	14	268	
	T2	230	13	246	
	T3	220	13	248	
Site 5	T1	266	13	272	
	T2	220	12	220	
	T3	232	12	230	
Site 6	T1	228	13	270	
	T2	230	12	222	
	T3	226	12	228	
Site 7	T1	228	14	258	
	T2	228	15	260	
	T3	224	15	269	
Site 8	T1	230	17	266	
	T2	235	15	270	
	T3	237	16	274	
Site 9	T1	242	13	254	
	T2	220	12	220	
	T3	239	13	228	
Site 10	T1	228	15	240	
	T2	232	14	236	
	T3	230	14	244	

Table 5.5.2: Yield maximization of rice through site specific Nutrient Management *(kharif 2018*): Yield and yield attributes:

Site No.	Treatment	CHINSURAH					FAIZABAD				
		Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Tillers/m^2	Panicle/m^2	Panicle wt (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Tillers/m^2	Panicle/m^2	1000 grain wt (g)
1	T1	5333	6407	362	314	3.1	4973	6835	289	282	24.0
	T2	5490	6227	391	335	3.2	5748	7708	308	302	24.5
	T3	5079	5690	351	304	3.0	6340	8218	330	321	24.7
	Mean	5301	6108	368	318	3.1	5687	7587	309	302	24.0
	LSD (p=0.05)	355	428	44.1	33.7	0.3	426	554	18.5	13.8	0.4
2	T1	5334	6322	356	308	3.2	3656	5666	242	233	23.4
	T2	5681	6172	394	344	3.3	4315	6406	261	253	23.6
	T3	5041	5952	335	289	3.1	6383	8169	326	319	25.0
	Mean	5352	6149	362	314	3.2	4785	6747	276	268	24.0
	LSD (p=0.05)	236	541	27.8	31.2	0.2	660	929	40.6	37.1	0.3
3	T1	5468	6458	364	318	3.4	4496	5995	300	291	25.1
	T2	5692	6618	390	339	3.5	5599	7246	316	310	25.3
	T3	5198	6299	324	280	3.0	6423	8366	343	330	25.4
	Mean	5453	6458	359	312	3.0	5506	7202	320	310	25.0
	LSD (p=0.05)	134	211	27.1	15.2	0.2	492	708	21.6	18.8	NS
4	T1	5412	6363	379	320	3.2	3442	4694	233	227	23.5
	T2	5570	6453	409	351	3.3	4694	5616	306	299	24.1
	T3	5198	6126	362	311	2.8	5583	7213	332	323	24.8
	Mean	5393	6314	383	327	3.1	4573	5841	290	283	24.0
	LSD (p=0.05)	157	192	29.8	5	0.2	398	461	15.9	16.9	0.3
5	T1	5406	6329	379	332	3.1	4595	5533	282	270	23.5
	T2	5619	6580	397	346	3.2	5254	6719	325	319	24.4
	T3	5209	6076	361	324	2.9	6077	7757	362	349	25.1
	Mean	5411	6328	379	334	3.1	5309	6670	323	313	24.0
	LSD (p=0.05)	127	243	25.5	32.6	0.1	781	926	22.9	24.1	0.5
	T1	5417	6610	372	346	3.2					
	T2	5586	6825	398	357	3.2					
	T3	5238	6519	366	331	3.1					
	Mean	5414	6651	379	345	3.1					
	LSD (p=0.05)	209	214	19.7	NS	NS					

Table contd…KARAIKAL

Site No.	Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Tillers/m^2	Panicle/m^2	Filled grains	1000 grain weight (g)
1	T1	6209	8102	329	291	111	23.1
	T2	5624	8398	327	283	121	23.1
	T3	5966	8485	338	294	127	23.1
	Mean	5933	8328	331	289	120	23
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
2	T1	3833	5087	264	218	133	20.5
	T2	3749	4851	272	238	144	20.2
	T3	3482	5113	276	243	129	20.5
	Mean	3688	5017	271	233	135	20
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
3	T1	2942	3907	266	236	144	17.9
	T2	3116	4577	252	226	158	17.8
	T3	3360	4133	266	237	159	18
	Mean	3139	4206	261	233	154	18
	LSD (p=0.05)	1132	1517	NS	NS	NS	NS
4	T1	3511	5347	315	258	138	21.9
	T2	3924	6318	318	259	148	22.1
	T3	4322	6089	338	294	149	22.2
	Mean	3919	5918	324	270	145	22
	LSD (p=0.05)	NS	484	NS	NS	NS	NS
5	T1	3456	5396	328	275	116	23.1
	T2	5040	6676	341	296	125	22.9
	T3	5584	8374	342	315	148	22.5
	Mean	4693	6815	337	NS	NS	23
	LSD (p=0.05)	1121	840	37.1	60	18.7	0.61
6	T1	3438	5980	272	234	121	22.6
	T2	5095	8040	305	242	111	22.6
	T3	5655	9151	337	313	133	22.1
	Mean	4729	7724	305	263	122	22
	LSD (p=0.05)	677	1615	38.4	63.7	NS	NS
7	T1	5420	8338	362	307	123	22.1
	T2	4855	7978	358	314	134	22
	T3	5529	8965	335	315	145	22.1
	Mean	5268	8427	352	312	134	22
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
8	T1	4805	8516	354	310	102	22.6
	T2	5164	8256	347	317	107	23.4
	T3	6147	9713	357	335	130	23.1
	Mean	5372	8828	353	321	113	23
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
9	T1	4249	5049	308	280	135	22.9
	T2	5553	6640	369	342	145	22.5
	T3	5625	6560	386	348	137	22.7
	Mean	5142	6083	354	323	139	23
	LSD (p=0.05)	807	954	34	49.4	NS	NS
10	T1	2775	3896	271	232	129	17.8
	T2	4124	4976	298	263	130	17.8
	T3	5245	6470	298	260	134	17.7
	Mean	4048	5114	289	252	131	18
	LSD (p=0.05)	529	1398	NS	NS	NS	NS

Table contd…KARAIKAL

Site No.	Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Tillers/m^2	Panicle/m^2	Filled grains	1000 grain weight (g)
11	T1	4102	6411	288	244	110	22.2
	T2	5527	8631	356	309	131	22.3
	T3	6271	8810	358	325	140	23
	Mean	5300	7951	334	293	127	23
	LSD (p=0.05)	1136	NS	NS	41.2	NS	NS
12	T1	5244	8694	348	307	111	22.1
	T2	6081	8676	351	323	129	22.1
	T3	6196	9509	354	344	145	22.2
	Mean	5840	8960	351	325	128	22
	LSD (p=0.05)	NS	NS	NS	NS	NS	2
13	T1	6184	9347	365	321	127	23.21
	T2	6536	9387	378	339	127	22.7
	T3	6398	9717	360	326	141	23.2
	Mean	6373	9484	368	329	132	23
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
14	T1	3980	6831	285	225	124	18.6
	T2	4029	8198	292	255	130	18
	T3	4082	9214	292	252	137	18.2
	Mean	4030	8081	290	244	130	18
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
15	T1	5360	6300	318	289	133	23.4
	T2	5009	6298	363	309	147	23.2
	T3	5729	7011	391	335	151	23.7
	Mean	5366	6536	357	311	144	23
	LSD (p=0.05)	NS	NS	37	NS	20.3	NS
16	T1	4949	5838	270	231	124	18.1
	T2	5002	5974	286	242	134	18.2
	T3	5689	6703	292	262	145	17.9
	Mean	5213	6172	283	245	134	18
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
17	T1	4189	5306	301	278	124	23.6
	T2	4211	5647	329	295	130	23.5
	T3	5151	6460	358	325	137	23.5
	Mean	4517	5804	329	299	130	24
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
18	T1	4661	5678	214	192	126	16.4
	T2	5167	6205	233	211	133	16.1
	T3	5702	6942	283	248	138	16.1
	Mean	5177	6275	243	217	132	16
	LSD (p=0.05)	681	NS 1157	35.7	26.3	NS	NS
19	T1	3051	4140	265	223	135	17.8
	T2	3353	4157	275	237	144	18.2
	T3	4058	5227	292	257	148	18.3
	Mean	3487	4508	277	239	142	18
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS
20	T1	3624	4805	289	246	125	18.4
	T2	4184	5545	289	242	138	18.3
	T3	4873	6111	300	262	145	18.3
	Mean	4227	5487	293	250	136	18
	LSD (p=0.05)	NS	NS	NS	NS	NS	NS

Table contd…KHUDWANI

Site No.	Treatment	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Panicles/m2	1000 grain wt (g)
1	T1	6807	9473	391	30
	T2	6624	9053	348	29.1
	T3	5648	8350	335	28.9
	Mean	6360	8959	358	29
	LSD (p=0.05)	870	NS	NS	NS
2	T1	7359	9323	369	30.3
	T2	7199	8897	335	30.2
	T3	6053	7963	229	29.5
	Mean	6870	8728	311	30
	LSD (p=0.05)	853	NS	49.4	NS
3	T1	7998	9861	452	30.2
	T2	7926	9762	406	29.7
	T3	6945	8583	360	29.4
	Mean	7623	9402	406	30
	LSD (p=0.05)	NS	NS	54.4	NS
4	T1	7325	9033	405	30.3
	T2	7218	8877	365	29.8
	T3	6323	8180	332	29.4
	Mean	6955	8697	367	30
	LSD (p=0.05)	NS	NS	NS	NS
5	T1	6848	8563	412	29.69
	T2	6812	8147	376	29.64
	T3	6362	7487	333	29.52
	Mean	6674	8066	374	30
	LSD (p=0.05)	NS	NS	3.78	NS
6	T1	7180	8699	399	30.01
	T2	7021	8437	360	29.9
	T3	6465	7836	339	29.6
	Mean	6889	8324	366	30
	LSD (p=0.05)	NS	640	NS	NS
7	T1	7041	8800	390	29.9
	T2	6908	8733	373	29.8
	T3	6270	7940	338	29.4
	Mean	6740	8491	367	30
	LSD (p=0.05)	NS	NS	NS	NS
8	T1	6944	8847	360	30.2
	T2	6895	8757	328	30
	T3	6038	8173	308	30
	Mean	6626	8592	332	30
	LSD (p=0.05)	NS	NS	NS	NS
9	T1	7284	9495	397	31
	T2	7200	9263	375	30
	T3	6381	8168	339	29.9
	Mean	6955	8975	370	30
	LSD (p=0.05)	NS	NS	NS	NS
10	T1	6665	9313	381	30
	T2	6566	9153	353	30
	T3	5768	8047	320	28.9
	Mean	6333	8838	351	30
	LSD (p=0.05)	662	NS	NS	NS

Table contd…MANDYA

Site No.	Treatment	Grain yield kg ha^{-1}	Straw yield kg ha^{-1}	Tillers/m^2	Panicles/m^2
1	T1	6745	7685	537	478
	T2	7052	7958	565	512
	T3	7685	8257	594	546
	Mean	7161	7967	565	512
	LSD (p=0.05)	NS	NS	NS	NS

Table contd…MARUTERU

Site No.	Treatment	Grain yield (kg/ha)	Straw yield (Kg/ha)	Tillers/m^2	Panicles/m^2
1	T1	5379	6455	301	289
	T2	5692	6714	275	235
	T3	5941	6830	274	242
	Mean	5671	6666	283	255
	LSD (p=0.05)	235	NS	14.1	23.9
2	T1	4833	5543	257	227
	T2	4738	5428	285	244
	T3	5444	6533	296	285
	Mean	5005	5835	279	252
	LSD (p=0.05)	306	458	NS	30.5
3	T1	5063	5806	268	221
	T2	5879	6696	285	247
	T3	6005	7273	310	289
	Mean	5649	6592	288	252
	LSD (p=0.05)	242	785	1.6	25.5
4	T1	4079	4961	259	193
	T2	4326	5076	251	218
	T3	4704	5268	292	282
	Mean	4370	5102	267	231
	LSD (p=0.05)	313	NS	NS	18.4
5	T1	4262	4948	248	215
	T2	5002	5866	260	227
	T3	5409	6058	312	293
	Mean	4891	5624	273	245
	LSD (p=0.05)	345	331	8.7	18.01

Table contd…PANTNAGAR

Site No.	Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Tillers/m^2	Panicles/m^2	Filled grain/ Panicle	1000 grain weight (g)
1	T1	4950	5890	175	119	105	21
	T2	5150	5950	180	125	118	21.1
	T3	5282	6183	183	128	123	22.5
	Mean	5127	6008	179	124	115	22
	LSD (p=0.05)	92	73	NS	4.4	11.9	0.61
2	T1	5190	6200	163	123	118	22.2
	T2	5317	6317	175	138	128	22.6
	T3	5440	6383	183	143	135	23.5
	Mean	5316	6300	174	135	127	23
	LSD (p=0.05)	67	46	12.8	11.3	3.8	NS
3	T1	5417	6533	153	120	118	20.2
	T2	5340	6668	167	127	130	21
	T3	5470	6767	177	138	133	22.3
	Mean	5409	6656	166	128	127	21
	LSD (p=0.05)	81	120	8.9	4.6	6	NS
4	T1	5040	6033	162	119	123	22.2
	T2	5117	6067	163	125	128	22.7
	T3	5017	6200	173	133	135	20.7
	Mean	5058	6100	166	126	129	22
	LSD (p=0.05)	61	131	NS	7.3	3.8	NS
5	T1	5183	6033	153	122	122	20.7
	T2	5297	6167	162	127	123	22.1
	T3	5333	6267	167	133	133	22.5
	Mean	5271	6156	161	127	126	22
	LSD (p=0.05)	30	151	NS	NS	NS	1.2

Table contd…PUDUCHERRY

Site No.	Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Tillers/m^2	Panicles/m^2
1	T1	5523	11133	384	352
	T2	6060	12100	386	353
	T3	6647	13833	413	366
	Mean	6077	12355	394	357
	LSD (p=0.05)	503	901	NS	NS
2	T1	5280	10967	349	304
	T2	5550	11800	378	320
	T3	5983	12467	388	344
	Mean	5604	11745	372	323
	LSD (p=0.05)	391	478	NS	NS
3	T1	5617	13033	365	320
	T2	5470	12067	337	302
	T3	5873	12667	375	345
	Mean	5653	12589	359	322
	LSD (p=0.05)	NS	NS	26.5	25.3
4	T1	4947	11000	312	285
	T2	5177	11867	294	240
	T3	5427	12267	314	256
	Mean	5184	11711	307	260
	LSD (p=0.05)	NS	NS	NS	NS
5	T1	5770	11500	318	287
	T2	6013	12133	347	299
	T3	6120	12500	38	334
	Mean	5968	12044	234	307
	LSD (p=0.05)	NS	NS	NS	NS

Table 5.5.3: Yield maximization of rice through site specific Nutrient Management *(kharif 2018*): Total nutrient uptake:

Site No	Treatment	FAIZABAD			MARUTERU		
		N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
1	T1	128.5	50.7	70.4	90.5	18.1	105.8
	T2	152.8	59.8	85.0	108.2	27.4	98.9
	T3	167.4	68.2	96.3	87.5	23.6	123.6
	Mean	149.6	59.6	83.9	95.4	23.0	109.4
	LSD (p=0.05)	17.3	10.4	16.1	12.5	1.4	7.2
2	T1	98.8	36.8	60.5	86.9	15.1	94.7
	T2	111.4	36.0	64.1	86.9	24.2	81.1
	T3	163.9	54.2	88.4	83.5	22.2	121.9
	Mean	124.7	42.3	71.0	85.8	20.5	99.2
	LSD (p=0.05)	22.1	10.3	15.9	NS	2.9	9.9
3	T1	119.1	39.7	70.3	98.4	16.2	106.2
	T2	155.6	47.9	80.3	106.6	34.3	107.0
	T3	185.3	58.8	95.2	95.5	25.2	136.4
	Mean	153.3	48.8	81.9	100.2	25.2	116.5
	LSD (p=0.05)	22.0	13.6	10.9	7.7	12.9	16.9
4	T1	89.0	23.0	45.9	75.5	15.4	85.5
	T2	116.0	38.7	68.7	77.5	23.1	79.1
	T3	148.4	60.6	88.9	67.4	19.2	97.4
	Mean	117.8	40.8	67.8	73.5	19.2	87.3
	LSD (p=0.05)	13.6	7.4	8.4	4.2	2.0	8.4
5	T1	112.1	35.9	64.7	69.8	16.1	84.6
	T2	137.5	47.9	87.6	85.5	24.7	92.9
	T3	166.1	70.9	97.1	78.9	23.4	118.9
	Mean	138.6	51.6	83.1	78.1	21.4	98.8
	LSD (p=0.05)	29.9	15.4	19.4	9.9	2.1	6.3

Table contd…MANDYA

Site No	Treatment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
1	T1	125.5	20.2	162.6
	T2	137.2	20.5	162.6
	T3	142.7	26.8	175.7
	Mean	135.1	22.5	167.0
	LSD (p=0.05)	NS	NS	NS

Table contd…KARAIKAL

Site No	Treatment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Site No	Treatment	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
1	T1	97.7	69.3	258.3	6	T1	61.3	27.7	161.3
	T2	102.0	46.0	256.3		T2	85.3	49.0	241.3
	T3	107.7	40.7	265.7		T3	100.7	53.7	277.3
	Mean	102.5	52.0	260.1		Mean	82.4	43.5	226.6
	LSD (p=0.05)	NS	NS	NS		LSD (p=0.05)	13.1	9.9	50.3
2	T1	68.7	29.7	155.7	7	T1	81.0	53.3	250.3
	T2	66.0	28.0	155.7		T2	74.7	45.0	221.7
	T3	67.7	29.0	154.3		T3	87.7	57.7	251.3
	Mean	67.5	28.9	155.2		Mean	81.1	52.0	241.1
	LSD (p=0.05)	NS	NS	NS		LSD (p=0.05)	NS	NS	NS
3	T1	47.3	24.7	122.7	8	T1	78.0	54.0	238.0
	T2	55.0	28.7	139.7		T2	79.0	49.7	231.3
	T3	54.7	24.7	137.7		T3	101.3	69.0	272.7
	Mean	52.3	26.0	133.4		Mean	86.1	57.6	247.3
	LSD (p=0.05)	NS	NS	NS		LSD (p=0.05)	NS	NS	NS
4	T1	54.0	29.0	158.7	9	T1	58.0	37.3	158.3
	T2	64.7	36.0	202.3		T2	71.0	42.7	209.7
	T3	62.0	33.3	196.3		T3	78.0	48.7	207.0
	Mean	60.2	32.8	185.8		Mean	69.0	42.9	191.7
	LSD (p=0.05)	NS	NS	16.1		LSD (p=0.05)	NS	NS	NS
5	T1	51.7	33.0	168.0	10	T1	37.7	18.7	100.7
	T2	77.0	45.0	213.7		T2	60.0	28.7	151.7
	T3	94.7	47.7	255.3		T3	74.3	33.7	195.0
	Mean	74.5	41.9	212.3		Mean	57.3	27.0	149.1
	LSD (p=0.05)	32.5	NS	18.7		LSD (p=0.05)	16.8	NS	32.3
11	T1	59.0	32.0	171.3	16	T1	71.7	29.3	164.7
	T2	83.0	43.0	240.3		T2	72.7	28.0	166.3
	T3	94.3	53.0	253.7		T3	92.3	42.3	198.0
	Mean	78.8	42.7	221.8		Mean	78.9	33.2	176.3
	LSD (p=0.05)	19.7	NS	37.3		LSD (p=0.05)	NS	NS	NS
12	T1	100.3	38.7	247.3	17	T1	77.7	28.3	207.7
	T2	120.3	43.3	280.3		T2	89.7	38.7	203.0
	T3	117.7	56.7	274.0		T3	100.7	41.3	243.0
	Mean	112.8	46.2	267.2		Mean	89.4	36.1	217.9
	LSD (p=0.05)	NS	NS	NS		LSD (p=0.05)	NS	15.3	NS
13	T1	80.7	44.0	190.7	18	T1	77.7	28.3	207.1
	T2	84.3	40.3	207.7		T2	89.7	38.7	203.0
	T3	92.7	41.3	239.0		T3	100.7	41.3	243.0
	Mean	85.9	41.9	212.5		Mean	89.4	36.1	217.7
	LSD (p=0.05)	NS	NS	NS		LSD (p=0.05)	NS	NS	NS
14	T1	87.7	49.7	210.7	19	T1	41.3	25.0	144.0
	T2	84.3	36.3	190.0		T2	57.0	28.3	148.3
	T3	89.7	50.3	224.7		T3	65.3	35.7	161.0
	Mean	87.2	45.4	208.5		Mean	54.5	29.7	151.1
	LSD (p=0.05)	NS	NS	NS		LSD (p=0.05)	NS	NS	NS
15	T1	77.3	39.3	190.3	20	T1	54.0	31.3	139.3
	T2	84.3	37.3	189.7		T2	69.7	33.3	164.7
	T3	83.0	38.3	212.3		T3	73.0	37.0	186.7
	Mean	81.5	38.3	197.4		Mean	65.6	33.9	163.6
	LSD (p=0.05)	NS	17.9	NS		LSD (p=0.05)	NS	NS	NS

Table contd…

Site	Treatment	PANTNAGAR			PUDUCHERRY		
		N	P	K	N	P	K
1	T1	6.9	38.3	549.7	117.9	32.2	117.9
	T2	8.3	44.6	614.8	122.1	34	118.2
	T3	11.3	47.4	684.1	263.1	36.1	152.8
	Mean	8.8	43.4	616.2	167.7	34.1	129.6
	LSD (p=0.05)	3.2	5.2	89.3	15	NS	28.1
2	T1	8.3	42.4	578.7	126.6	27.8	130.3
	T2	8.5	48.4	673.8	121.1	35.6	144.8
	T3	12.3	52.1	723.5	137	33.1	126.5
	Mean	9.7	47.6	658.7	128.2	32.2	133.9
	LSD (p=0.05)	NS	4	77.6	NS	NS	NS
3	T1	9.4	34.9	592.2	146	40.5	124.7
	T2	11.1	37.8	633.7	137.8	31.3	117.1
	T3	14.7	39.7	755.7	139.2	28.5	133.4
	Mean	11.7	37.5	660.5	141	33.4	125.1
	LSD (p=0.05)	NS	NS	NS	NS	8.4	NS
4	T1	7.8	26.2	573	106.1	29.1	102.9
	T2	10.3	33.4	626.7	110.8	26.4	123.6
	T3	7.4	38.2	723.3	121.5	31.3	125.1
	Mean	8.5	32.6	641	112.8	28.9	117.2
	LSD (p=0.05)	NS	2.4	NS	NS	NS	17.5
5	T1	8	30.2	563	138.9	28.2	130.7
	T2	9.3	32.9	688.8	136.6	31.2	116.5
	T3	11.7	42.9	791.6	122.9	33.5	137.6
	Mean	9.7	35.3	681.1	132.8	31	128.3
	LSD (p=0.05)	2.7	5.4	99.2	NS	NS	NS

5.6 Bio - Intensive Pest Management (BIPM) in rice under Organic Farming

This trial was initiated during *kharif* 2015 in collaboration with Entomologists to study the influence of organic farming on productivity, grain quality, soil health and Pest dynamics in rice and also to develop a package of bio-intensive pest management (BIPM) practices in organic farming. There are two treatments here viz., BIPM block and Farmers Practice (FP) block. In BIPM block, all organic farming practices involving from seed treatment, nursery application, nutrient and pest management using organic sources only were practiced as per the technical programme. Whereas, in FP block, general POP with RDF and need based application of insecticides were practiced. Each main block was divided into 6 smaller blocks and observations on pest incidence, yield parameters and grain yield were recorded. Plant nutrient (NPK) uptake was calculated using nutrient concentration and dry matter yield. Soil samples were collected before conducting experiment and after harvest and were analysed for important soil properties. The trial was conducted at ten locations but the data from four centres viz., [Chinsurah (CHN), IIRR, Puducherry (PDU) and Titabar (TTB)] during *kharif* 2018 are presented in Tables 5.6.1 to 5.6.8.

Yield parameters and yield of Boro rice at Chinsurah

Yield parameters viz., (Tiller/m^2, Panicle/ m^2, and panicle weight) were significantly superior in BIPM compared to FP at CHN (Table 5.6.2) but this could not reflect in higher yield in BIPM and both treatments were at par.

Yield parameters, yield and nutrients uptake during *kharif* 2018

At CHN, yield parameters were significantly superior in BIPM compared to FP (Table 5.6.3) and at PDU, both treatments were at par in case of all yield parameters. Among four locations, grain yield (Table 5.6.4) was significantly superior in BIPM block compared to FP at CHN and TTB that recorded 17 and 48 % higher grain yield in BIPM over FP at CHN and TTB, respectively. Whereas, at IIRR and PDU, both BIPM and FP treatments were at par. Straw yield followed the similar trend as that of grain yield at all locations. With regard to nutrient (NPK) concentration in grain and straw at PDU, both treatments were on par (Table 5.6.5). Nutrient uptake by grain, straw and total uptake at PDU did not differ significantly between BIPM and FP except for total K uptake which was higher in FP (Table 5.6.6).

Observations on Pest incidence

The pest incidence was either reduced in BIPM plots as in Chinsurah and Titabar or on par as in IIRR compared to Farmers' practice. The natural enemies were higher in BIPM plots in all locations.

(Detailed report is given in Entomology progress report).

Grain quality characteristics

Important nutritional quality parameters were estimated in grain of IIRR and presented in Table 5.6.7. Grain quality parameters and nutrient concentration did not differ much between BIPM and farmers' practices at IIRR.

Soil Properties after harvest

The important soil properties from three locations (CHN, PDU and TTB) are presented in Table 5.6.8. Most of the soil properties (OC and available NPK) improved in BIPM compared to FP at CHN (boro and *kharif*) and TTB while not much difference was noticed at PDU. The organic carbon content ranged from 0.36-1.20% in BIPM and 0.42-1.20% in FP treatment across locations. Soil available N, P and K ranged across locations from 142-524, 17.2-156 and 96-360 kg/ha, respectively.

Summary

From the fourth year of study on "Bio-intensive pest management", it can be summarized that among four locations (CHN, IIRR, PDU and TTB), BIPM was significantly superior to FP at CHN and TTB locations during *kharif* and both treatments were on par at IIRR and PDU, in terms of grain yield. This could be attributed to the significant increase in yield components at CHN. The pest incidence was either reduced in BIPM plots or on par compared to Farmers' practice. The natural enemies were higher in BIPM plots in all locations. No significant difference was noticed in nutrient content, uptake and grain quality parameters between BIPM and FP and improvement in soil properties with BIPM was observed at CHN and TTB.

Table 5.6.1 Bio-intensive Pest Management (BIPM) in Rice under Organic farming
Soil, Crop and weather data - *Kharif* 2018

Parameter	Chinsurah	Puducherry	Titabar
Cropping system	Rice-Rice	Rice-Rice	Rice-Rice
Variety	Swarna	CoR52	Keteki Joha
FP (kg NPK/ha)	60-30-30	150:50:50	60-20-40
Crop growth	Satisfactory	Good	-
% clay	-	-	42.0
% silt	-	-	28.5
% sand	-	-	29.5
Soil Texture	Clay loam	Clay loam	Silty clay
pH (1:1)	7.1	6.95	5.5
Org.carbon (%)	0.89	0.46	1.1
EC (dS/m)	0.22	0.22	0.28
Avail.N (kg/ha)	518	257.6	-
Avail. P_2O_5 (kg/ha)	132.8	33.7	-
Avail. K_2O (kg/ha)	347.4	129	-
Max. Temp (ºC)	30.3	33.5	28.5
Min. Temp (ºC)	19.2	23.4	19.7
Total Rainfall(mm)	751	777.8	1954
RH(%)	-	75.83	93.5

Table 5.6.2: Bio-intensive pest management (BIPM) in Rice under Organic farming
Yield and yield parameters in *Boro* rice (Location: Chinsurah)

Treatments	Tillers/m^2	Panicle/m^2	Panicle weight (g)	Grain yield (kg/ha)	Straw Yield (kg/ha)
BIPM	337	290	3.19	4329	5262
FP	309	263	2.97	4584	5549
t-test	**	**	**	NS	NS

Table 5.6.3: Bio-intensive Pest Management (BIPM) in Rice under Organic farming
Yield parameters at different locations - *kharif* 2018

Treatments	Chinsurah				Puducherry			
	Tiller/ m^2	Panicle/ m^2	Filled grains/ panicle	1000 grain wt	Tiller/ m^2	Panicle/m^2	Filled grain/ panicle	1000 grain wt
BIPM	347	286	211	21.5	437	383.3	156	19.56
FP	288	241	194	20.71	455.5	391.7	162	19.62
t – test	**	**	*	**	NS	NS	NS	NS

Table 5.6.4: Bio-intensive Pest Management (BIPM) in Rice under Organic farming Grain yield (kg/ha) at different locations - *kharif* 2018

Treatments	Grain yield (kg/ha)				Straw yield (kg/ha)		
	Chinsurah	IIRR	Puducherry	Titabar	Chinsurah	Puducherry	Titabar
BIPM	5244	5950	5629	5223	6455	11036	8733
FP	4471	6300	5759	3520	5663	11684	6267
t – test	*	NS	NS	**	*	NS	**

Table 5.6.5: Bio-intensive Pest Management (BIPM) in Rice under Organic farming Nutrient concentration (%) in rice grain and straw - *kharif* 2018

Treatments	Puducherry							
	Grain (%)			Straw (%)				
	N	P	K	N	P	K		
BIPM	1.22	0.24	0.42	0.49	0.14	0.9		
FP	1.17	0.25	0.46	0.53	0.13	1.15		
t-test	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**		
	IIRR							
	Grain (%)			**Grain (ppm)**		**Straw (%)**		
	N	P	K	Zn	Fe	N	P	K
BIPM	1.20	0.14	0.45	11.3	2.20	0.57	0.07	0.93
FP	1.18	0.12	0.36	11.4	2.25	0.45	0.07	0.95

Table 5.6.6: Bio-intensive Pest Management (BIPM) in Rice under Organic farming Nutrient uptake (kg/ha) at Puducherry - *kharif* 2018

Treatments	Puducherry (kg/ha)								
	Grain			Straw			Total		
	N	P	K	N	P	K	N	P	K
BIPM	69.03	13.14	23.76	53.82	14.89	99.4	123	28	123
FP	67.56	14.29	26.15	62.28	15.01	134.4	130	29	161
t-test	NS	NS	NS	NS	NS	NS	NS	NS	*

Table 5.6.7: Bio-intensive Pest Management (BIPM) in Rice under Organic farming Physical and Cooking quality parameters at IIRR - *kharif* 2018

Treatments	Hull %	Mill %	HRR %	KL	KB	L/B	Gr. type	Chalki-ness	ASV	AC%	GC (mm)
BIPM	75.4	64.8	49.1	4.96	1.81	2.74	MS	VOC	5.0	23.6	22
FP	76.0	68.8	56.8	4.91	1.78	2.75	MS	OC	4.5	23.8	22

Table 5.6.8: Bio-intensive pest management (BIPM) in Rice under Organic farming

Soil properties after harvest at different locations – K*harif* 2018

Treatments	pH	EC	Org. C. (%)	Available Nitrogen (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Puducherry						
BIPM	7.01	0.11	0.36	142	21.6	107
FP	7.08	0.11	0.42	159	24.0	96
Chinsurah (*kharif*)						
BIPM	7.00	0.19	1.14	524	151	360
FP	7.01	0.23	1.2	485	103	296
Chinsurah (*boro*)						
BIPM	7.02	0.23	1.09	518	156	345
FP	6.89	0.21	0.87	418	98	289
Titabar						
BIPM	5.55	-	1.20	376	20.5	159
FP	5.50	-	1.10	352	17.2	152

Trial 5.7: Residue management in organic rice based cropping systems:

In India, about 371 million tons (mt) crop residues are produced annually of which wheat and paddy residues constitute 27–36% and 51–57% respectively. The disposal of such huge quantity of paddy residues has become a big problem, particularly in North-West Indian states, mainly due to the use of combine harvester and narrow time gap (one to three weeks) between paddy harvesting and planting of wheat in NW India, resulting in farmers preferring to burn the residues in-situ. Burning biomass not only pollutes environment by depleting air quality, emitting green house gases, but also causes smog in the environment, results in loss of appreciable amount of plant essential nutrients besides being deleterious to soil microbes. The incineration of crop residues contributes to emissions of harmful air pollutants, which can cause severe impacts on human health too. Thus, proper residue management is of utmost important as it contains plant nutrients and improves the soil-plant-atmospheric continuum. As an alternative strategy, these crop residues can be used for mulching, compost making and in-situ incorporation for improving soil fertility in organic farming.

Keeping this in view, the present trial was initiated, in *kharif* 2018, to study the influence of rice/wheat residue on rice crop productivity, soil health, pest dynamics and grain quality in organic rice based cropping systems. The trial was conducted at nine centres *viz*., Ghaghraghat (GHG), Kanpur (KNP), Karaikal (KRK), Khudwani (KHD), Maruteru (MTU), Pantnagar (PNT), Pusa, Raipur (RPR) and IIRR, Hyderabad.

The treatments (8) consisted of application of crop residues alone and in combination with either green manure (GM), green leaf manure (GLM), vermicompost (VC) or efficient microbial culture (MC) to supply 100% and 150% of N requirement in addition to Control and recommended dose of N. The data from eight locations are presented in Tables 5.7.1 to 5.7.5. The test varieties were NDGR-201 at GHG, NDR-359 at KNP, ADT 45 at KRK, SR-4 at KHD, MTU-1061 at MTU, Pant Dhan-12 at PNT, Rajendra Bhagwati at Pusa, Dubraj at RPR, and RP Bio 226 at IIRR. The details of crop, soil and weather parameters of the experimental sites (Table 5.7.1) show variation in soil characteristics with reference to pH, organic carbon content, soil texture and available nutrient status.

Rice productivity

Data presented in Table 5.7.2 shows that the rice productivity significantly varied with the source of nitrogen application. Across the centres, application of RDF resulted in significantly highest grain yield ranging from 2.26 t/ha at IIRR to 6.74 t/ha at KHD while Control maintained the lowest grain yield values. However, crop residues at 100 & 150% N were on par and significantly superior to RDF at GHG while combined application of residues (75% N) with GM/GLM (25% N) was on par with RDF at GHG, KRK and Pusa. Application of VC (50% N) + crop residue (50% N) too was on par with RDF at MTU, Pusa and RPR. At other centres, the treatments consisting of different combinations of crop residues with either GM/GLM, VC or MC/BM were on par with each other in terms of grain yield. Similar trend was also observed for straw yield as well. At IIRR, the effect of crop residues was not significant.

Nutrient uptake and use efficiency

Data presented in Table 5.7.3 show significant effect of source of N application on nutrient uptake. RDF recorded the highest N (78-101 kg/ha), P (15-32 kg/ha) and K (78-220 kg/ha) uptake. The crop residue treatments were at par and didn't vary much.

Data presented in Table 5.7.4 show lower nutrient use efficiencies in RDF as compared to crop residue treatments.

Post harvest soil nutrient status:

The available nutrient status (N, P and K) of soils at are presented in Table 5.7.5. The data reveals that the soil nitrogen, phosphorus and potassium contents after harvest of the crop were not influenced by various residue treatments.

Summary

Rice productivity was highest under RDF while Control maintained the lowest grain yield values. The treatments consisting of different combinations of crop residues with either GM/GLM, VC or MC/BM were on par with each other in terms of grain yield. Nutrient uptake too was highest under RDF [N (78-101 kg/ha), P (15-32 kg/ha) and K (78-220 kg/ha)]. The crop residue treatments were at par and didn't vary much in terms of nutrient uptake and maintained higher nutrient use efficiencies over RDF. This being the first year of the trial, no significant change in post-harvest soil nutrient status was observed with residue treatments.

Table: 5.7.1 Residue management in organic rice based cropping systems
Crop and soil characteristics

Parameter	**GHG**	**KNP**	**KRK**	**KHD**	**MTU**	**PNT**	**PUSA**	**RPR**	**IIRR**
Cropping system	Rice-Wheat	Rice-Wheat	Rice- RF	Rice-Wheat	Rice-Rice	Rice-Wheat	Rice-Wheat	Rice-Wheat	Rice-Rice
Variety									
Kharif	NDGR-201	NDR-359	ADT 45	SR-4	MTU-1061	Pant Dhan-12	Rajendra	Dubraj	RP Bio 226
Rabi	-	-		-	-	-		-	-
RFD (Kg NPK/ha)									
Kharif	80:60:40	120:60:60	150: 50: 50	-	90:60:60	120:60:30	130:50:56	100:60:40	120:60:40
Rabi	-	-	-	-	-	-	-	-	-
Crop growth									
Kharif	Good	Good	Good	Good	Good	Good	Good	Good	Good
Rabi	-	-	-	-	-	-	-	-	-
Soil data									
% clay	26	21	17	-	38	25.9	15%	60	-
% silt	33	22	2	-	28	61.4	32%	14	-
% sand	41	57	82	-	34	12.9	52.5%	26	-
Soil Texture	Sandy Loam	Sandy Loam	Sandy loam	-	Clay loam	Silty clay loam	Sandy loam	Clay	Clay
pH (1:1)	8.3	8.0	7.8	-	6.1	7.4	8.6	7.0	8.1
Org. carbon (%)	0.6	0.38	0.36	-	1.05	0.62	0.58	0.57	-
CEC [c mol (p+)/kg]	-	0.27	8.2	-	48.6	23.2	--	15.3	-
EC (ds/m)	-		1.01	-	0.57	0.35	0.12	0.22	-
Avail.N (kg/ha)	205	205	94	-	157	144	193	195	119
Avail. P_2O_5 (kg/ha)	11	18	48	-	48	10.1	32	18	85
Avail. K_2O (kg/ha)	240	194	142	-	249	196	203	362	615

Table: 5.7.2 Residue management in organic rice based cropping systems
Grain and straw yields (*Kharif* 2018)

Treatment	Grain yield (t/ha)									Straw yield (t/ha)								
	GHG	KNP	KRK	KHD	MTU	PNT	Pusa	RPR	IIRR	GHG	KNP	KRK	KHD	MTU	PNT	Pusa	RPR	IIRR
Control (no fertilizers)	4.05	1.95	3.10	3.12	3.85	1.26	3.05	2.89	2.12	4.94	2.27	7.57	3.97	4.81	1.84	4.07	4.33	4.33
RDF	4.02	3.75	4.13	6.74	5.59	4.44	4.32	5.22	2.26	4.92	5.1	9.07	8.70	6.99	5.25	5.53	8.17	4.73
Crop residue (100%N)	4.43	2.29	3.76	4.77	4.60	2.77	3.81	4.31	2.97	5.49	2.67	7.01	5.80	5.75	3.44	4.52	6.20	6.21
Crop residue (150%N)	4.35	2.46	4.02	5.13	4.50	2.94	3.91	4.61	2.82	5.39	2.87	8.96	6.37	5.62	3.64	4.49	6.58	5.18
Crop residue (50% N) + GM/GLM (50% N)	4.21	2.73	3.66	5.33	4.27	3.25	4.08	4.50	2.73	5.19	3.21	7.43	6.70	5.34	3.61	4.49	6.42	6.25
Crop residue (75% N) + GM/GLM (25% N)	2.20	2.99	3.98	5.80	4.57	3.44	4.24	4.50	2.89	2.69	3.52	9.34	7.30	5.71	3.73	4.49	6.45	7.78
Crop residue (50% N) + VC (50% N)	3.73	2.84	4.07	6.06	4.88	3.59	3.95	4.69	2.62	4.57	3.35	7.04	7.57	6.10	4.11	4.49	6.69	5.56
Crop residue (75% N) + VC (25% N)	3.69	3.12	3.55	6.18	5.30	3.63	4.20	5.08	2.53	4.52	3.74	8.64	8.03	6.63	4.19	4.49	7.30	4.95
Crop residue (100% N) + MC/BM	-	2.37	3.40	-	-	-	-	4.25	-	-	2.77	8.71	-	-	-	-	6.08	-
Crop residue (150% N) MC/BM	-	2.59	2.78	-	-	-	-	4.28	-	-	3.04	8.82	-	-	-	-	6.22	-
Expt. Mean	3.84	2.71	3.65	5.39	4.69	3.17	3.95	4.43	2.62	4.71	3.25	8.26	6.80	5.87	3.73	4.57	6.44	5.62
CD (0.05)	0.16	0.50	0.49	0.59	0.59	0.10	0.23	0.18	NS	0.21	0.14	0.72	0.77	0.74	0.10	0.20	0.13	1.66
CV (%)	2.41	10.74	7.82	6.21	7.15	1.86	3.29	2.39	28.00	2.53	2.53	5.11	6.44	7.18	1.47	2.44	1.15	16.9

Table: 5.7.3 Residue management in organic rice based cropping systems
Nutrient uptake (kg/ha) in total dry matter (*Kharif* 2018)

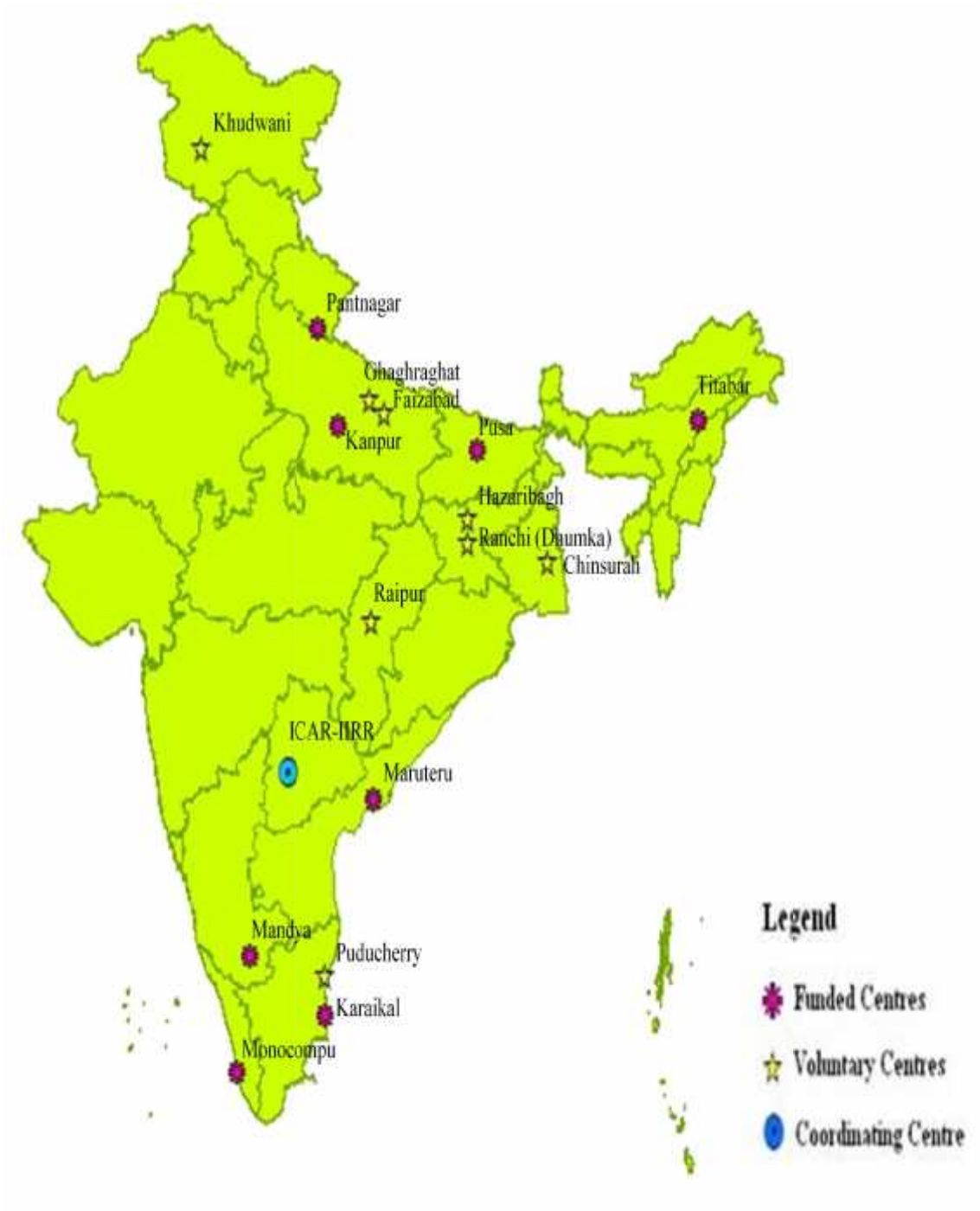
Treatment	KNP			KRK			MTU			PNT			PUSA			RPR		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Control (no fertilizers)	44	9	44	64	20	88	71	17	64	19	3	18	46	20	65	46	6	104
RDF	96	24	100	95	31	125	97	23	128	78	17	78	83	32	106	101	15	220
Wheat/Rice residue (100%N)	52	10	52	87	20	101	86	20	96	40	8	40	62	24	82	66	9	154
Wheat/Rice residue (150%N)	53	14	56	92	26	127	83	17	93	46	9	44	71	24	84	79	11	171
Wheat/Rice residue (50% N) + GM/GLM (50% N)	63	15	63	74	24	98	75	19	84	51	11	49	72	28	88	77	11	170
Wheat/Rice residue (75% N) + GM/GLM (25% N)	71	18	70	79	32	120	76	20	88	54	10	54	75	27	91	81	11	162
Wheat/Rice residue (50% N) + Vermicompost (50% N)	66	16	66	81	19	115	98	23	105	58	12	60	69	26	86	80	11	174
Wheat/Rice residue (75% N) + Vermicompost (25% N)	75	18	75	80	23	112	102	21	107	59	13	65	75	27	85	94	13	196
Wheat/Rice residue (100% N) + Microbial culture/bonemeal	54	13	54	79	27	120	-	-	-	-	-	-	-	-	-	82	11	154
Wheat/Rice residue (150% N) + Microbial culture/bonemeal	61	15	60	70	29	109	-	-	-	-	-	-	-	-	-	76	11	164
Expt. Mean	**64**	**15**	**64**	**80**	**25**	**111**	**86**	**20**	**96**	**51**	**10**	**51**	**69**	**26**	**86**	**78**	**11**	**167**
CD (0.05)	**7.15**	**2.10**	**3.82**	**20.76**	**8.00**	**16.43**	**17.81**	**3.92**	**20.61**	**2.74**	**1.37**	**3.19**	**4.28**	**2.29**	**7.75**	**3.76**	**1.18**	**7.41**
CV (%)	**6.56**	**8.05**	**3.49**	**15.12**	**18.59**	**8.61**	**11.82**	**11.15**	**12.29**	**3.07**	**7.61**	**3.58**	**3.53**	**5.06**	**5.16**	**2.80**	**6.35**	**2.59**

Table: 5.7.4 Residue management in organic rice based cropping systems Nutrient use efficiency (kg grain/kg uptake) (Kharif 2018)

Treatment	KNP			KRK			MTU			PNT			PUSA			RPR		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Control (no fertilizers)	44.6	225.4	44.8	48.9	164.1	35.3	54.0	227.8	60.5	65.1	433.4	71.0	66.8	154.8	46.7	62.5	528.2	27.8
RDF	38.6	157.9	37.3	44.2	141.4	33.2	57.8	240.6	44.0	56.8	265.2	56.9	52.0	134.9	40.9	51.6	340.8	23.8
Wheat/Rice residue (100%N)	44.3	222.5	44.3	43.5	193.4	37.6	53.9	232.7	46.8	68.8	347.0	69.6	61.3	159.4	46.4	65.6	504.0	28.0
Wheat/Rice residue (150%N)	46.3	180.7	44.1	45.1	156.4	31.8	54.4	259.7	48.3	63.7	324.9	67.8	55.0	162.3	46.8	58.6	432.1	26.9
Wheat/Rice residue (50% N) + GM/GLM (50% N)	43.2	176.4	43.4	50.0	154.9	37.6	57.6	230.5	51.6	63.2	308.9	66.2	56.9	145.2	46.5	58.2	418.7	26.4
Wheat/Rice residue (75% N) + GM/GLM (25% N)	42.2	170.8	42.6	50.6	127.1	33.5	60.1	231.5	52.3	63.2	331.5	64.4	56.3	160.6	46.5	55.3	399.6	27.9
Wheat/Rice residue (50% N) + Vermicompost (50% N)	42.8	173.9	43.0	50.4	216.8	35.8	50.0	209.9	47.1	62.0	305.0	59.5	57.4	154.3	46.2	58.7	441.5	27.0
Wheat/Rice residue (75% N) + Vermicompost (25% N)	41.7	168.9	41.8	44.3	154.9	31.7	54.5	251.4	50.6	61.2	286.5	55.6	55.9	156.9	49.8	54.3	378.3	26.0
Wheat/Rice residue (100% N) + Microbial culture/bonemeal	43.6	178.3	43.8	43.6	126.4	28.4	-	-	-	-	-	-	-	-	-	52.2	403.7	27.6
Wheat/Rice residue (150% N) + Microbial culture/bonemeal	42.5	172.5	42.9	40.1	97.1	35.3	-	-	-	-	-	-	-	-	-	56.4	376.3	26.1
Expt. Mean	**43.0**	**182.7**	**42.8**	**46.1**	**153.24**	**33.0**	**55.3**	**235.5**	**50.2**	**63.0**	**325.3**	**63.9**	**57.7**	**153.6**	**46.2**	**57.3**	**422.3**	**26.7**
CD (0.05)	**3.57**	**8.26**	**4.01**	**8.9**	**50.05**	**4.75**	**7.87**	**39.96**	**9.14**	**2.75**	**43.26**	**3.65**	**3.63**	**17.42**	**NS**	**2.5**	**70.84**	**1.37**
CV (%)	**4.84**	**2.63**	**5.47**	**11.26**	**19.04**	**8.38**	**8.13**	**9.69**	**10.41**	**2.5**	**8.12**	**3.27**	**3.59**	**6.48**	**4.47**	**2.54**	**9.78**	**2.99**

Table: 5.7.5 Residue management in organic rice based cropping systems
Available nutrient status of soils (Kg/ha) (*Kharif* 2018)

Treatment	KNP			KRK			MTU			PNT			Pusa			RPR		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
Control (no fertilizers)	207	19	196	240	59	158	204	49	278	147	10.1	195	174	21	172	113	15	149
RDF	217	26	207	167	43	140	271	65	389	146	10.2	196	209	32	223	138	12	131
Wheat/Rice residue (100%N)	208	20	196	187	81	592	208	67	292	145	10.0	195	203	22	203	151	16	176
Wheat/Rice residue (150%N)	209	20	198	177	81	191	273	67	315	146	10.0	196	208	26	205	138	15	220
Wheat/Rice residue (50% N) + GM/GLM (50% N)	211	22	199	230	58	175	247	74	301	143	10.1	195	215	25	213	151	16	191
Wheat/Rice residue (75% N) + GM/GLM (25% N)	213	24	202	211	68	629	282	70	296	144	10.1	197	214	30	222	138	15	219
Wheat/Rice residue (50% N) + Vermicompost (50% N)	212	23	201	175	46	569	258	63	305	146	10.2	195	208	23	213	163	15	181
Wheat/Rice residue (75% N) + Vermicompost (25% N)	215	25	203	180	58	480	279	58	288	145	10.2	197	214	29	222	151	12	186
Wheat/Rice residue (100% N) + Microbial culture/bonemeal	210	21	199	204	83	571	-	-	-	-	-	-	-	-	-	163	15	205
Wheat/Rice residue (150% N) + Microbial culture/bonemeal	213	23	202	159	75	615	-	-	-	-	-	-	-	-	-	138	12	215
Expt. Mean	**211**	**22**	**200**	**193**	**65**	**412**	**253**	**64**	**308**	**145**	**10**	**196**	**206**	**26**	**209**	**144**	**14**	**187**



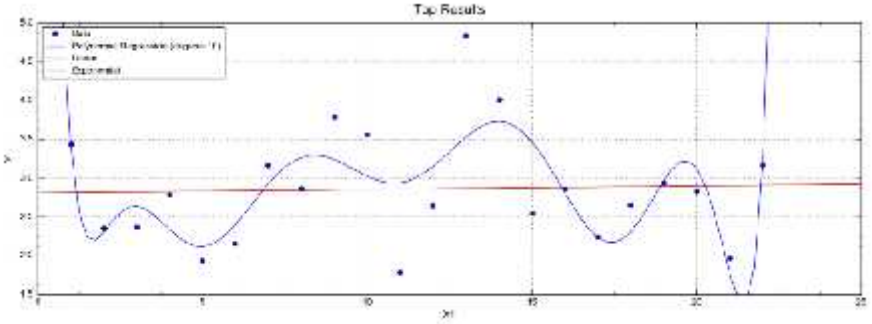
Map showing Soil Science AICRIP Funded and Voluntary centres (2018-19)

Appendix 1

Comparison of different growth models for different treatments (Maruteru)

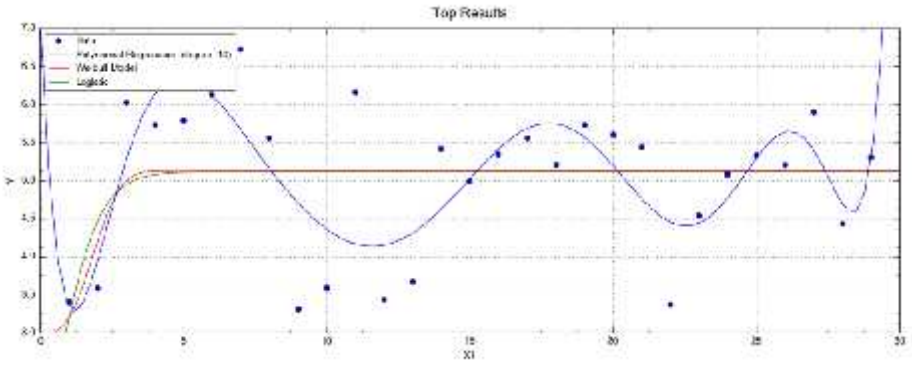
1. Control

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	2.81	4.57	Y= a + bx	0.756	0.0016
Polynomial (Degree =10)	2.02	-35.9, 28.3, -11.5, 2.76, -0.408, 0.0384, -0.00230, 0.0000852, -0.00000176, 0.0000000857	$Y= a + bx + cx^2 + dx^3$+....	0.716	0.5076
Exponential	2.81	1.52	$Y= ae^{bx}$	0.756	0.0015
Logistic	2.97	1.26, 1.90	$Y= a/(1+be^{-cx})$	0.772	0.0110



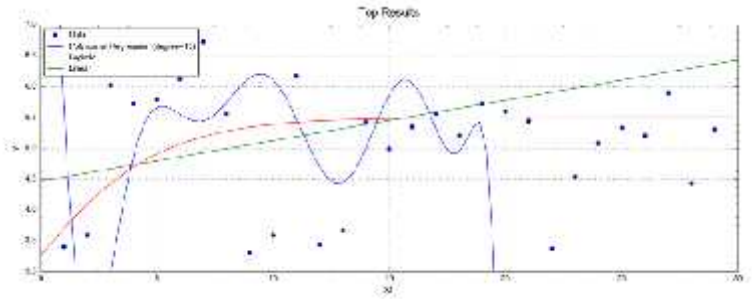
2. 100%NPKSZn

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	4.92	6.68	Y = a=bx	1.012	0.003
Polynomial (Degree =10)	7.09	-8.06, 5.86, -1.83, 0.321, -0.0352, 0.00251, -0.000116, 0.0000033, -0.0000000538, 0.000000000373	$Y =a + bx +cx^2 + dx^3$....	0.86	0.52
Exponential	4.92	1.32	$Y=ae^{bx}$	1.012	0.003
Weibull	5.12	2.15,1.06, 2.96	$Y =a-be^{-cxd}$	0.96	0.16
Gompertz	5.11	5.47, 1.30	$Y =ae-^{eb-cx}$	0.96	0.133
Logistic	5.11	2.55, 1.42	$Y =a/(1+be^{-cx})$	0.96	0.136



3. NPKZNS + FYM

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	4.46	0.0065	Y = a=bx	1.16	0.096
Polynomial (Degree =10)	1.25	-2.24, -10.9, 9.06, -3.10, 0.589, -0.0674, 0.00477, -.0000204, 0.000000487, -0.00000000494	$Y =a + bx +cx^2 + dx^3$....	0.75	0.82
Exponential	4.53	0.012	$Y=ae^{bx}$	1.16	0.09
Logistic	5.49	0.694, 0.348	$Y =a/(1+be^{-cx})$	1.13	0.18



4. FYM alone

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	4.41	-0.0055	Y = a=bx	1.19	0.0018
Polynomial (Degree =10)	13.0	-20.0, 13.0, -3.93, -0.651, -0.0662,	Y =a + bx +cx^2 + dx^3....	0.99	0.48
Exponential			Y=ae^{bx}		
Weibull	4.49	2.29, 0.0673, 2.97	Y =a-be^{-cxd}	1.05	0.17
Gompertz	4.48	0.66, 1.08	Y =ae-$^{eb-cx}$	1.05	0.14
Logistic	4.48	3.57, 1.27	Y =a/(1+be^{-cx})	1.05	0.14

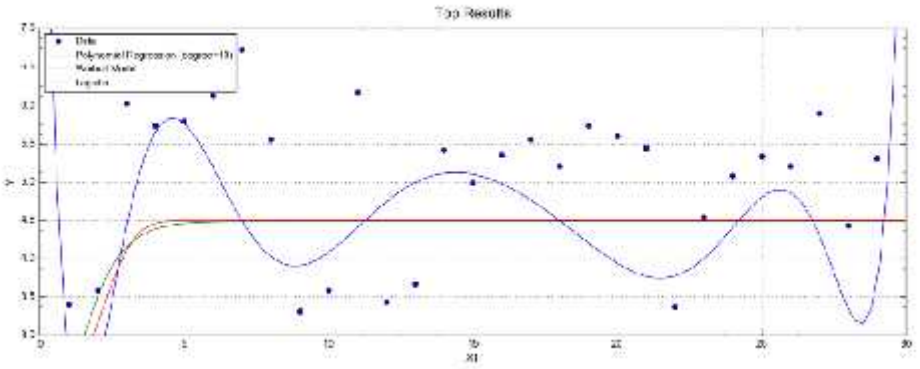
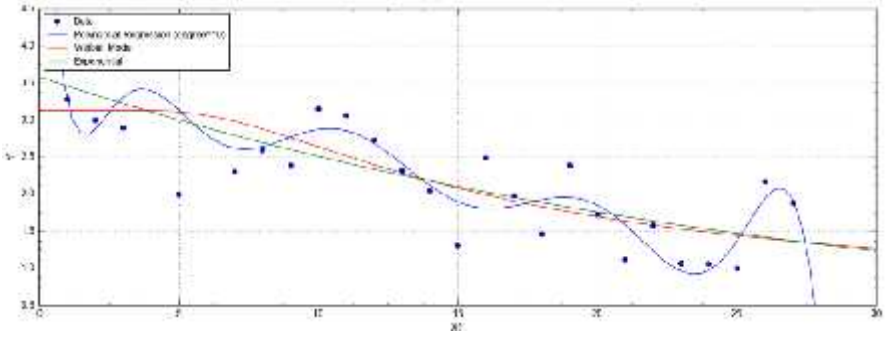


Table : Comparison of different growth models for different treatments (Mandya)

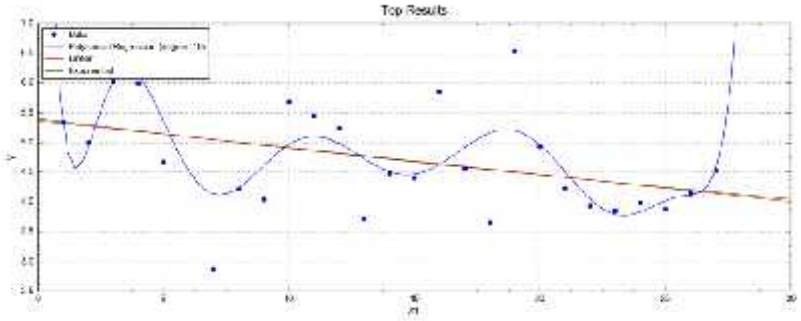
1. Control

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	3.38	-0.080	Y = a=bx	0.56	0.574
Polynomial (Degree =10)	8.67	-10.4, 6.95, -2.25, 0.410, -0.0451, -0.00312, -.000135, 0.0000036, -0.0000000533, 0.00000000033	Y =a + bx +cx^2 + dx^3....	0.576	0.711
Exponential	3.58	-0.0035	Y=ae^{bx}	0.558	0.576
Weibull	3.13	2.51, 56.7, -1.54	Y =a-be^{-cxd}	0.571	0.769
Logistic	-0.0000780	-1.00, -0.00000112	Y =a/(1+be^{-cx})	0.583	0.556



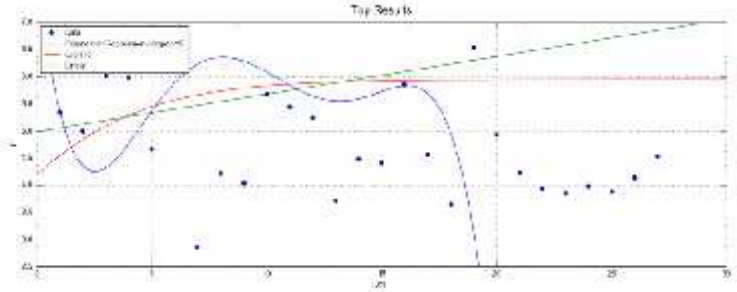
2. NPKZNS

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	5.36	-0.045	Y = a=bx	0.88	0.15
Polynomial (Degree =10)	10.71	-23.9, 16.8, -5.69, 1.07, -0.012, 0.00902, -0.00041, 0.000011, -0.00000018, 0.00000000127	$Y = a + bx + cx^2 + dx^3$....	0.92	0.40
Exponential	5.39	-0.0096	$Y=ae^{bx}$	0.88	0.15
Weibull	5.56	209.4, 7.54, -0.122	$Y = a-be^{-cxd}$	0.92	0.15
Gompertz			$Y = ae-^{eb-cx}$		
Logistic	2.33	-0.572, -0.00935	$Y = a/(1+be^{-cx})$	0.90	0.15



3. asNPKZNS + FYM

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	4.98	0.0691	Y = a=bx	0.77	0.16
Polynomial (Degree =10)	8.02	-3.70, 1.21, -15.4, 0.00846, -0.00016	$Y = a + bx + cx^2 + dx^3$....	0.64	0.59
Exponential	5.03	0.018	$Y=ae^{bx}$	0.77	0.16
Weibull			$Y = a-be^{-cxd}$		
Gompertz			$Y = ae-^{eb-cx}$		
Logistic	5.95	-0.419, -0.301	$Y = a/(1+be^{-cx})$	0.75	0.26



4. FYM alone

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	3.70	-0.032	Y = a=bx	0.90	0.07
Polynomial (Degree =8)	2.47	0.98, -0.234, 0.0284, -0.0014,-0.000027, 0.0000068, -0.00000028, 0.00000000374	$Y = a + bx + cx^2 + dx^3$....	0.99	0.19
Exponential	3.72	0.00768	$Y=ae^{bx}$	0.90	0.07
Weibull	24.4	21.7, 0.0362, 0.255	$Y = a-be^{-cxd}$	0.95	0.08
Gompertz	4.81	-1.22, 0.055	$Y = ae-^{eb-cx}$	0.92	0.08
Logistic	4.78	0.330, 0.0624	$Y = a/(1+be^{-cx})$	0.92	0.08

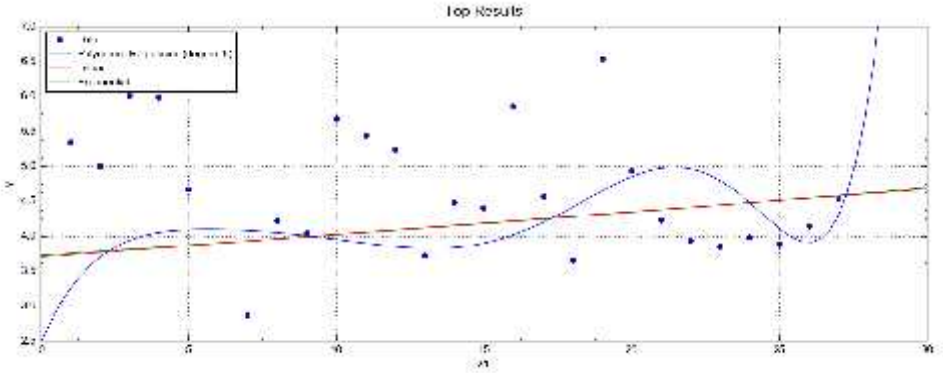
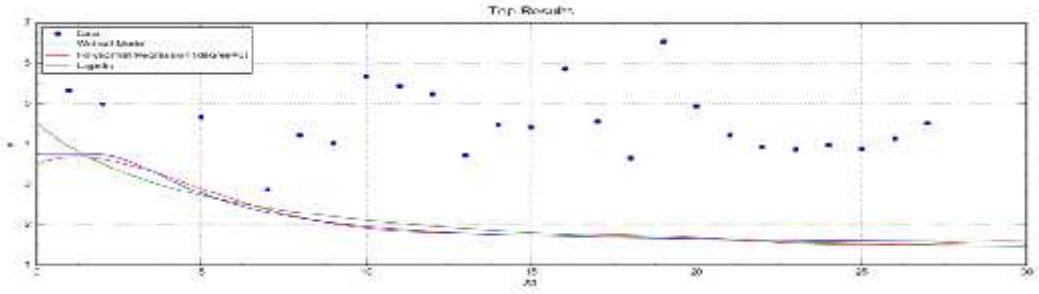


Table : Comparison of different growth models for different treatments (Titabar)

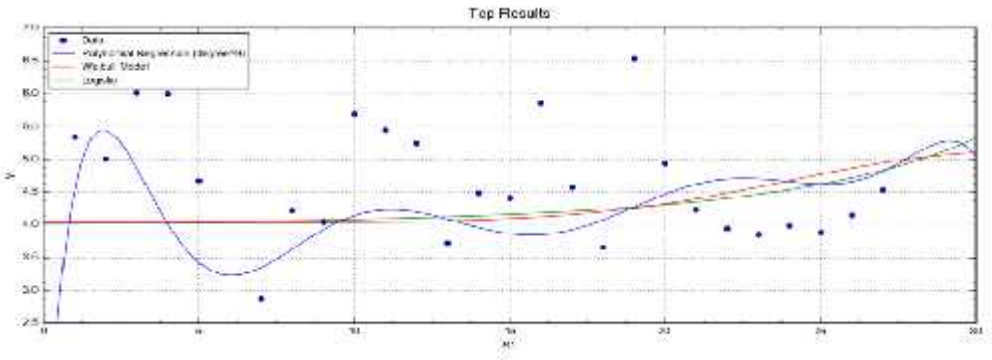
1. Control

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	3.03	-0.064	Y = a=bx	0.47	0.59
Polynomial (Degree =4)	4.31	-0.415, 0.0025, -0.000704, 0.00000752	$Y = a + bx + cx^2 + dx^3$....	0.34	0.81
Exponential	3.38	-0.0364	$Y=ae^{bx}$	0.46	0.68
Weibull	3.76	2.24, 18.1, -1.90	$Y = a-be^{-cxd}$	0.30	0.84
Gompertz	-	-	$Y = ae-^{eb-cx}$	-	-
Logistic	1.29	-0.713, 0.0613	$Y = a/(1+be^{-cx})$	0.339	0.79



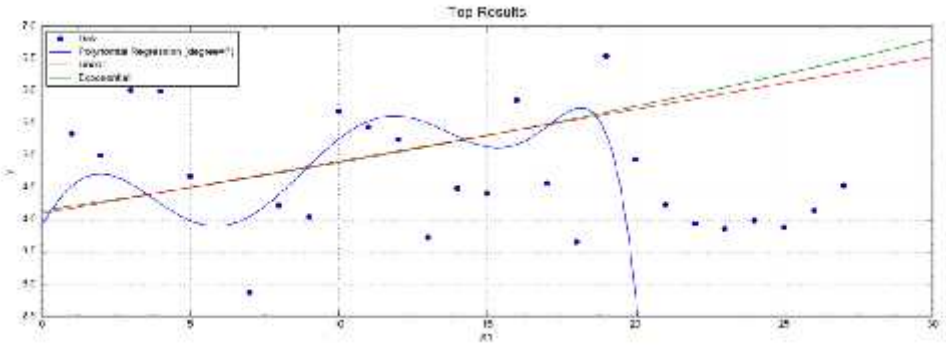
2. NPKSZN

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Polynomial (Degree =10)	-0.286	7.83, -3.82, 0.827, -0.093, -0.00656, -0.00026, 0.0000063, -0.0000000811, 0.00000000041	$Y = a + bx + cx^2 + dx^3$....	0.95	0.33
Exponential	3.48	0.0078	$Y=ae^{bx}$	0.95	0.08
Weibull	5.16	1.13, 0.0000000098, 5.47	$Y = a-be^{-cxd}$	0.95	0.15
Logistic	3.99	-0.0069, -0.123	$Y = a/(1+be^{-cx})$	0.94	0.13



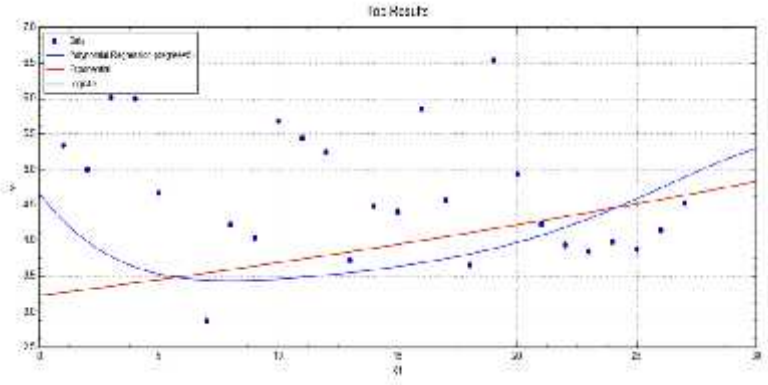
3. NPKSZN + FYM

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	4.09	0.081	Y = a=bx	0.66	0.33
Polynomial (Degree =7)	3.88	0.798, -0.128, -0.066, 0.0207, -0.00215, 0.0000973, -0.00000161	Y =a + bx +cx^2 + dx^3....	0.66	0.57
Exponential	4.13	0.016	Y=ae^{bx}	0.66	0.33
Gompertz	52.6	0.935, 0.0069	Y =ae-$^{eb-cx}$	0.68	0.33
Logistic	13.0	2.16, 0.0266	Y =a/(1+be^{-cx})	0.68	0.33



4. FYM alone

Model	Parameter		Equation	SE	R2 value
	Intercept (a)	Slope (b1,b2,b3...)			
Linear	3.22	0.0498	Y = a+bx	0.48	0.45
Polynomial (Degree =5)	4.66	-0.443, 0.059, -0.00369, 0.00011, -0.00000135	Y =a + bx +cx^2 + dx^3....	0.35	0.76
Exponential	3.22	0.0134	Y=ae^{bx}	0.47	0.49
Logistic	950388.1	294810, 0.013	Y =a/(1+be^{-cx})	0.48	0.49



Scientists involved in Soil Science Co-ordinated Programme 2018-19 (Appendix II)

S.No	State	Organization	Location	Name	Designation	Telephone	E-mail
Funded centres							
1	Andhra Pradesh	ANGRAU	Maruteru	Dr. A. Sireesha	Scientist	09441415808	siridevaharshini@gmail.com
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3	Bihar	RAU	Pusa	Dr. Pankaj Singh	Jr. Scientist	09430998401	pankaj.singh30@gmail.com
4	Karnataka	UAS	Mandya	Dr. Umesh	Jr. Scientist	09481191754	umeshhr1@rediffmail.com
5	Kerala	KAU	Moncompu	Dr. Reena Mathews	Assistant Professor	09446494769	reenajose86@yahoo.co.in
6	Puducherry	PJNCOA&RI	Karaikal	Dr. A. Bhaskar Dr. L.Aruna Mohan	Professor & Head Assistant Professor	09443165382 094877 31178	baskara59@gmail.com marunassac@gmail.com
7	Uttar Pradesh	CSAUAT	Kanpur	Dr. B. N. Tripathi	Jr. Soil Scientist	09935649510	dr.bnt1957@gmail.com
8	Uttarakhand	G.B.P.U.A &T	Pantnagar	Dr. A .K. Pant	J.R.O.	09412419872	akpsoil@yahoo.com
Voluntary Centres							
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2	Chattisgarh	IGKV	Raipur	Dr. Anurag	Professor	09329602206	anuragscientist@gmail.com
3	Puducherry	PKKVK	Kurumbapet	Dr. V. PrabhuKumar	Incharge	09489052303	Prabhukumar80@yahoo.com
4	Uttar Pradesh	NDUAT	Faizabad	Dr. Alok pandey	Asst. Professor	09450763127	alokpandey13ster@gmail.com
5	West Bengal	Govt. of WB	Chinsurah	Dr. Malay Kumar Bhowmick	Assistant Agronomist	09434239688	bhowmick_malay@rediffmail.com
6	Jharkhand	RAU, Ranchi	Ranchi(Dumka)	Dr. Purnendu B. Saha	Soil Scientist	09934525212	saha_purnendu@yahoo.com
7	Jharkhand	CRURRS	Hazaribagh	Dr. Bibhash Chandra Verma,	Scientist	9863083855	*Bibhash.ssac@gmail.com*
8	Uttar Pradesh	Crop Research Station	Ghaghraghat	Dr. Tejendra Kumar	Senior Soil Scientist	09415560503	*tejendra.kumar3159@gmail.com*
Head quarters							
1	ICAR	ICAR -IIRR	Hyderabad	Dr. K. Surekha	Principal Scientist	09440963382	surekhakuchi@gmail.com
2	ICAR	ICAR -IIRR	Hyderabad	Dr. M.B.B. Prasad Babu	Principal Scientist	09666852265	mbbprasadbabu@gmail.com
3	ICAR	ICAR -IIRR	Hyderabad	Dr. D.V.K. Nageswara Rao	Principal Scientist	09502382943	dvknrao@gmail.com
4	ICAR	ICAR -IIRR	Hyderabad	Dr. Brajendra	Principal Scientist	08247820872	briju1973@rediffmail.com
5	ICAR	ICAR -IIRR	Hyderabad	Dr. P.C. Latha	Principal Scientist	09866282968	lathapc@gmail.com
6	ICAR	ICAR -IIRR	Hyderabad	Dr. Bandeppa	Scientist	09555871091	bgsonth@gmail.com
7	ICAR	ICAR-IIRR	Hyderabad	Mr. Gobinath, R.	Scientist	09971720207	gnathatr@gmail.com
8	ICAR	ICAR-IIRR	Hyderabad	Dr. Manasa, V.	Scientist	08762497942	vakadamanasa@gmail.com

List of cooperating centers of Soil Science and allotment of trials - 2018-2019 (Appendix III)

S.No	Locations	Trial 1		Trial 2	Trial 3		Trial 4	Trial 5		Trial 6		Trial 7		Total		Total Allotted	Total Conducted	Conducted %
		K	R	K	K	R	K	K	R	K	R	K	R	K	R			
1	Kanpur (F)	-	-	-	X	X	-	-	-	-	-	X	-	2	1	3	3	100
2	Maruteru (F)	X	X	X	-	-	-	X	-	-	-	X	-	4	1	5	5	100
3	Titabar (F)	X	X	X	-	-	X	-	-	X	-	-	-	4	1	5	5	100
4	Chinsurah (V)	-	-	X	-	-	-	X	-	X	X	-	-	3	1	4	4	100
5	Faizabad (V)	-	-	X	X	-	-	X	-	NC	-	-	-	4	-	4	3	75
6	Karaikal (F)	-	-	X	-	-	-	X	-	-	-	X	-	3	-	3	3	100
7	Khudwani(V)	-	-	-	-	-	-	X	-	-	-	X	-	2	-	2	2	100
8	Mandya(F)	X	-	-	X	-	-	X	-	-	-	-	-	3	-	3	3	100
9	Moncompu(F)	-	-	NC	-	-	NC	NC	-	-	-	-	-	3	-	3	0	00
10	Puducherry (V)	-	-	-	-	-		X	-	X	-	-	-	2	-	2	2	100
11	Dumka (Ranchi)(V)	-	-	-	-	-	X	-	-	-	-	-	-	1	-	1	1	100
12	Raipur(V)	-	-	-	-	-	X	NC	-	-	-	X	-	3	-	3	2	67
13	Pusa(F)	-	-	-	-	-	-		-	-	-	X	-	1	-	1	1	100
14	Pantnagar(F)	-	-	X	-	-	-	X	-	NC	-	X	-	4	-	4	3	75
15	Hazaribagh(V)	-	-	-	-	-	X	-	-	-	-	-	-	1	-	1	1	100
16	Ghaghraghat(V)	-	-	X	-	-	-	-	-	-	-	X	-	2	-	2	2	100
	Total allotted	3	2	8	3	1	5	10	0	5	1	8	0	42	04	46	40	87

K – kharif R- Rabi; F – Funded center V – Voluntary center X-Conducted NC-Not conducted

Trial No.1: Long- term soil fertility management in rice – based cropping systems (RBCS) (*Kharif and rabi*)

Trial *No.*2: Soil quality and productivity assessment for bridging the yield gap in farmers' fields (*Kharif)*

Trial No.3: Screening of germplasm for sodicity and management of sodic soils in RBCS (*Kharif and rabi)*

Trial No.4: Screening of rice genotypes for tolerance to soil acidity and related nutritional constraints (*Kharif)*

Trial No.5: Yield maximization of rice in farmers' fields using Nutrient expert software (*Kharif* and *rabi*)

Trial No.6: Bio-intensive pest management (BIPM) in rice under organic farming (*Kharif* and *rabi)*

Trial No.7: Residue management in organic rice based cropping system

ACKNOWLEDGEMENTS

Our thanks are due to the scientists of different co-operating centres for the conduct of trials and timely reporting of soil science coordinated programme. We thank the technical staff of Soil Science department ***Sri CH. Sivanarayana*** *and Sri* ***C. Muralidhar Reddy*** *for their unstinted support in the conduct of trials at IIRR and data compilation. We are extremely thankful to* ***Dr. B. Sailaja****, Principal Scientist (Computer Applications),* ***Dr. Santhosha Rathod****, Scientist, Agricultural Statistics, IIRR and Smt. S. Gayathri for their support in statistical analysis of data and preparation of map and the adhoc staff (Ms. Humera Quadriya, Mr. S. Mahesh and Mr. G. Srikanth) of the department for their assistance in field studies and laboratory analysis. We also thank Sri* ***K. Ramulu****, Technical Officer, Plant Physiology Section for the help in formatting, page setting and printing of the progress report.*

PLANT PHYSIOLOGY

6. PLANT PHYSIOLOGY

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3	Screening for elite rice culture for drought tolerance	6.29
4.	Evaluation of rice genotypes for terminal heat stress tolerance suitable for future climate	6.50
5.	Physiological characterization of selected rice genotypes for Multiple abiotic stress tolerance	6.78
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7.	Screening of elite rice germplasm for low-light stress tolerance	6.127
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6. Plant Physiology

Summary

Physiological studies under All India Co-ordinated Rice Improvement Program were conducted at eight funded centres, (Coimbatore, Maruteru, Pantnagar, Pattambi, Rewa, Raipur, Karjat and Titabar), two ICAR institutions (IIRR Hyderabad and NRRI Cuttack) and six voluntary centres (RARS Chinsurah, NDUAT Faizabad, PJNAR Karaikal, RARS Karjat, IGKV RAIPUR and BAU Ranchi). The trials conducted during 2018 are given as below.

Star Chart of Plant Physiology Coordinated Studies for the Year Kharif 2018

Locations	Trials						Allotted	Conducted	Conducted (%)	Not conducted	Grand Total
	Silicon	Heat Tolerance	RFU	MAS	RNUE	LLS					
CHN	√	√	-	-	-	-	2	2	100	-	2
CBT	√	-	-	√	√	-	3	3	100	-	3
NRRI	√	-	√	-	-	√	3	3	100	-	3
IIRR	√	√	-	√	√	√	5	5	100	-	5
FZB	-	-	√	-	√	-	2	1	50	1	1
KJT	√	-	-	√	√	√	4	4	100	-	4
KRK	√	-	-	√	-	-	2	2	100	-	2
MTU	√	√	-	√	√	√	5	5	100	-	5
PNR	√	√	-	-	√	√	4	4	100	-	4
PTB	√	√	√	√	√	-	5	5	100	-	5
REWA	-	√	√	√	-	-	3	3	100	-	3
TTB	√	√	-	√	√	√	5	5	100	-	5
RPUR	-	-	√	-	√	√	3	3	100	-	3
RANCHI	√	-	√	√	-	-	3	3	100	-	3
Total	**11**	**7**	**6**	**9**	**9**	**7**	**49**	**48**		**1**	**49**

The salient findings of the experimental research are presented below:

6.1 Influence of silicon solubilises on induced stress tolerance in rice genotypes

In view of the importance of silica in rice nutrition, a trial was conducted at different AICRIP locations spread across the country. The experimental lay-out was split-plot with three replications. The treatments include T1= Control (water spray), T2=0.8% silixol, T3 = Silixol + water stress, T4=Water stress. Water stress was imposed after PI stage by withholding irrigation. The results revealed that application of silicon (T2) resulted in >9% increase in mean grain yield (mean of all varieties & locations). Imposition of water stress (T4) resulted in >20% reduction in mean grain yield. Maximum yield improvement was observed in US-312 , KRH-4 (>14%) over control treatment (T1) and PA-6444 (12% over control). No improvement in yield was observed in case of Sahabhagidhan and the improvement is only minor (<5%) in PA-6129. Imposition of water stress had resulted in substantial yield loss in all the varieties. The mean grain yield (mean of all varieties and locations) was reduced by>20% over control by water stress. Maximum yield loss was observed in Sahabhagidhan followed by HRI-174. Minimum yield loss was observed in KRH-4 and PA-6444. Silicon application on plant undergoing water stress (T3) had resulted in partial mitigation of negative impact of water stress and significant genotypic differences were observed. The reduction in yield loss due to silicon application was higher (> 9% over

T4) in PA-6129, Sahabhagidhan and HRI-174. The mitigation was marginal in PA-6444 and US-413

6.2 Screening of elite rice cultures for drought tolerance:

A trial to study the drought tolerance traits of rice cultures with respect to yield and other attributes under dry spells was conducted with 22 AVT entries and 8 released varieties at 5 AICRIP centres. The treatments consisted of two irrigation regimes a. Irrigated as per the recommended schedule and one totally rain fed condition without any supplementary irrigation. The reduction in grain yield was highest in IET 27524, Tulasi, IET27510 and IET 27509. In fact, very few entries IET 27515, Sahabhagidhan and IET 27525 showed yield reduction <50% over irrigated control. All other entries suffered substantial yield losses under rain fed condition. The variety Govind produced highest yield followed by IET 27514, IET 27522, IET 27520, IET 27525, IET 27519 and Sammaleswari under rainfed condition and may be considered as relatively suitable for rainfed condition. The data revealed that Govind, IET 27514, IET 27522, IET 27515, IET 27517, IET 27519, IET 27520 and IET 27525 have high Mean Rank with low SEm and they may be considered as relatively drought tolerant and are suitable for rain fed cultivation.

6.3 Evaluation of rice genotypes for terminal heat stress tolerance suitable for future climate

Covering the field grown crop at PI stage with polythene increased the temperature and crop is exposed to elevated temperature from PI stage to maturity. The mean grain yield recorded for all varieties and locations was reduced by >25% under elevated temperature regime. Under elevated temperature the grain yield varied between 315 g m^{-2} (IET 26790) to 472 g m^{-2} (IET 25713). The mean grain yield *(mean of all genotyps)* varied between locations. The percent reduction in grain yield under elevated temperature is minimum (>5% over control) at HAT where as the reduction in grain yield was highest at REWA (>66% over control) followed by PTB (>60% reduction over control). Based on percent reduction in yield under elevated temperature condition **IET 26780** and **IET 25713** show <15% yield reduction in comparison with ambient control condition, where as IET 26790 and IET 26465 followed by Sahabhagidhan show >35% yield reduction under elevated temperatures. Based on the yield indices computed from yield recorded under control and elevated temperature conditions, the genotypes IET 26804, IET 26799, IET 26756 and MTU 1153 showed high rank value and low SE. The genotypes with low ASV are said to be stable and CO-51 followed by IET 26804 and IET 26807 are having low ASV value and can be identified as stable genotypes under elevated temperature. However, CO-51 yield averaged across the locations is less than the mean grand yield where as both IET 26804 and IET 26807 yielded slightly higher than the grand mean yield. In this trial IET 26468 ranked first in stability followed by IET 26468, IET 26477 and IET 24911.

6.4 Physiological characterization of selected rice genotypes for multiple abiotic stress Tolerance

MAS tolerance of traditional cultivars are more tolerant to abiotic stresses, but these cultivars possess poor agronomical traits such as photosensitivity, poor grain quality and are low yielding. Hence, an effort was made to identify rice cultivars which may be resistant to more than one stresses at a given point of time. In the present study attempts were made to screen 21 entries for multiple abiotic stress (MAS). Entries, IET 26487, IET 26493, BPT 2782, Karjat7 and Lalat are identified as promising for multiple abiotic stress (MAS). However, the study reveals that entries with MAS tolerance are very few and it was observed that the different entries performed differently under stress induced conditions.

6.5 Evaluation of Radiation and Nitrogen use efficient promising rice genotypes

Nitrogen (N) nutrition affects all levels of plant function from metabolism to resource allocation, growth. Nitrogen use efficiency (NUE) in plants is a complex phenomenon that depends on a number of internal and external factors, which include soil N availability, its uptake and assimilation of carbon and nitrogen. The highest grain yield averaged across the locations was produced by *Varadhan x BPT 5204/10* (413 g m^{-2}) followed by *Sampada x Jaya/3* (408 g m^{-2}) under 0 kg N ha^{-1} where as under 50 kg N ha^{-1} highest mean grain yield was produced by Sampada x Jaya 3 (543 413 g m^{-2}) followed by Sampada x Jaya/2 (523 g/m^{-2}) and Varadhan x BPT 5204/10 (509 g m^{-2}). Entries producing higher grain yield under low nitrogen levels can be considered as nitrogen use efficient genotypes. The AMMI biplot analysis was conducted for both 0 and 50% RDBN revealed that MTU, KJT, PNR, CBT locations are similar and do not exert significant environmental effect. Sampada x Jaya/3, Varadhan x MTU1010/2 and Rasi x Jaya/2 are less affected by environments. The genotypes with low ASV are said to be stable. The rASV was lowest in Sampada, Sampada x Jaya/3 followed by MTU 1010 0 kg N ha^{-1} and under 50 kg N ha^{-1} treatment, the ASV is lowest in Varadhan x BPT 5204/10 followed by MTU and Sampada. The genotypes having low ASV value and can be identified as stable genotypes under low nitrogen levels. Based on yield stability index (rYSI) values Varadhan x BPT 5204/10 and Sampada x Jaya/3 can be identified as stable genotypes under 0 kg N ha^{-1} where as under 50 kg N ha^{-1} Sampada x Jaya/3, Sampada x Jaya/2 followed by Varadhan x BPT 5294/10 can be identified as stable genotypes across the environments.

6.6 Screening of rice varieties for tolerance to low light stress

Light intensity is one of the most important environmental factors that determine the basic characteristics of rice development. . In view of the importance of low light tolerance in rice crop a new trial was formulated during the 51st Annual Rice workers Group Meeting of AICRIP held at IGKVV, Raipur. During this year 15 AVT entries were tested at 7 locations. The mean grain yield was reduced by 45% under low light treatment. Maximum reduction in grain yield under low light treatment was observed at NRRI followed by RPR and PNR where the reduction in grain yield is >50%. The reduction in grain yield was highest in IET 27543 followed by IET 27563 and IET 27550. The reduction was minimum in case of

IET 27559 (>27% reduction) over control. In case of the remaining genotypes the reduction in grain yield is very high <35% over control, suggesting that none of the tested genotypes are tolerant to low light stress. Amongst the 15 entries tested only IET 27559 showed relative tolerance to low light stress.

6.1 Influence of silicon on induced stress tolerance in rice genotypes

Locations: CBT, NRRI, IIRR, KJT, MTU, PNR, PTB, RANCHI and TTB

Silicon (Si) is the second most abundant element of the earth's crust after oxygen. It has long been neglected by ecologists, as it is not considered as an essential nutrient for plants. Rice exhibits the greatest uptake of silicic acid in the grass family. With the application of large quantity of silicon fertilizers, rice can accumulate silicon in the stem and leaves up to 10- 15% of its dry weight. Rice depends mainly on its root system to absorb moisture and most of the minerals. In view of the importance of silica in rice nutrition, a trial was conducted at different AICRIP locations spread across the country to investigate the role of silicon in plant nutrition and increasing productivity of rice with 6 rice varieties including hybrids and one Sahabhagidhan at 9 locations with the objective to study the effect of silicon (silixol @400ml in 200 litres/acre (as spray) were used at active tillering, panicle initiation, 50% flowering and milky grain stages. The experimental lay-out was split-plot with three replications. The treatments include T1=Control (water spray), T2=0.8% silixol, T3=Silixol + water stress, T4=Water stress. Water stress was imposed after PI stage by withholding irrigation.

The mean days to flowering (mean of all locations and genotypes) was not significantly affected by silicon application and water stress (Table 6.1.1). The mean days to flowering (DF) is 93, 93, 94, and 83 days, respectively at Control, T1, T2, T3 and T4. Imposition of water stress had decreased DF from 93 to 83 days, but by combining water stress and Silicon application (T3), water stress effect was nullified (Table 6.1.1 and Fig. 1). The interaction between Location x treatment was found to be significant ($p<0.01$). With the exception of NRRI, treatments show no significant effect on the mean days to flowering. However, at NRRI the treatments T3(Water stress+Slicon), and T4(water stress) had resulted in postponement of flowering significant genotypic differences were observed. In all varieties DF has not changed significantly by the silicon application. However, imposition of water stress (T4) had resulted in postponement of flowering by 7-10 days. Silicon application in combination with water stress (T3) could restore the days to flowering at par with control treatment.

Days to maturity (DM) was not significantly affected by the treatments (silicon+water stress+ and silicon and water stress) (Table 6.1.2). However, imposition of water stress (T4) had resulted in reduced growth period and the DM had reduced to 110 days from 123 days under control (T1). Silicon application had not altered the DM by T2, but application of silicon in combination with water stress had restored the days to maturity at par with control treatment (T1) thus silicon application can be beneficial to rice plant as it is helping the plants to overcome the adverse effects of water stress. The interaction between Location x Treatment was found to be significant ($p<0.01$). The mean (average of all treatments and genotypes) days to maturity varied from 116 days (KRK) to 128 days(IIRR). Significant differences were observed among the tested genotypes. The mean days to maturity varied between 115 days (Sahabhagidhan) to 122 days (KRH-4, and HR-174) (Table 6.1.2). The

interaction between Location x variety was also found to be significant ($p<0.01$). However, the interaction between genotype x treatment was non-significant (Table 6.1.2).

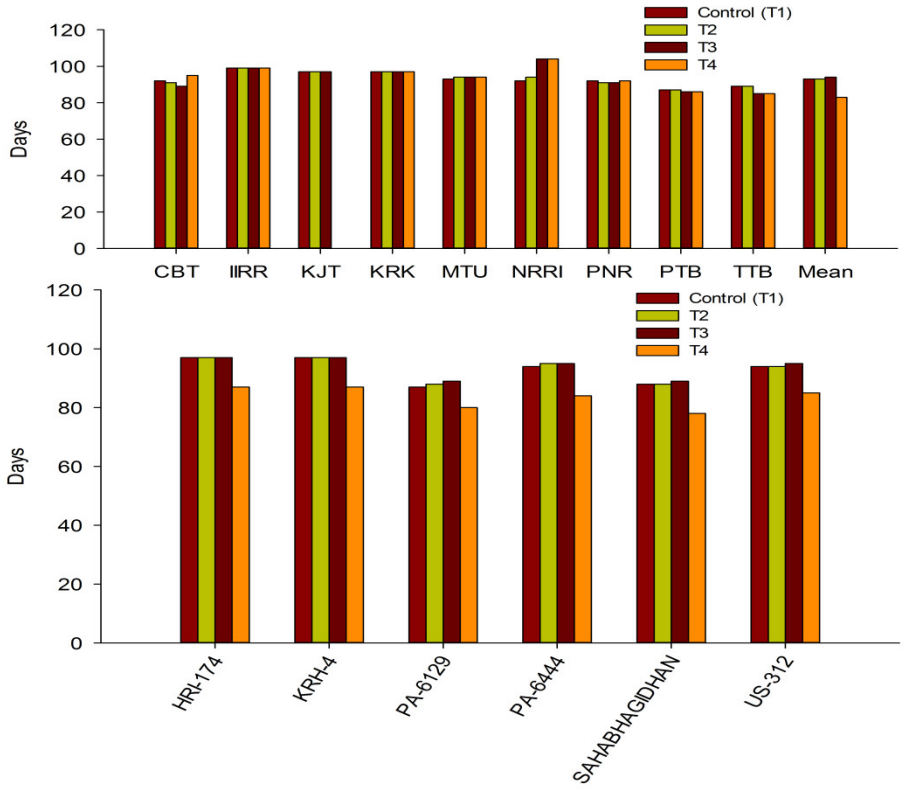


Fig. 1 Influence of silicon application and water stress on days to flowering of selected rice varieties. Each value represents the mean of 3 replications.

Plant height was not significantly affected by the treatments. The mean plant height under control treatment is 104 cm where as under silicon application, the mean plant height was 105.6 cm, whereas under water stress treatment (T4) the mean plant height was reduced to 87.7 cm. When water stress and silicon were applied together the mean plant height was partially improved to 99.2 cm. Nevertheless, the analysis of variance indicated that the treatments had not significantly affected the mean plant height. Furthermore, the interaction between Location x Treatment was found to be highly significant ($p<0.01$) implying that the applied treatment effect varied amongst the locations. The mean plant height (mean of all genotypes) varied between 67.4 cm (Ranchi) to 136 cm (MTU) followed by PNR (118 cm). Significant ($p<0.01$) differences were observed amongst the genotypes included in this study. The mean plant height (mean of all locations and treatments) varied between 92.3 cm (PA-6129) to 108.5 cm (KRH-4). However, the interaction effect between Treatment x Variety was statistically non-significant *(Table 6.1.3)*.

No. of tillers/m^2 is one of the important yield contributing traits. Analysis of variance indicated that the effect of treatments in the present study had not significantly affected the number of Tillers/m^2. The interactive effect of Location x Treatment was found to be significant ($p<0.01$) indicating that the treatment response differed between locations. The

mean Tiller number (mean of all treatments and varieties) varied between 197 (KJT) to 406(CBT) with a mean of 270 Tillers/m^2. The differences between the varieties for number of Tillers/m^2 was statistically non-significant. However, the interaction between Location x Genotype was statistically significant ($p<0.01$) indicating that the genotypes behaved differently between locations. The mean panicles/m^2 was highest in PA-6444 (281) and US-312 had minimum number of Tillers (260) (Table 6.1.4).

Table 6.1.5 presents the data pertaining to the effect of silicon application on stem weight (g m^{-2}) recorded at maturity. Analysis of variance revealed that the treatments had no significant influence on mean stem weight (Table 6.1.5). However, the interaction between Location x Treatment was statistically significant ($p<0.01$) indicating that the effect of treatment on stem weight varied across the locations. The mean stem weight (mean of all genotypes and treatment)varied from 499 g m^{-2} (NRRI) to a maximum of 1361 g m^{-2} at PTB centre. The treatments (silicon, WS+Silicon+WS) had no significant impact on mean stem weight at CBT, IIRR, KJT, RANCHI and TTB centres (Fig.2). Application of silicon had resulted in a minor but non-significant increase (3% over control) in mean stem weight (Fig.2B). Imposition of water stress (T4) resulted in >17% reduction in mean stem weight. However, under T3 (Silicon +WS), application silicon to water stressed crop had resulted in amelioration of stem weight reduction.

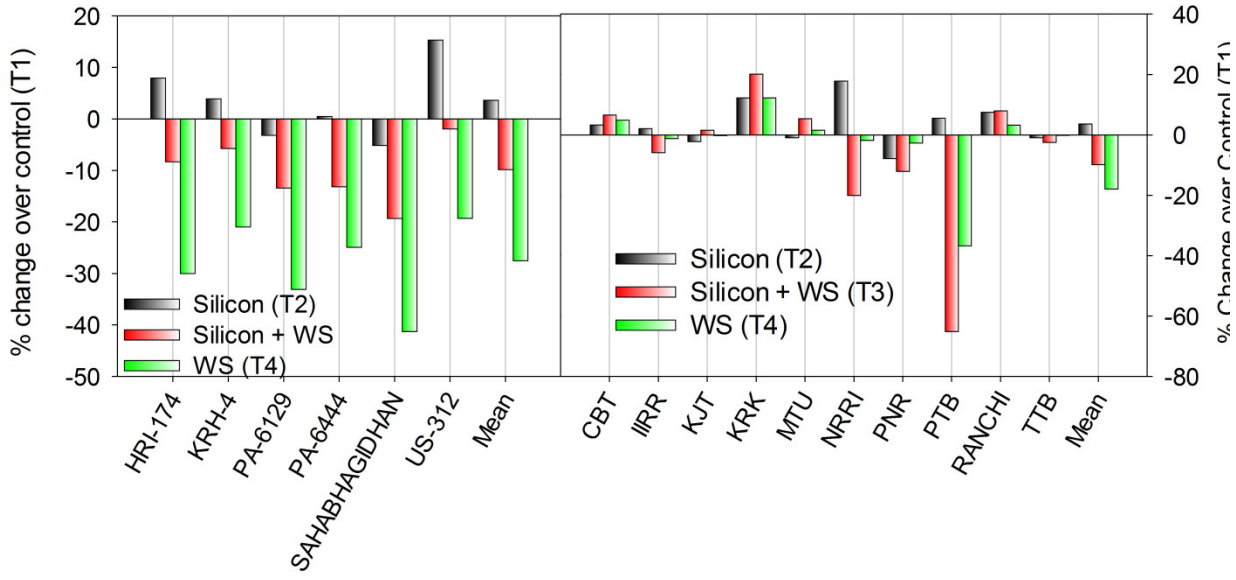


Fig. 2 Influence of silicon and water stress treatment on mean stem weight in selected rice varieties. [A] Mean of all locations [B] Mean of all genotypes. Each bar represents % change in stem weight over control treatment (T1)

The interaction between Treatment x Variety was found to be non-significant (Table 6.1.5). Significant ($p<0.01$) differences were observed among the varieties. The mean stem weight was highest in KRH-4 with 1065 g m^{-2} and minimum mean stem weight was recorded in Sahabhagidhan (695 g m^{-2}). Silicon application (T2) had a positive effect on mean stem weight. The positive response is more pronounced in case of US-312 (15% increase over

control) followed by HRI-174 (>7% increase over control). However, PA-6129 showed a marginal reduction in mean stem weight (mean of all locations).

No. of panicles m^{-2} is one of the important yield contributing trait. The data pertaining to No. of panicles m^{-2} was presented in Table 6.1.6. The data revealed that the treatment effect on this trait is statistically non-significant. However, the interaction between Location x Treatment is highly significant ($p<0.01$) indicating that the treatment effect varies from location to location. The mean (mean of all treatments) varies from 478 (IIRR) to 191 (KJT). The differences between the genotypes for mean No. of panicles m^{-2} was non-significant. However, the interaction between Location x Genotype was significant ($p<0.01$) implying that the genotype response varied from location to location *(Table 6.1.6)*. Results of Analysis of variance also revealed that the interaction between *Treatment x Variety* was also statistically non-significant. Nevertheless, mean (mean of all treatment) of No. of panicles m^{-2} varied from 321 (KRH-4) to a minimum of 299 (US-312). Silicon application (T2) showed positive influence on No. of panicles m^{-2} in HRI-174 (>8% increase over control) and US-312 (>7% increase). However, in case of Shahabaghidhan >11% reduction in No. of panicles m^{-2} was observed. The response in the remaining varieties is negligible *(Fig.3)*

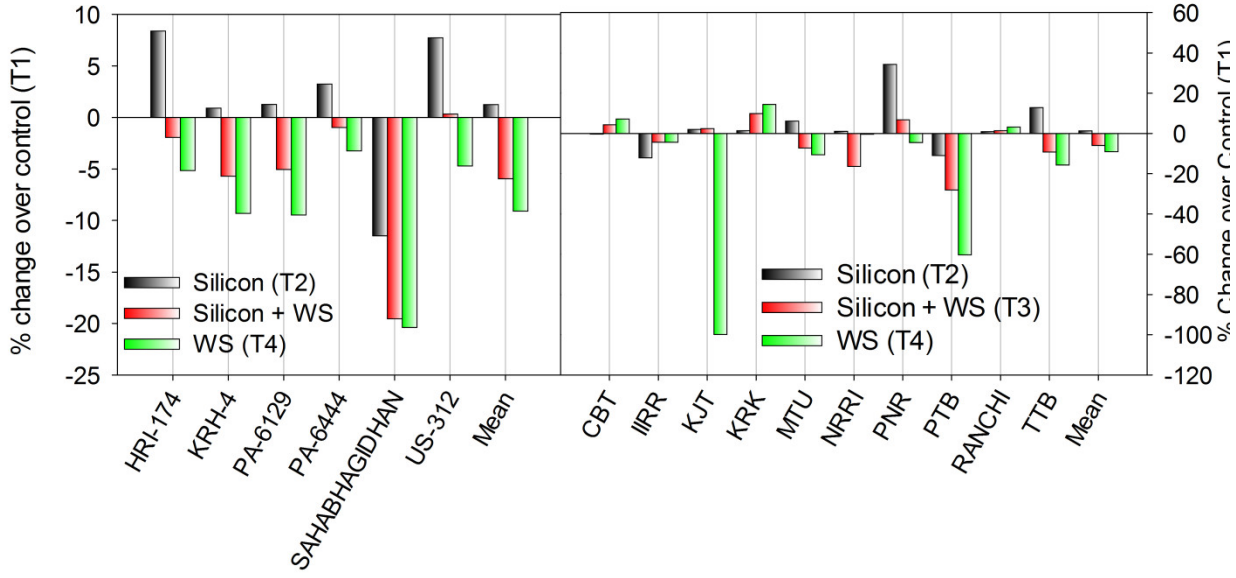


Fig.3 Influence of silicon application and water stress on No. of panicles m^{-2} [A] Mean of all locations [B] Mean of all varieties. Each bar represents % change over control treatment (T1)

Imposition of water stress (T4) during reproductive stage resulted in reduction in No. of panicles m^{-2}. The mean No. of panicles m^{-2} (Mean of all varieties) was reduced by >9% over control treatment (T4). Maximum reduction (>20% over control) was noticed in Sahabhagidhan followed by KRH-4 and PA-6129 (>9% over control). Silicon application to crop undergoing water stress (T3) could partially reverse the reduction in No. of panicles m^{-2} by water stress (*Fig.3)*.

Panicle weight m^{-2} is an important yield trait which was significantly ($p<0.01$) affected by the imposed treatments *(Table 6.1.7)* Application silicon (T2) had significantly ($p<0.01$) increased the mean (mean of all varieties and locations) Panicle weight m^{-2} by >16% over control treatment (T1). Similarly, imposition of water stress (T4) resulted in significant reduction (>16% over control). Silicon application on crop undergoing water stress (T3) had resulted in significant recovery from the negative effect of water stress imposition. Significant varietal differences were noticed *(Fig.4)*

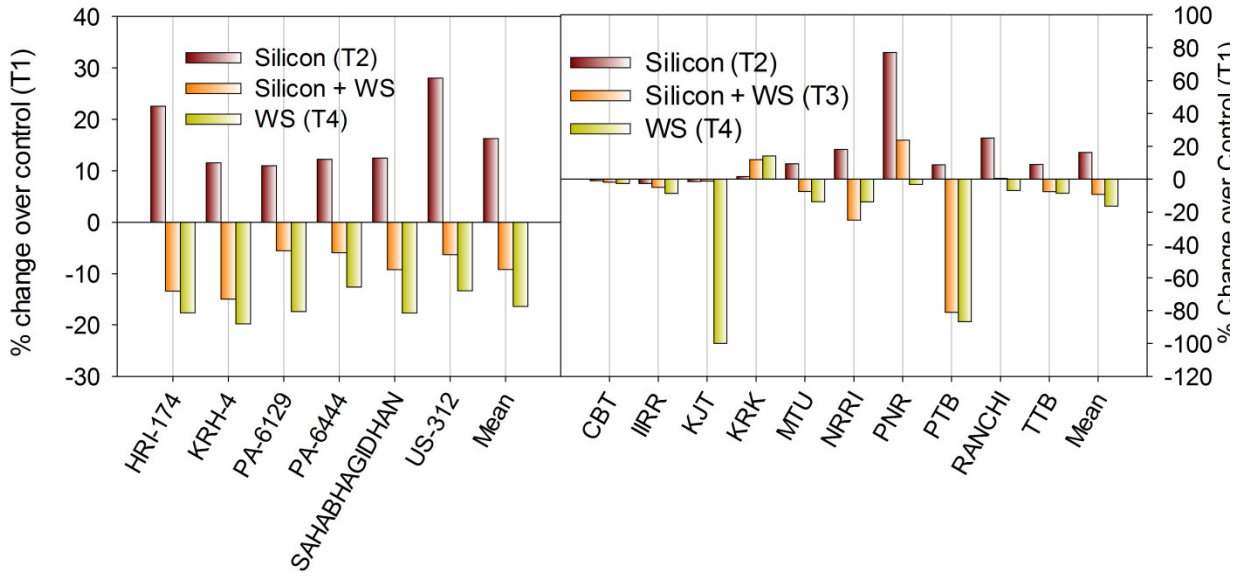


Fig. 4 Influence of silicon application and water stress on Panicles weight(g) m^{-2} [A] Mean of all locations [B] Mean of all varieties. Each bar represents % change over control treatment (T1)

The interaction between Location x Treatment was found to be significant ($p<0.01$). The mean (mean of all varieties and treatments) varied between 1525 g (PNR) to 442 g (Ranchi) with a mean of 774 g *(Table 6.1.7)*. The extent of treatment effect varied between the locations. At CBT, IIRR centres the effect is only marginal. Silicon application (T2) had resulted in an increase in Panicle weight (g), the effect was more pronounced at PNR and Ranchi where the increase is >20% over T1. Moderate increase in panicle weight was observed at NRRI (>18%), PTB and TTB. Whereas the change is negligible in case of CBT, IIRR and KJT (*Fig.4B)*. Varieties also differ in their response to silicon application, the change in panicle weight due to silicon application is maximum in US-312 (28% over control) followed by HRI-174 (22% over control) in all the remaining varieties the increase is >10% over control (T1).

Number of grains per panicle is very important yield related traits which affect the final grain yield in rice. The data pertaining to the number of grains per panicle was presented in (Table 6.1.8). The data revealed that the treatments have no significant influence on mean (average of all locations & varieties) No. of grains $Panicle^{-1}$. However, the interaction of Location x Treatment is highly significant ($p<0.01$) implying that the treatment

effect differs from centre to centre. The mean (mean of all varieties and treatments) No. of grains Panicle^{-1} varied between 236 (PNR) followed by TTB (157 grains) to 64 (Ranchi) and PTB (80 grains Panicle^{-1}) with a mean of 128. Application of silicon (T2) had resulted in an increase (>9% over control,T1) in mean (average of all locations) No. of grains Panicle^{-1}.

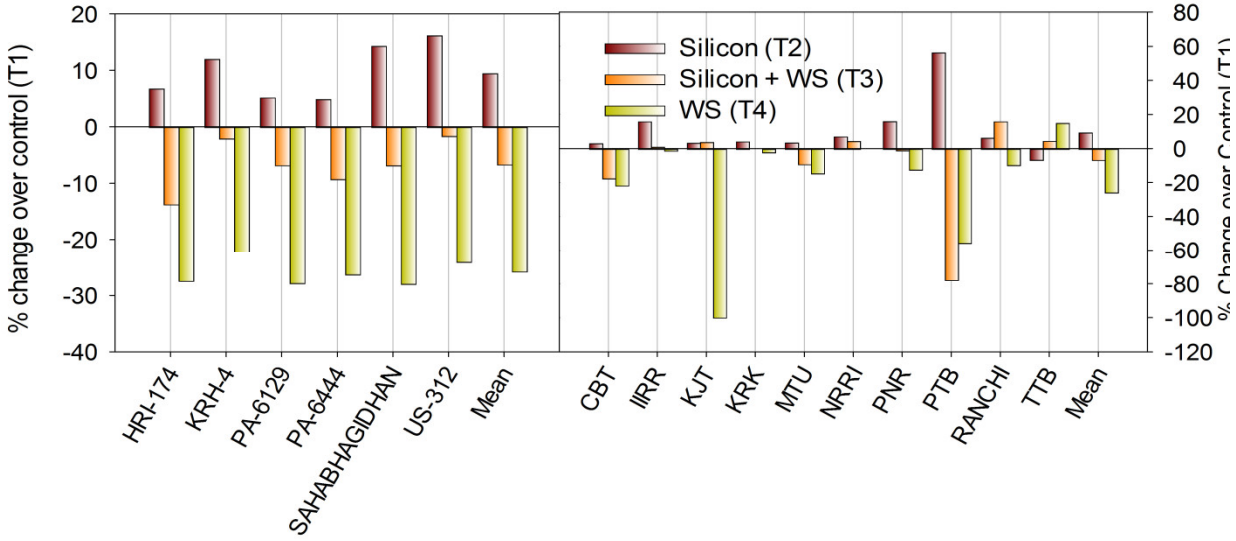


Fig.5 Influence of silicon application and water stress on No. grains Panicle^{-1} [A] Mean of all locations [B] Mean of all varieties. Each bar represents % change over control treatment (T1).

Significant differences were observed amongst the varieties ($p<0.01$). The mean *No. grains Panicle^{-1}* varied between 112 (Sahabhagidhan) to 144 (KRH-4) with a mean of 128. The interaction between Treatment x Genotype was found to be non-significant. However, the three way interaction between Treatment x Genotype x Location was highly significant ($p<0.01$). Application of silicon (T2) had resulted in an increase in *No. grains Panicle^{-1}*. The mean (mean of all locations and varieties) *No. grains Panicle^{-1}* had shown >9% increase. The extent of improvement due to silicon application (T2) varied from >16% and 14% in US-312 and KRH-4, respectively. The improvement in remaining genotypes is only marginal *(Fig.5)*. Imposition of water stress (T4) resulted in significant reduction (>25% over T1) in *No. grains Panicle^{-1}*. All varieties suffered adversely with >22% reduction in grain number. When silicon was applied on plants under going water stress (T4) the adverse impact of water stress was reversed. Silicon application had helped in mitigating deleterious effect of water stress. Significant varietal difference were observed in the mitigating effect of silicon (*Fig.5).*

Analysis of variance for 1000 grain weight (g) revealed that the mean test weight was not significantly influenced by the treatments. However, the interaction Location x Treatment was found to be highly significant indicating that the treatment effect varied from location to location (Table 6.1.12). The mean test weight (mean of all treatments and varieties) varied from 16.5 g (PTB) to 35.2(KRK). The effect of silicon application was also

non-significant. The mean test weight was marginally and non-significantly reduced (<2% over T1). However, imposition of water stress (T4) had resulted in significant reduction in mean test weight (>17% over T1). When silicon was applied on water stressed plants, it mitigated the adverse effect of water stress by restricting the reduction in test weight to 3.9% only (Fig.6).

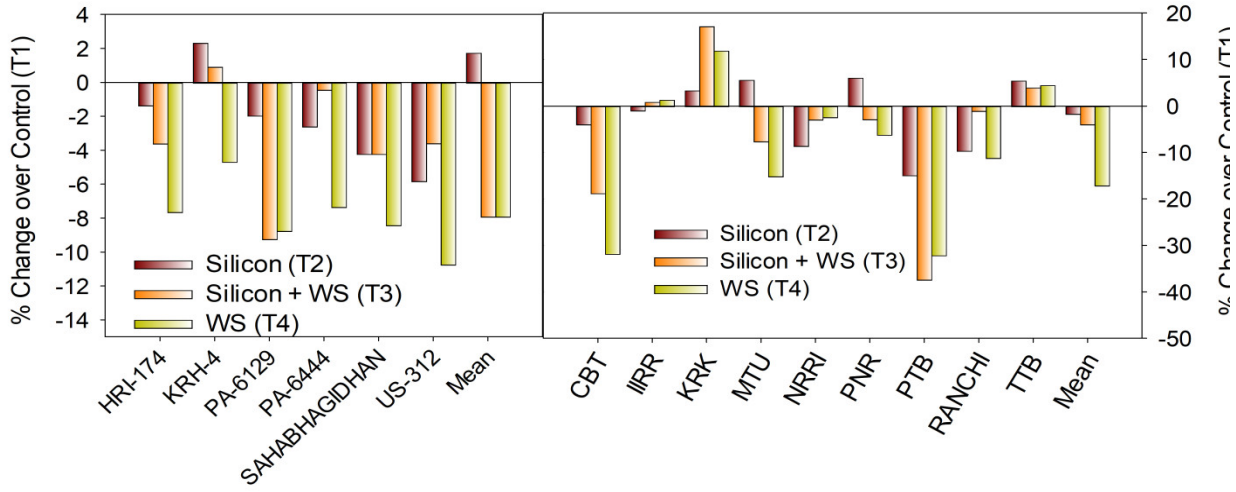


Fig.6 Influence of silicon application and water stress on 1000 grain weight (g) [A] Mean of all locations [B] Mean of all varieties. Each bar represents % change over control treatment (T1).

Data pertaining to above ground dry matter (TDM) was presented in Table 6.1.13. The data revealed that the imposed treatments had not significantly influenced the TDM. However, the Location x Treatment interaction is statistically significant ($p<0.01$). The mean TDM (mean of all varieties and treatments) varied between 2337 g m^{-2} (KRK) to 986 (PTB). Application silicon (T) had a positive effect on TDM. The mean TDM was increased by >9% by silicon application. Imposition of water stress (T4) had resulted in significant reduction in TDM (>19% over T1). Application of silicon to water stressed (T4) crop mitigated the adverse impact of water stress by reducing the reduction in TDM to 5.1% from 19% reduction with water stress alone (Fig. 7). Significant differences were observed amongst the varieties. The mean TDM (mean of all locations) varied between 1029 g (Sahabhagidhan) to 1371 g m^{-2} . The interaction between Treatment x Variety was found to be non-significant. Application of silicon (T2) resulted in an increase in TDM. The increase in TDM is more in US-312 (13% increase over T1) followed by HR-174 (11% over control) and PA-6128 (10%). Minimum effect was observed in PA-6444 *(Table 6.1.13)*

Data pertaining to grain yield was presented in Table 6.1.14. Analysis of variance indicated that the treatments had significantly influenced grain yield (g m^{-2}). Application of silicon (T2) resulted in >9% increase in mean grain yield(mean of all varieties & locations) (Fig. 7). Imposition of water stress (T4) resulted in >20% reduction in mean grain yield. A

significant reduction in yield loss caused by the water stress was observed when silicon was applied on crop undergoing water stress (T4). The result show that application of silicon can mitigate the adverse effect of water stress by reducing the yield losses caused by the water stress. The interaction between Location x Treatment was highly significant ($p<0.01$). The mean grain yield (mean of all treatments and varieties) varied between 200 g m^{-2} (RANCHI) followed by 400 g m^{-2} (PTB) to 921 (IIRR) followed by 803 g m^{-2} (KJT). Maximum yield improvement (>23% over control T1) was observed at PTB followed by NRRI (>17% over T1), PNR (>14%) and KJT (>13% over control). The increase in mean grain yield at other centres is <10% over T1.

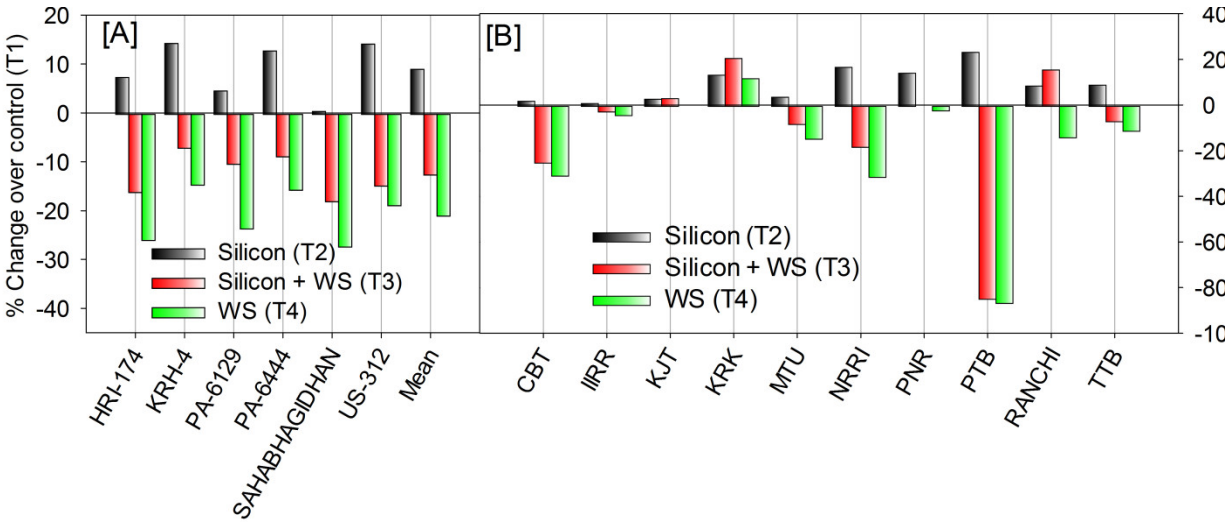


Fig.7: Influence of silicon application and water stress on Grain Yield (g m^{-2}) [A] Mean of all locations [B] Mean of all varieties. Each bar represents % change over control treatment (T1)

The differences in the mean grain yield (mean of all treatments and locations) amongst the varieties was found to be non-significant (Table 6.1.14). The interaction between Treatment x Variety is also found to be non-significant. Indicating that no genotypic differences were observed between the varieties for mean grain yield. However, the three way interaction Location x Treatment x Variety was found to be highly significant ($p<0.01$) . Silicon application (T2) had significant effect on grain yield (mean of all locations). Maximum yield improvement was observed in US-312 , KRH-4 (>14%) over control treatment (T1) and PA-6444 (12% over control). No improvement in yield was observed in case of Sahabhagidhan and the improvement is only minor (<5%) in PA-6129. Imposition of water stress had resulted in substantial yield loss in all the varieties. The mean grain yield (mean of all varieties and locations) was reduced by >20% over control by water stress. Maximum yield loss was observed in Sahabhagidhan followed by HRI-174. Minimum yield loss was observed in KRH-4 and PA-6444 (Fig.7 and Table 6.1.14). Silicon application on plant undergoing water stress (T3) had resulted in partial mitigation of negative impact of water stress and significant genotypic differences were observed. The reduction in yield loss due to silicon application was higher (>9% over T4) in PA-6129, Sahabhagidhan and HRI-174. The mitigation was marginal in PA-6444 and US-413.

Table 6.1.15 presents the data pertaining to harvest index (HI). Analysis of variance revealed that the treatment effect was statistically significant ($p<0.01$). The mean HI was improved (2% over T1) by silicon application, but imposition of water stress (T4) during reproductive phase resulted in >23% reduction in HI. Application of silicon on plants undergoing water stress (T3) resulted in mitigation of negative effect of water stress by partially reducing the losses in harvest index. The differences in mean HI amongst varieties was non-significant. The interaction Location x Treatment was significant ($p<0.01$) indicating that the treatment effect varied from location to location. The mean HI for all treatments and genotypes varied from 48 (MTU) to 21.5 (PTB) with a mean of 38.4. The interaction between Treatment x Genotype was found to be non-significant. Silicon application resulted in increase in HI, the improvement is >5% in PA-6444, KRH-4, US-312 where as no effect of observed in PA-6129.

Summary & Conclusion

In view of the importance of silica in rice nutrition, a trial was conducted at different AICRIP locations spread across the country. The experimental lay-out was split-plot with three replications. The treatments include T1 = Control (water spray), T2 =0.8% silixol, T3 = Silixol + water stress, T4 = Water stress. Water stress was imposed after PI stage by withholding irrigation. The results revealed that application of silicon (T2) resulted in >9% increase in mean grain yield(mean of all varieties & locations) . Imposition of water stress (T4) resulted in >20% reduction in mean grain yield. Maximum yield improvement was observed in US-312 , KRH-4 (>14%) over control treatment (T1) and PA-6444 (12% over control). No improvement in yield was observed in case of Sahabhagidhan and the improvement is only minor (<5%) in PA-6129. Imposition of water stress had resulted in substantial yield loss in all the varieties. The mean grain yield (mean of all varieties and locations) was reduced by >20% over control by water stress. Maximum yield loss was observed in Sahabhagidhan followed by HRI-174. Minimum yield loss was observed in KRH-4 and PA-6444. Silicon application on plant undergoing water stress (T3) had resulted in partial mitigation of negative impact of water stress and significant genotypic differences were observed. The reduction in yield loss due to silicon application was higher (>9% over T4) in PA-6129, Sahabhagidhan and HRI-174. The mitigation was marginal in PA-6444 and US-413

Table 6.1.1 Influence of Silica application Days to flowering at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	92	103	94	104	97	100	101	83	0	98	97
	2	KRH-4	96	98	98	100	96	95	104	92	0	98	97
	3	PA-6129	91	94	91	93	84	80	81	85	0	86	87
	4	PA-6444	91	105	97	101	97	100	99	87	0	73	94
	5	SAHABHAGIDHAN	88	89	102	90	88	85	81	87	0	86	88
	6	US-312	93	105	99	96	98	93	83	90	0	92	94
		T1 Mean	**92**	**99**	**97**	**97**	**93**	**92**	**92**	**87**	**0**	**89**	**93**
T2 (0.6% Silixol)	1	HRI-174	92	104	95	104	98	100	101	83	0	98	97
	2	KRH-4	92	98	99	100	97	95	104	92	0	98	97
	3	PA-6129	89	93	92	93	85	85	79	85	0	86	88
	4	PA-6444	90	105	98	101	98	103	99	87	0	73	95
	5	SAHABHAGIDHAN	86	89	102	90	87	85	81	87	0	86	88
	6	US-312	93	105	98	96	97	95	83	90	0	92	94
		T2 Mean	**91**	**99**	**97**	**97**	**94**	**94**	**91**	**87**	**0**	**89**	**93**
T3 (Silixol + water stress)	1	HRI-174	91	103	95	104	99	107	101	83	0	93	97
	2	KRH-4	89	99	98	100	97	105	104	90	0	92	97
	3	PA-6129	88	94	91	93	86	102	79	83	0	83	89
	4	PA-6444	88	105	98	101	99	107	99	85	0	70	95
	5	SAHABHAGIDHAN	84	90	102	90	86	98	81	85	0	81	89
	6	US-312	93	105	99	96	98	104	83	88	0	89	95
		T3 Mean	**89**	**99**	**97**	**97**	**94**	**104**	**91**	**86**	**0**	**85**	**94**
T4 (water stress)	1	HRI-174	96	104	0	104	97	107	101	83	0	93	87
	2	KRH-4	97	99	0	100	95	105	104	90	0	92	87
	3	PA-6129	94	94	0	93	87	102	81	83	0	83	80
	4	PA-6444	93	104	0	101	98	107	99	85	0	70	84
	5	SAHABHAGIDHAN	90	90	0	90	87	100	81	85	0	81	78
	6	US-312	98	104	0	96	97	105	83	88	0	89	85
		T4 Mean	**95**	**99**	**0**	**97**	**94**	**104**	**92**	**86**	**0**	**85**	**83**
		Grand Mean	**92**	**99**	**73**	**97**	**94**	**99**	**91**	**87**	**0**	**87**	**82**
		LSD (Silicon)				Ns		LSD(Silicon X Variety)				ns	
		LSD(Centre x Silicon)				0.89**		LSD(Centre x Silicon x Variety)				1.37**	
		LSD(Variety)				0.22**		CV Treat (%)				1.07	
		LSD (Centre x Variety)				0.668**		CV Residual (%)				0.799	

Table 6.1.2 Influence of Silica application Days to maturity at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	123	131	126	117	127	136	117	128	0	132	126
	2	KRH-4	124	127	128	117	126	126	119	135	0	129	126
	3	PA-6129	126	122	121	114	116	110	103	130	0	120	118
	4	PA-6444	121	135	130	117	127	136	119	132	0	110	125
	5	SAHABHAGIDHAN	117	117	120	114	118	115	108	132	0	122	118
	6	US-312	128	135	125	114	128	126	106	133	0	125	124
		T1 Mean	**123**	**128**	**125**	**116**	**124**	**125**	**112**	**132**	**0**	**123**	**123**
T2 (0.6% Silixol)	1	HRI-174	121	134	127	117	127	136	116	128	0	132	127
	2	KRH-4	122	127	128	117	126	126	117	135	0	129	125
	3	PA-6129	126	122	120	114	116	115	102	130	0	120	118
	4	PA-6444	118	134	129	117	127	136	119	132	0	110	125
	5	SAHABHAGIDHAN	115	118	121	114	118	115	108	132	0	122	118
	6	US-312	128	134	124	114	125	126	106	133	0	126	124
		T2 Mean	**122**	**128**	**125**	**116**	**123**	**126**	**111**	**132**	**0**	**123**	**123**
T3 (Silixol + water stress)	1	HRI-174	120	133	126	117	127	138	117	128	0	128	126
	2	KRH-4	119	128	129	117	126	138	121	135	0	127	127
	3	PA-6129	125	122	120	114	117	136	102	130	0	117	120
	4	PA-6444	116	134	130	117	128	138	123	132	0	105	125
	5	SAHABHAGIDHAN	113	118	121	114	115	136	108	132	0	117	119
	6	US-312	128	135	125	114	126	136	106	133	0	122	125
		T3 Mean	**120**	**128**	**125**	**116**	**123**	**137**	**113**	**132**	**0**	**119**	**124**
T4 (water stress)	1	HRI-174	125	134	0	117	125	138	117	128	0	127	112
	2	KRH-4	126	128	0	117	127	136	119	135	0	126	113
	3	PA-6129	129	123	0	114	117	136	103	130	0	116	107
	4	PA-6444	123	135	0	117	129	138	119	132	0	104	111
	5	SAHABHAGIDHAN	121	118	0	114	115	136	108	132	0	116	107
	6	US-312	131	133	0	114	129	136	106	133	0	121	112
		T4 Mean	**126**	**129**	**0**	**116**	**124**	**137**	**112**	**132**	**0**	**118**	**110**
		Grand Mean	**123**	**128**	**94**	**116**	**123**	**131**	**112**	**132**	**0**	**121**	**120**
		LSD (Silicon)			NS			LSD(Silicon X Variety)			ns		
		LSD(Centre x Silicon)			0.98**			LSD(Centre x Silicon x Variety)			1.97**		
		LSD(Variety)			0.32**			CV Treat (%)			1.02		
		LSD (Centre x Variety)			0.99**			CV Residual (%)			0.89		

Table 6.1.3 Influence of Silica application Plant height (cm) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	100.0	105.2	115.7	104.0	142.3	109.6	111.7	92.0	65.3	89.7	103.6
	2	KRH-4	115.7	121.7	81.1	118.3	155.0	137.0	146.7	99.3	66.0	101.3	114.2
	3	PA-6129	99.7	97.0	101.3	84.3	123.0	106.4	113.3	105.3	61.7	86.0	97.8
	4	PA-6444	104.0	109.3	115.3	97.7	133.3	104.4	111.0	110.3	65.0	86.8	103.7
	5	SAHABHAGIDHAN	97.3	104.7	109.1	81.7	130.7	111.0	115.3	99.7	73.7	83.2	100.6
	6	US-312	82.7	103.8	115.8	100.7	137.7	118.8	119.0	109.3	78.7	94.7	106.1
		T1 Mean	**99.9**	**106.9**	**106.4**	**97.8**	**137.0**	**114.5**	**119.5**	**102.7**	**68.4**	**90.3**	**104.3**
T2 (0.6% Silixol)	1	HRI-174	107.7	107.7	113.9	112.0	144.3	115.9	118.3	90.7	62.3	79.5	105.2
	2	KRH-4	119.7	121.7	79.4	114.7	159.0	136.0	147.7	95.3	64.3	99.0	113.7
	3	PA-6129	90.0	106.0	102.7	80.3	123.7	101.0	115.3	126.3	60.7	80.2	98.6
	4	PA-6444	109.7	102.7	114.0	125.0	135.7	107.0	118.0	109.7	64.7	86.3	107.3
	5	SAHABHAGIDHAN	97.7	119.0	109.4	87.7	132.0	107.9	120.7	95.7	73.0	87.2	103.0
	6	US-312	84.3	101.3	114.2	99.0	137.3	123.4	113.0	107.7	85.3	89.7	105.5
		T2 Mean	**101.5**	**109.7**	**105.6**	**103.1**	**138.7**	**115.2**	**122.2**	**104.2**	**68.4**	**87.0**	**105.6**
T3 (Silixol + water stress)	1	HRI-174	103.7	121.3	115.7	103.0	143.0	102.5	108.3	64.7	60.3	73.7	99.6
	2	KRH-4	121.3	115.3	81.0	127.0	157.0	115.8	139.3	64.3	65.3	95.7	108.2
	3	PA-6129	96.7	100.0	99.6	75.0	122.0	89.2	123.3	85.3	59.3	75.0	92.5
	4	PA-6444	102.0	101.0	116.4	105.7	131.3	102.6	105.7	71.0	65.7	88.3	99.0
	5	SAHABHAGIDHAN	96.7	106.3	109.9	96.3	130.3	106.2	120.3	61.0	72.7	85.2	98.5
	6	US-312	80.3	105.3	119.1	83.3	133.3	106.5	120.0	60.7	81.0	86.5	97.6
		T3 Mean	**100.1**	**108.2**	**106.9**	**98.4**	**136.2**	**103.8**	**119.5**	**67.8**	**67.4**	**84.1**	**99.2**
T4 (water stress)	1	HRI-174	97.3	108.0	0.0	95.7	137.3	99.8	105.3	65.0	58.0	81.3	84.8
	2	KRH-4	124.3	103.7	0.0	118.0	155.3	123.9	135.3	81.0	60.3	95.3	99.7
	3	PA-6129	88.3	98.7	0.0	86.3	121.7	86.7	102.7	76.3	60.3	82.2	80.3
	4	PA-6444	105.7	101.0	0.0	101.3	131.7	99.9	108.7	68.0	66.7	75.7	85.9
	5	SAHABHAGIDHAN	91.0	113.3	0.0	101.7	130.0	98.9	107.3	80.0	71.0	83.3	87.7
	6	US-312	79.0	105.7	0.0	98.7	129.3	105.5	110.7	78.3	76.7	92.7	87.7
		T4 Mean	**97.6**	**105.1**	**0.0**	**100.3**	**134.2**	**102.4**	**111.7**	**74.8**	**65.5**	**85.1**	**87.7**
		Grand Mean	**99.8**	**107.5**	**79.7**	**99.9**	**136.5**	**109.0**	**118.2**	**87.4**	**67.4**	**86.6**	**99.2**
		LSD (Silicon)				NS			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				9.6**			LSD(Centre x Silicon x Variety)			14.47**	
		LSD(Variety)				2.28**			CV Treat (%)			11.08	
		LSD (Centre x Variety)				4.23**			CV Residual (%)			6.89	

Table 6.1.4 Influence of Silica application tiller number (m2) at flowering from different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	425	267	217	233	217	322	275	360	200	253	277
	2	KRH-4	425	234	217	225	250	275	300	413	250	369	296
	3	PA-6129	400	234	175	258	325	235	250	307	308	237	273
	4	PA-6444	525	204	200	283	325	326	233	333	217	298	295
	5	SAHABHAGIDHAN	400	229	192	217	275	211	283	387	317	213	272
	6	US-312	350	225	175	167	275	240	250	400	250	256	259
		T1 Mean	**421**	**232**	**196**	**231**	**278**	**268**	**265**	**367**	**257**	**271**	**279**
T2 (0.6% Silixol)	1	HRI-174	400	234	192	308	250	273	367	400	242	286	295
	2	KRH-4	300	304	183	233	233	278	400	293	275	363	286
	3	PA-6129	450	221	208	275	317	224	333	320	283	312	294
	4	PA-6444	350	246	200	267	333	253	333	347	242	353	292
	5	SAHABHAGIDHAN	425	275	208	217	333	220	367	533	308	262	315
	6	US-312	325	225	192	275	300	226	333	267	258	302	270
		T2 Mean	**375**	**251**	**197**	**263**	**294**	**246**	**356**	**360**	**268**	**313**	**292**
T3 (Silixol + water stress)	1	HRI-174	450	175	192	200	258	293	283	297	250	228	263
	2	KRH-4	350	275	200	233	267	313	300	283	208	253	268
	3	PA-6129	400	238	200	242	317	238	283	273	242	231	266
	4	PA-6444	550	238	217	250	308	278	300	300	208	229	288
	5	SAHABHAGIDHAN	325	221	175	192	292	311	283	237	225	208	247
	6	US-312	400	238	208	267	258	311	250	267	217	294	271
		T3 Mean	**413**	**231**	**199**	**231**	**283**	**290**	**283**	**276**	**225**	**241**	**267**
T4 (water stress)	1	HRI-174	350	242	0	283	258	280	267	167	267	204	232
	2	KRH-4	475	238	0	242	250	271	250	260	217	246	245
	3	PA-6129	475	238	0	325	292	329	233	237	250	221	260
	4	PA-6444	475	204	0	275	300	304	267	187	267	203	248
	5	SAHABHAGIDHAN	275	242	0	250	283	315	267	177	258	206	227
	6	US-312	425	209	0	317	250	280	233	203	217	245	238
		T4 Mean	**413**	**229**	**0**	**282**	**272**	**296**	**253**	**205**	**246**	**221**	**242**
		Grand Mean	**405**	**236**	**148**	**251**	**282**	**275**	**289**	**302**	**249**	**261**	**270**
		LSD (Silicon)				ns			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				46.57**			LSD(Centre x Silicon x Variety)			88.08**	
		LSD(Variety)				ns			CV Treat (%)			19.45	
		LSD (Centre x Variety)				44.07**			CV Residual (%)			15.44	

Table 6.1.5 Influence of Silica application shoot weight (g/m2) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	1046	934	1276	2205	388	455	1105	1640	579	694	1032
	2	KRH-4	1604	1121	1280	1936	685	668	1323	1393	620	668	1130
	3	PA-6129	1086	851	1361	836	600	441	633	2120	613	550	909
	4	PA-6444	1190	905	1254	1686	469	509	1178	1687	647	870	1039
	5	SAHABHAGIDHAN	738	747	1313	830	471	414	574	2327	634	271	832
	6	US-312	1465	953	1366	1442	530	537	933	1597	594	828	1025
		T1 Mean	**1188**	**918**	**1308**	**1489**	**524**	**504**	**958**	**1794**	**614**	**647**	**994**
T2 (0.6% Silixol)	1	HRI-174	1083	1118	1236	2450	358	709	1074	1840	645	623	1114
	2	KRH-4	1668	1043	1310	2030	738	678	978	2013	656	628	1174
	3	PA-6129	1114	879	1294	916	658	477	595	1620	659	587	880
	4	PA-6444	1236	930	1264	1763	453	529	1145	1633	668	822	1044
	5	SAHABHAGIDHAN	753	716	1297	1053	439	530	541	1647	654	259	789
	6	US-312	1507	934	1273	1820	469	640	965	2607	678	928	1182
		T2 Mean	**1227**	**937**	**1279**	**1672**	**519**	**594**	**883**	**1893**	**660**	**641**	**1030**
T3 (Silixol + water stress)	1	HRI-174	1120	885	1257	1954	442	467	1080	1007	611	634	946
	2	KRH-4	1732	922	1421	2221	741	447	1039	807	672	653	1065
	3	PA-6129	1142	776	1373	1316	585	330	519	707	681	444	787
	4	PA-6444	1282	838	1249	1804	502	434	994	400	674	842	902
	5	SAHABHAGIDHAN	768	889	1347	1109	435	323	524	320	672	323	671
	6	US-312	1549	874	1319	2329	606	419	896	507	666	889	1005
		T3 Mean	**1266**	**864**	**1328**	**1789**	**552**	**403**	**842**	**624**	**663**	**631**	**896**
T4 (water stress)	1	HRI-174	1157	967	0	1926	397	534	1165	280	561	717	722
	2	KRH-4	1796	1050	0	1820	615	544	1443	287	654	753	893
	3	PA-6129	1170	838	0	1294	545	348	609	260	600	494	608
	4	PA-6444	1328	960	0	2067	498	459	1294	207	624	872	780
	5	SAHABHAGIDHAN	783	682	0	1260	427	440	558	107	568	344	488
	6	US-312	1591	963	0	2051	708	544	1213	213	585	801	827
		T4 Mean	**1304**	**910**	**0**	**1737**	**532**	**478**	**1047**	**226**	**599**	**664**	**720**
		Grand Mean	**1246**	**907**	**1305**	**1672**	**532**	**495**	**932**	**1134**	**634**	**646**	**816**
		LSD (Silicon)			ns			LSD(Silicon X Variety)				ns	
		LSD(Centre x Silicon)			191**			LSD(Centre x Silicon x Variety)				319.2**	
		LSD(Variety)			50.5**			CV Treat (%)				23.5	
		LSD (Centre x Variety)			159.6**			CV Residual (%)				16.45	

Table 6.1.6 Influence of Silica application Panicle number (m2) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	320	493	272	236	418	268	275	367	214	235	310
	2	KRH-4	406	540	252	240	374	307	300	360	218	328	333
	3	PA-6129	339	560	223	261	363	273	250	460	220	219	317
	4	PA-6444	318	483	272	236	407	269	233	373	220	271	308
	5	SAHABHAGIDHAN	381	443	249	186	396	281	283	820	235	201	348
	6	US-312	325	510	234	173	374	289	250	353	222	237	297
		T1 Mean	**348**	**505**	**251**	**222**	**389**	**281**	**265**	**456**	**221**	**249**	**319**
T2 (0.6% Silixol)	1	HRI-174	333	500	276	232	462	321	367	387	222	264	336
	2	KRH-4	420	460	292	232	385	274	400	353	223	323	336
	3	PA-6129	354	483	210	248	396	286	333	393	227	283	321
	4	PA-6444	335	383	242	253	440	265	333	387	229	315	318
	5	SAHABHAGIDHAN	298	400	265	165	407	312	367	420	220	224	308
	6	US-312	341	437	247	223	385	243	333	493	219	277	320
		T2 Mean	**347**	**444**	**256**	**225**	**413**	**284**	**356**	**406**	**223**	**281**	**323**
T3 (Silixol + water stress)	1	HRI-174	345	480	251	207	396	264	283	367	231	217	304
	2	KRH-4	434	500	279	248	363	206	300	347	226	240	314
	3	PA-6129	369	467	248	273	352	251	283	327	225	216	301
	4	PA-6444	352	477	252	236	363	244	300	380	230	218	305
	5	SAHABHAGIDHAN	319	480	253	236	352	228	283	227	222	197	280
	6	US-312	358	493	259	261	341	214	250	320	212	269	298
		T3 Mean	**363**	**483**	**257**	**244**	**361**	**235**	**283**	**328**	**224**	**226**	**300**
T4 (water stress)	1	HRI-174	358	503	0	232	396	258	267	213	222	195	294
	2	KRH-4	448	550	0	219	352	282	250	160	221	231	302
	3	PA-6129	354	473	0	282	319	306	233	173	232	211	287
	4	PA-6444	367	440	0	290	352	272	267	260	236	195	298
	5	SAHABHAGIDHAN	339	473	0	236	341	276	267	133	233	198	277
	6	US-312	374	457	0	265	330	288	233	147	221	230	283
		T4 Mean	**373**	**483**	**0**	**254**	**348**	**280**	**253**	**181**	**228**	**210**	**290**
		Grand Mean	**358**	**479**	**191**	**236**	**378**	**270**	**289**	**343**	**224**	**241**	**301**
		LSD (Silicon)				ns			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				38.68**			LSD(Centre x Silicon x Variety)			106.5**	
		LSD(Variety)				ns			CV Treat (%)			14.45	
		LSD (Centre x Variety)				53.25**			CV Residual (%)			16.75	

Table 6.1.7 Influence of Silica application panicle weight (g/m2) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	1101	1166	854	493	531	745	1127	653	416	447	753
	2	KRH-4	1479	1060	874	522	424	519	1440	1027	399	485	823
	3	PA-6129	1316	1216	837	496	682	477	1375	780	430	486	810
	4	PA-6444	1338	1180	742	572	449	494	1133	1027	407	591	793
	5	SAHABHAGIDHAN	1437	1051	774	201	631	614	1125	1120	456	283	769
	6	US-312	1343	1114	811	342	561	666	1158	1020	428	661	810
		T1 Mean	**1336**	**1131**	**815**	**438**	**546**	**586**	**1226**	**938**	**423**	**492**	**793**
T2 (0.6% Silixol)	1	HRI-174	1089	1147	662	554	606	904	2008	1220	546	491	923
	2	KRH-4	1467	1141	821	412	419	586	2307	953	536	535	918
	3	PA-6129	1303	1127	726	462	788	561	2280	693	526	527	899
	4	PA-6444	1325	1036	903	414	475	539	2165	873	538	626	890
	5	SAHABHAGIDHAN	1426	1091	798	226	681	700	2217	720	497	292	865
	6	US-312	1329	1067	911	602	613	864	2050	1660	532	742	1037
		T2 Mean	**1323**	**1101**	**803**	**445**	**597**	**692**	**2171**	**1020**	**529**	**536**	**922**
T3 (Silixol + water stress)	1	HRI-174	1079	1088	735	452	484	448	1287	187	406	358	652
	2	KRH-4	1455	1071	746	408	363	386	1500	180	429	467	700
	3	PA-6129	1291	1181	709	523	619	443	1812	213	414	448	765
	4	PA-6444	1315	1095	826	406	417	367	1850	200	413	572	746
	5	SAHABHAGIDHAN	1412	1029	887	255	598	443	1485	113	448	305	698
	6	US-312	1318	986	936	894	550	553	1167	167	437	582	759
		T3 Mean	**1312**	**1075**	**806**	**490**	**505**	**440**	**1517**	**177**	**425**	**455**	**720**
T4 (water stress)	1	HRI-174	1071	995	0	426	457	557	1153	160	399	365	620
	2	KRH-4	1443	1050	0	470	344	441	1225	100	400	463	660
	3	PA-6129	1280	1115	0	501	546	462	1147	120	408	446	669
	4	PA-6444	1306	991	0	503	393	491	1428	213	381	527	693
	5	SAHABHAGIDHAN	1402	1078	0	282	585	420	1163	53	400	309	633
	6	US-312	1306	969	0	817	502	656	1005	100	375	588	702
		T4 Mean	**1301**	**1033**	**0**	**500**	**471**	**505**	**1187**	**124**	**394**	**450**	**663**
		Grand Mean	**1318**	**1085**	**606**	**468**	**530**	**556**	**1525**	**565**	**443**	**483**	**758**
		LSD (Silicon)				25.25*		LSD(Silicon X Variety)				ns	
		LSD(Centre x Silicon)				106.5**		LSD(Centre x Silicon x Variety)				230.5**	
		LSD(Variety)				ns		CV Treat (%)				15.03	
		LSD (Centre x Variety)				115.12**		CV Residual (%)				14.36	

Table 6.1.8 Influence of Silica application grain number/panicle at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	206	85	268	127	96	140	234	55	57	193	146
	2	KRH-4	213	91	224	110	110	112	279	148	56	151	149
	3	PA-6129	174	78	218	85	109	89	258	90	74	156	133
	4	PA-6444	182	83	225	71	113	91	262	114	70	200	141
	5	SAHABHAGIDHAN	209	95	209	72	115	95	175	70	61	83	118
	6	US-312	154	88	204	85	117	135	203	116	57	128	129
		T1 Mean	**189**	**87**	**225**	**92**	**110**	**110**	**235**	**99**	**62**	**152**	**136**
T2 (0.6% Silixol)	1	HRI-174	214	86	274	93	102	132	259	168	74	159	156
	2	KRH-4	221	119	240	148	111	123	327	165	75	137	167
	3	PA-6129	182	83	247	83	116	88	282	147	49	128	140
	4	PA-6444	190	113	217	69	116	86	277	142	76	197	148
	5	SAHABHAGIDHAN	217	104	211	95	118	97	216	132	73	85	135
	6	US-312	145	104	208	90	120	181	279	176	52	144	150
		T2 Mean	**195**	**101**	**233**	**96**	**114**	**118**	**273**	**155**	**66**	**142**	**149**
T3 (Silixol + water stress)	1	HRI-174	173	81	249	81	86	107	242	17	73	151	126
	2	KRH-4	180	101	261	116	100	131	258	38	76	202	146
	3	PA-6129	141	84	251	82	91	92	253	26	71	151	124
	4	PA-6444	149	84	215	71	107	112	239	22	72	212	128
	5	SAHABHAGIDHAN	176	83	217	66	111	91	180	12	72	97	110
	6	US-312	121	94	214	133	104	155	222	16	71	143	127
		T3 Mean	**156**	**88**	**234**	**92**	**100**	**115**	**233**	**22**	**72**	**159**	**127**
T4 (water stress)	1	HRI-174	165	75	0	93	82	114	221	60	48	202	106
	2	KRH-4	172	87	0	136	95	128	228	40	67	207	116
	3	PA-6129	133	84	0	56	84	100	214	40	48	201	96
	4	PA-6444	141	84	0	112	102	102	220	55	64	160	104
	5	SAHABHAGIDHAN	168	88	0	63	101	90	155	29	49	110	85
	6	US-312	113	98	0	81	99	125	195	40	62	168	98
		T4 Mean	**148**	**86**	**0**	**90**	**94**	**110**	**206**	**44**	**56**	**175**	**101**
		Grand Mean	**172**	**90**	**173**	**92**	**104**	**113**	**237**	**80**	**64**	**157**	**128**
		LSD (Silicon)				NS			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				14.4**			LSD(Centre x Silicon x Variety)			35.5**	
		LSD(Variety)				4.24*			CV Treat (%)			17.68	
		LSD (Centre x Variety)				17.65**			CV Residual (%)			13.03	

Table 6.1.9 Influence of Silica application spikelet number/panicle at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	229	113	**0**	179	104	154	261	144	67	236	165
	2	KRH-4	235	120	**0**	128	119	137	316	176	68	179	164
	3	PA-6129	196	104	**0**	93	118	114	289	170	88	183	151
	4	PA-6444	205	121	**0**	95	123	114	293	165	78	239	159
	5	SAHABHAGIDHAN	232	119	**0**	84	123	129	201	153	71	98	134
	6	US-312	176	111	**0**	109	128	185	233	178	71	150	149
		T1 Mean	**212**	**115**	**0**	**115**	**119**	**139**	**265**	**164**	**74**	**181**	**154**
T2 (0.6% Silixol)	1	HRI-174	237	107	**0**	108	110	143	300	196	84	200	165
	2	KRH-4	244	169	**0**	181	122	140	356	197	83	171	185
	3	PA-6129	205	99	**0**	100	124	112	317	172	85	152	152
	4	PA-6444	214	148	**0**	92	126	103	306	181	88	244	167
	5	SAHABHAGIDHAN	241	136	**0**	106	126	130	234	151	84	104	146
	6	US-312	166	140	**0**	91	131	190	307	216	79	164	165
		T2 Mean	**218**	**133**	**0**	**113**	**123**	**136**	**303**	**185**	**84**	**172**	**163**
T3 (Silixol + water stress)	1	HRI-174	192	111	**0**	110	97	131	288	46	84	186	138
	2	KRH-4	199	142	**0**	141	111	153	289	75	86	263	162
	3	PA-6129	159	134	**0**	91	104	120	286	43	81	164	131
	4	PA-6444	167	111	**0**	104	120	145	278	42	84	251	145
	5	SAHABHAGIDHAN	195	107	**0**	77	125	117	220	38	83	112	119
	6	US-312	138	116	**0**	161	118	182	253	50	83	162	140
		T3 Mean	**175**	**120**	**0**	**114**	**113**	**142**	**269**	**49**	**84**	**190**	**139**
T4 (water stress)	1	HRI-174	183	91	**0**	113	93	145	283	87	56	253	145
	2	KRH-4	190	119	**0**	150	109	156	269	75	77	271	158
	3	PA-6129	150	125	**0**	68	98	128	261	110	80	246	141
	4	PA-6444	158	110	**0**	133	117	130	275	90	74	200	143
	5	SAHABHAGIDHAN	186	111	**0**	63	117	115	199	41	64	139	115
	6	US-312	129	119	**0**	102	116	143	245	75	68	203	133
		T4 Mean	**166**	**113**	**0**	**105**	**108**	**136**	**255**	**80**	**70**	**219**	**139**
		Grand Mean	**193**	**120**	**0**	**112**	**116**	**138**	**273**	**120**	**78**	**190**	**134**
		LSD (Silicon)				ns			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				16.06**			LSD(Centre x Silicon x Variety)			37.04**	
		LSD(Variety)				4.54*			CV Treat (%)			13.53	
		LSD (Centre x Variety)				18.9**			CV Residual (%)			13.35	

Table 6.1.10 Influence of Silica application grain number/m2 at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	53906	41680	0	29947	39853	36755	54467	20747	19795	45220	34237
	2	KRH-4	70782	48966	0	26355	41162	34365	83600	55733	21471	49516	43195
	3	PA-6129	48220	42860	0	21275	39567	24345	64583	41667	28318	34229	34506
	4	PA-6444	47315	39344	0	16647	45980	24265	61217	42680	26527	54441	35841
	5	SAHABHAGIDHAN	65175	41618	0	13043	45485	26949	49433	55440	21558	16550	33525
	6	US-312	40945	44821	0	14820	43703	38874	50667	43920	18339	30484	32657
		T1 Mean	**54391**	**43215**	**0**	**20348**	**42625**	**30925**	**60661**	**43364**	**22668**	**38407**	**35660**
T2 (0.6% Silixol)	1	HRI-174	58223	42998	0	21870	47300	41930	95100	67653	26743	42155	44397
	2	KRH-4	75971	54880	0	32057	42845	33532	130800	58720	32890	43844	50554
	3	PA-6129	52623	39573	0	20523	45782	24964	93783	61173	25639	36040	40010
	4	PA-6444	52041	42846	0	16932	51106	23129	92300	56507	31811	62064	42874
	5	SAHABHAGIDHAN	52887	41143	0	14537	48015	30247	79933	56480	34207	18502	37595
	6	US-312	40439	45127	0	18353	46057	43998	93283	88147	25517	39849	44077
		T2 Mean	**55364**	**44428**	**0**	**20712**	**46851**	**32967**	**97533**	**64780**	**29468**	**40409**	**43251**
T3 (Silixol + water stress)	1	HRI-174	48838	38991	0	14687	34067	28316	68833	9550	29304	32841	30543
	2	KRH-4	63815	50425	0	29838	36179	27212	77500	12487	30196	48533	37618
	3	PA-6129	42546	38916	0	21123	32142	23741	71633	10663	33601	32713	30708
	4	PA-6444	42818	39697	0	16474	38819	27161	71700	9743	35832	46383	32863
	5	SAHABHAGIDHAN	45898	39636	0	16168	38951	20618	51100	2773	29148	19162	26345
	6	US-312	35374	44546	0	34535	35387	32880	55750	2043	27009	38871	30640
		T3 Mean	**46548**	**42035**	**0**	**22138**	**35924**	**26655**	**66086**	**7877**	**30848**	**36417**	**31453**
T4 (water stress)	1	HRI-174	48280	37266	0	21727	32472	29221	58933	9620	17838	39527	29488
	2	KRH-4	63037	47917	0	32803	33583	36106	57000	6320	24445	48410	34962
	3	PA-6129	38426	39554	0	16847	26829	30919	49650	6110	18285	42606	26923
	4	PA-6444	42316	36761	0	30290	36069	27762	58733	10670	37570	31171	31134
	5	SAHABHAGIDHAN	46552	41501	0	15130	34452	24900	41133	3350	19381	21836	24824
	6	US-312	34476	43212	0	23715	32637	36033	45417	5480	24860	38598	28443
		T4 Mean	**45515**	**41035**	**0**	**23419**	**32674**	**30823**	**51811**	**6925**	**23730**	**37025**	**29296**
		Grand Mean	**50454**	**42678**	**0**	**21654**	**39518**	**30343**	**69023**	**30737**	**26679**	**38064**	**34915**
		LSD (Silicon)				1447*			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				6086**			LSD(Centre x Silicon x Variety)			14919**	
		LSD(Variety)				2359**			CV Treat (%)			19.65	
		LSD (Centre x Variety)				7459**			CV Residual (%)			20.22	

Table 6.1.11 Influence of Silica application spikelet number/m2 at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	54820	55023	0	42149	43175	40697	60750	53307	24076	55433	47714
	2	KRH-4	71637	64960	0	30695	44517	41124	94900	66600	25836	58625	55433
	3	PA-6129	49858	57694	0	23509	42900	31226	72167	78400	32892	40105	47639
	4	PA-6444	48757	58168	0	21991	50061	30543	68650	62120	31411	65078	48531
	5	SAHABHAGIDHAN	66185	51994	0	15345	48730	34327	56533	123147	26443	19448	49128
	6	US-312	42973	56301	0	18673	47927	43600	58333	66800	22888	35880	43708
		T1 Mean	**55705**	**57357**	**0**	**25394**	**46218**	**36920**	**68556**	**75062**	**27257**	**45762**	**48692**
T2 (0.6% Silixol)	1	HRI-174	59149	53360	0	25255	50655	45385	110317	78693	31249	52724	56310
	2	KRH-4	76936	77563	0	39408	46816	38410	142533	71667	37356	54959	65072
	3	PA-6129	54399	47648	0	24837	49093	31977	105500	71560	28652	42842	50723
	4	PA-6444	53624	56058	0	22144	55484	27381	101983	71973	35641	76263	55617
	5	SAHABHAGIDHAN	53733	54015	0	17003	51337	40239	86933	64400	38160	22604	47603
	6	US-312	42525	60600	0	18447	50556	46207	102717	107427	28406	45510	55822
		T2 Mean	**56728**	**58207**	**0**	**24516**	**50657**	**38267**	**108331**	**77620**	**33244**	**49150**	**55191**
T3 (Silixol + water stress)	1	HRI-174	49586	53126	0	20150	38445	34720	81617	15390	33235	40560	40759
	2	KRH-4	64542	70977	0	36515	40293	31708	86700	20600	34374	63427	49904
	3	PA-6129	44076	60836	0	23603	36597	30503	80900	10700	37617	35272	40012
	4	PA-6444	44077	52447	0	23359	43384	35293	83500	13520	40023	54625	43359
	5	SAHABHAGIDHAN	46602	51576	0	18636	44121	26681	62700	6340	32589	22120	34596
	6	US-312	37089	55410	0	41888	40172	38677	63217	13980	31437	43844	40635
		T3 Mean	**47662**	**57395**	**0**	**27359**	**40502**	**32930**	**76439**	**13422**	**34879**	**43308**	**41544**
T4 (water stress)	1	HRI-174	49077	45597	0	26493	36960	37297	75433	13740	22371	49442	39601
	2	KRH-4	63815	65555	0	36393	38291	44011	67333	10340	28924	63036	46411
	3	PA-6129	39739	59318	0	19570	31284	39389	60483	19240	21253	52010	38032
	4	PA-6444	43562	48810	0	35870	41239	35411	73433	18380	41733	38951	41932
	5	SAHABHAGIDHAN	47235	52786	0	14521	39996	31834	53000	4730	23343	27473	32769
	6	US-312	36195	53436	0	28963	38280	41212	57033	9180	28599	46752	37739
		T4 Mean	**46604**	**54251**	**0**	**26968**	**37675**	**38192**	**64453**	**12602**	**27704**	**46277**	**39414**
		Grand Mean	**51675**	**56802**	**0**	**26059**	**43763**	**36577**	**79444**	**44676**	**30771**	**46124**	**41589**
		LSD (Silicon)				ns			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				6506**			LSD(Centre x Silicon x Variety)			17430**	
		LSD(Variety)				2773**			CV Treat (%)			17.6	
		LSD (Centre x Variety)				8770**			CV Residual (%)			19.15	

Table 6.1.12 Influence of Silica application 1000 grain weight (g) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	20.3	22.4	22.5	27.4	21.0	20.8	21.0	21.7	18.1	18.7	21.4
	2	KRH-4	21.1	18.5	17.8	30.3	21.8	17.3	19.1	23.0	21.6	15.3	20.6
	3	PA-6129	23.8	23.9	25.9	35.9	21.1	21.1	23.9	18.3	18.7	19.3	23.2
	4	PA-6444	24.9	23.3	22.9	38.2	21.2	21.0	21.3	20.0	20.2	25.3	23.8
	5	SAHABHAGIDHAN	24.3	21.8	23.6	33.4	21.1	23.1	20.8	21.7	20.2	14.0	22.4
	6	US-312	23.1	20.3	19.6	30.4	21.1	23.6	21.4	21.0	20.1	27.0	22.8
		T1 Mean	**23.0**	**21.7**	**22.0**	**32.6**	**21.2**	**21.1**	**21.2**	**20.9**	**19.8**	**19.9**	**22.3**
T2 (0.6% Silixol)	1	HRI-174	18.3	22.9	21.9	34.5	22.2	20.7	22.7	16.7	17.5	21.7	21.9
	2	KRH-4	21.4	18.0	17.9	28.3	25.4	16.5	21.7	16.7	19.7	16.7	20.2
	3	PA-6129	24.5	24.1	24.8	33.7	22.2	20.4	24.1	18.3	14.5	19.3	22.6
	4	PA-6444	24.1	21.4	23.3	34.6	20.9	19.9	23.3	16.7	20.2	24.0	22.8
	5	SAHABHAGIDHAN	23.5	22.4	22.5	27.3	22.1	18.9	20.7	18.3	20.2	15.0	21.1
	6	US-312	20.6	20.1	19.2	43.7	22.0	19.3	22.7	20.0	15.0	29.3	23.2
		T2 Mean	**22.1**	**21.5**	**21.6**	**33.7**	**22.4**	**19.3**	**22.5**	**17.8**	**17.9**	**21.0**	**22.0**
T3 (Silixol + water stress)	1	HRI-174	16.0	23.1	22.7	41.3	19.6	22.0	20.4	15.0	16.7	19.0	21.6
	2	KRH-4	16.8	18.4	17.6	28.9	19.1	17.8	18.7	13.3	17.8	19.0	18.7
	3	PA-6129	19.5	24.1	25.4	48.4	19.3	21.5	21.1	11.7	20.4	19.3	23.1
	4	PA-6444	20.6	23.5	22.2	39.9	19.8	21.6	22.2	13.3	20.5	24.3	22.8
	5	SAHABHAGIDHAN	19.9	22.1	22.2	40.5	20.0	21.4	22.5	11.7	20.3	15.0	21.6
	6	US-312	18.8	20.1	20.8	30.4	19.5	18.4	18.7	13.3	21.8	27.7	21.0
		T3 Mean	**18.7**	**21.9**	**21.8**	**38.2**	**19.6**	**20.5**	**20.6**	**13.1**	**19.6**	**20.7**	**21.5**
T4 (water stress)	1	HRI-174	13.0	23.4	0.0	36.9	17.8	19.9	19.9	15.0	18.3	19.3	20.4
	2	KRH-4	13.8	18.4	0.0	32.2	17.3	19.9	17.2	13.3	19.7	17.3	18.8
	3	PA-6129	16.5	24.4	0.0	44.5	18.6	21.7	21.3	11.7	12.4	22.0	21.5
	4	PA-6444	17.6	23.4	0.0	35.5	18.2	21.8	20.7	18.3	17.7	23.0	21.8
	5	SAHABHAGIDHAN	16.9	22.7	0.0	31.5	18.1	22.0	20.7	13.3	19.2	15.7	20.0
	6	US-312	15.8	19.8	0.0	38.5	18.2	18.1	19.4	13.3	18.1	27.7	21.0
		T4 Mean	**15.7**	**22.0**	**0.0**	**36.5**	**18.0**	**20.6**	**19.9**	**14.2**	**17.6**	**20.8**	**20.6**
		Grand Mean	**19.8**	**21.8**	**16.4**	**35.3**	**20.3**	**20.4**	**21.1**	**16.5**	**18.7**	**20.6**	**21.1**
		LSD (Silicon)				ns			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				2.84**			LSD(Centre x Silicon x Variety)			ns	
		LSD(Variety)				0.794*			CV Treat (%)			15.21	
		LSD (Centre x Variety)				3.30**			CV Residual (%)			14.876	

Table 6.1.13 Influence of Silica application Total dry matter (g/m2) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	1362	2101	55	3038	920	1201	2158	1073	220	1208	1334
	2	KRH-4	1610	2181	54	2354	1109	1188	2325	1313	218	1153	1351
	3	PA-6129	1600	2067	58	1260	1282	920	1617	1247	239	1036	1133
	4	PA-6444	1511	2085	49	2289	918	1004	2292	1180	223	1461	1301
	5	SAHABHAGIDHAN	1528	1798	59	1019	1102	1029	1508	1313	223	555	1013
	6	US-312	1469	2067	54	2206	1091	1204	1942	1433	227	1351	1304
		T1 Mean	**1513**	**2050**	**55**	**2028**	**1070**	**1091**	**1974**	**1260**	**225**	**1127**	**1239**
T2 (0.6% Silixol)	1	HRI-174	1372	2265	57	3159	964	1614	2200	1707	321	1264	1492
	2	KRH-4	1771	2184	54	2775	1157	1265	2092	1820	316	1163	1460
	3	PA-6129	1638	2007	58	1614	1446	1039	1750	1567	324	1114	1256
	4	PA-6444	1518	1966	53	2581	928	1070	2333	1567	324	1450	1379
	5	SAHABHAGIDHAN	1584	1806	57	1405	1120	1231	1575	1267	319	551	1092
	6	US-312	1312	2002	46	2672	1081	1505	2158	2273	324	1478	1485
		T2 Mean	**1533**	**2038**	**54**	**2368**	**1116**	**1287**	**2018**	**1700**	**321**	**1170**	**1361**
T3 (Silixol + water stress)	1	HRI-174	1261	1973	57	2839	926	916	2075	530	344	1120	1204
	2	KRH-4	1468	1993	55	3167	1105	833	2008	420	323	1120	1249
	3	PA-6129	1673	1957	53	1911	1205	774	1633	735	317	962	1122
	4	PA-6444	1358	1934	55	2788	919	802	2000	565	945	1458	1282
	5	SAHABHAGIDHAN	1682	1919	58	1525	1033	767	1483	335	344	629	977
	6	US-312	1250	1860	57	2945	1156	972	1950	440	354	1303	1229
		T3 Mean	**1449**	**1939**	**56**	**2529**	**1057**	**844**	**1858**	**504**	**438**	**1099**	**1177**
T4 (water stress)	1	HRI-174	1468	1962	0	2674	854	1092	2142	395	295	1030	1324
	2	KRH-4	1705	2100	0	2651	959	986	2517	410	291	1216	1426
	3	PA-6129	1348	1954	0	1778	1090	810	1575	450	244	940	1132
	4	PA-6444	1348	1951	0	3018	891	950	2292	605	304	1399	1418
	5	SAHABHAGIDHAN	1374	1760	0	1635	1012	860	1425	360	256	653	1037
	6	US-312	1227	1932	0	2780	1210	1201	2333	665	274	1474	1455
		T4 Mean	**1412**	**1943**	**0**	**2423**	**1003**	**983**	**2047**	**481**	**277**	**1119**	**1299**
		Grand Mean	**1477**	**1993**	**41**	**2337**	**1062**	**1051**	**1974**	**986**	**315**	**1129**	**1236**
		LSD (Silicon)				ns			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				199**			LSD(Centre x Silicon x Variety)			ns	
		LSD(Variety)				53.2*			CV Treat (%)			18.3	
		LSD (Centre x Variety)				221**			CV Residual (%)			16.9	

Table 6.1.14 Influence of Silica application Grain yield (g/m2) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	690.7	933.0	818.7	833.0	480.0	596.4	853.3	685.7	218.9	443.0	655.3
	2	KRH-4	794.0	907.3	804.7	418.3	574.7	420.4	802.0	739.7	263.1	404.0	612.8
	3	PA-6129	801.0	1022.3	718.3	424.3	600.0	356.9	784.0	654.3	303.4	410.0	607.5
	4	PA-6444	746.3	916.3	688.0	603.0	470.0	382.4	914.0	737.0	310.6	493.0	626.1
	5	SAHABHAGIDHAN	760.3	907.7	831.3	629.3	551.0	462.4	734.3	543.3	286.7	237.7	594.4
	6	US-312	639.0	910.0	912.3	763.3	576.0	562.8	808.3	442.0	256.6	491.0	636.1
		T1 Mean	**738.6**	**932.8**	**795.6**	**611.9**	**541.9**	**463.6**	**816.0**	**633.7**	**273.2**	**413.1**	**622.0**
T2 (0.6% Silixol)	1	HRI-174	705.7	985.7	879.7	709.0	491.7	676.6	925.7	913.0	287.1	472.7	704.7
	2	KRH-4	842.7	987.7	835.0	745.3	588.3	491.4	914.0	825.3	327.7	459.0	701.6
	3	PA-6129	800.7	952.7	701.7	698.0	668.3	433.0	955.0	470.3	236.3	449.0	636.5
	4	PA-6444	761.7	918.3	814.0	818.7	479.0	433.0	988.0	974.3	353.7	531.0	707.2
	5	SAHABHAGIDHAN	775.3	918.0	781.0	351.7	566.3	517.1	833.7	665.3	324.7	245.0	597.8
	6	US-312	647.0	907.7	913.0	852.3	590.3	706.1	993.7	854.3	256.6	552.7	727.4
		T2 Mean	**755.5**	**945.0**	**820.7**	**695.8**	**564.0**	**542.9**	**935.0**	**783.8**	**297.7**	**451.6**	**679.2**
T3 (Silixol + water stress)	1	HRI-174	521.7	897.0	840.7	885.3	453.7	352.8	795.3	97.7	279.5	382.7	550.6
	2	KRH-4	558.3	925.3	892.7	946.3	531.3	274.6	769.3	96.3	303.3	406.0	570.3
	3	PA-6129	600.7	940.0	773.3	595.7	536.7	299.5	914.3	90.7	325.4	378.0	545.4
	4	PA-6444	577.7	933.3	811.3	984.0	445.7	232.8	805.7	98.7	340.8	488.0	571.8
	5	SAHABHAGIDHAN	591.7	873.7	739.3	415.7	492.7	327.2	759.3	98.3	325.0	258.7	488.2
	6	US-312	484.3	895.0	880.0	616.0	535.7	327.0	854.0	109.7	326.5	400.0	542.8
		T3 Mean	**555.7**	**910.7**	**822.9**	**740.5**	**499.3**	**302.3**	**816.3**	**98.6**	**316.8**	**385.6**	**544.9**
T4 (water stress)	1	HRI-174	478.7	873.0	0.0	748.0	411.0	446.2	776.7	83.0	197.0	363.0	486.3
	2	KRH-4	542.0	884.7	0.0	830.3	488.0	309.8	874.0	102.7	293.1	393.0	524.2
	3	PA-6129	537.3	964.0	0.0	483.7	458.7	335.7	766.0	99.0	203.8	337.7	465.1
	4	PA-6444	534.7	858.3	0.0	950.3	429.3	377.3	798.0	104.3	265.4	444.0	529.1
	5	SAHABHAGIDHAN	548.7	940.7	0.0	374.7	473.0	347.6	667.3	73.0	210.5	261.7	433.0
	6	US-312	441.7	854.3	0.0	729.3	526.3	468.0	920.0	60.3	244.4	411.0	517.3
		T4 Mean	**513.8**	**895.8**	**0.0**	**686.1**	**464.4**	**380.8**	**800.3**	**87.1**	**235.7**	**368.4**	**492.5**
		Grand Mean	**640.9**	**921.1**	**813.1**	**683.6**	**517.4**	**422.4**	**841.9**	**400.8**	**280.8**	**404.7**	**592.7**
		LSD (Silicon)				24.5*			LSD(Silicon X Variety)				ns
		LSD(Centre x Silicon)				102.9**			LSD(Centre x Silicon x Variety)				188**
		LSD(Variety)				ns			CV Treat (%)				20.7
		LSD (Centre x Variety)				29.8**			CV Residual (%)				15.6

Table 6.1.15 Influence of Silica application Harvest Index (%) at different AICRIP locations Kharif 2018

Treat	S.No.	Genotypes	CBT	IIRR	KJT	KRK	MTU	NRRI	PNR	PTB	RANCHI	TTB	Grand Mean
T1 (Control)	1	HRI-174	50.7	44.4	50.0	27.7	52.4	49.7	39.6	36.0	38.0	36.8	42.5
	2	KRH-4	49.3	41.6	46.2	17.7	51.8	35.3	34.6	39.0	42.4	35.0	39.3
	3	PA-6129	50.0	49.5	45.5	35.0	46.9	38.7	48.5	22.3	49.7	39.6	42.6
	4	PA-6444	49.7	44.0	44.4	27.0	51.3	38.0	39.9	30.3	48.0	33.8	40.6
	5	SAHABHAGIDHAN	49.7	50.5	44.4	59.3	50.3	45.3	48.6	22.3	45.3	42.9	45.9
	6	US-312	43.7	44.3	45.5	33.3	52.9	47.3	41.7	19.7	43.1	36.3	40.8
		T1 Mean	**48.8**	**45.7**	**46.0**	**33.3**	**50.9**	**42.4**	**42.1**	**28.3**	**44.4**	**37.4**	**41.9**
T2 (0.6% Silixol)	1	HRI-174	51.3	43.5	50.0	22.0	51.0	42.0	42.1	37.7	44.5	37.5	42.2
	2	KRH-4	47.7	45.3	45.5	28.0	50.8	39.0	43.7	38.0	49.8	39.5	42.7
	3	PA-6129	48.7	47.5	45.5	43.3	46.3	41.3	54.6	20.7	34.6	40.3	42.3
	4	PA-6444	50.3	46.7	44.4	32.0	51.6	40.7	42.4	30.7	52.8	36.6	42.8
	5	SAHABHAGIDHAN	48.7	50.9	44.4	24.0	50.8	42.3	53.0	29.7	49.5	44.5	43.8
	6	US-312	49.7	45.5	45.5	32.7	54.6	46.7	46.0	39.0	36.4	37.6	43.4
		T2 Mean	**49.4**	**46.6**	**45.9**	**30.3**	**50.9**	**42.0**	**47.0**	**32.6**	**44.6**	**39.3**	**42.9**
T3 (Silixol + water stress)	1	HRI-174	41.3	45.5	50.0	31.3	49.1	38.7	38.3	11.7	45.9	34.3	38.6
	2	KRH-4	38.0	46.4	46.9	30.0	48.1	33.7	38.3	14.7	45.1	36.3	37.8
	3	PA-6129	36.0	48.0	45.5	31.0	44.6	39.0	55.9	11.7	47.8	39.3	39.9
	4	PA-6444	42.7	48.3	44.4	35.3	48.5	29.0	40.3	13.0	50.5	33.5	38.6
	5	SAHABHAGIDHAN	35.0	45.6	44.4	28.0	47.8	43.0	51.2	13.0	48.4	41.2	39.8
	6	US-312	38.7	48.2	45.5	21.0	46.5	34.3	43.7	8.7	49.0	30.7	36.6
		T3 Mean	**38.6**	**47.0**	**46.1**	**29.4**	**47.4**	**36.3**	**44.6**	**12.1**	**47.8**	**35.9**	**38.5**
T4 (water stress)	1	HRI-174	32.7	44.5	0.0	28.3	48.2	41.0	36.2	12.0	34.5	35.9	31.3
	2	KRH-4	31.7	42.2	0.0	31.3	50.9	31.3	34.8	9.3	45.7	32.4	31.0
	3	PA-6129	40.0	49.4	0.0	27.3	42.1	41.3	48.6	12.0	31.9	36.0	32.9
	4	PA-6444	39.7	44.0	0.0	31.3	48.2	39.7	35.0	14.0	42.0	32.1	32.6
	5	SAHABHAGIDHAN	39.7	53.6	0.0	22.3	46.8	40.3	46.8	14.0	36.7	40.1	34.0
	6	US-312	36.0	44.3	0.0	26.0	43.5	39.3	39.4	10.7	40.1	28.3	30.8
		T4 Mean	**36.6**	**46.3**	**0.0**	**27.8**	**46.6**	**38.8**	**40.2**	**12.0**	**38.5**	**34.1**	**32.1**
		Grand Mean	**43.4**	**46.4**	**34.5**	**30.2**	**49.0**	**39.9**	**43.5**	**21.3**	**43.8**	**36.7**	**38.9**
		LSD (Silicon)				1.53*			LSD(Silicon X Variety)			ns	
		LSD(Centre x Silicon)				6.45**			LSD(Centre x Silicon x Variety)			12.45**	
		LSD(Variety)				ns			CV Treat (%)			18.7	
		LSD (Centre x Variety)				1.97**			CV Residual (%)			15.17	

6.2 Screening of elite rice cultures for drought tolerance:

Locations: NRRI, RANCHI, RPR, PTB AND REWA

Improving crops yield under water-limited conditions is the most daunting challenge faced by breeders. To this end, accurate, relevant phenotyping plays an increasingly pivotal role for the selection of drought-resilient genotypes and, more in general, for a meaningful dissection of the quantitative genetic landscape that underscores the adaptive response of crops to drought. Crops are exposed to the ravages of drought in various ways and to different extents. Unfortunately, global climate change will increase the occurrence and severity of drought episodes, not least due to the higher evapotranspirative demand created by rising temperatures. Altogether, these changes have already been shown to offset a significant portion of the increases in average yields that during the past three decades arose from technology. Identification of suitable rice cultures for rainfed conditions is one of the research area of Plant Physiology group under AICRIP. A trial to study the drought tolerance traits of rice cultures with respect to yield and other attributes under dry spells was conducted with 22 AVT entries and 8 released varieties at 5 AICRIP centres. The treatments consisted of two irrigation regimes a. Irrigated as per the recommended schedule and one totally rainfed condition without any supplementary irrigation.

The stem weight/plant (g) is an important parameter as the stems store carbon and nitrogen during vegetative stage and remobilize the same during grain filling period and supplement the carbon from flag leaf photosynthesis. The data indicated that the mean stem weight (mean of all genotypes and locations) show 25% reduction over irrigated control under rainfed condition (Table 6.2.1). The reduction in stem weight varies between 45.6% over irrigated control (IET 27520) to only 3% (IET 27528). IET 27519 and IET 27529 are the other genotypes wherein the reduction in stem weight is <10% (Fig.1 & Table 6.2.1). Significant differences in the mean stem weight was observed between the locations. The interaction between Location x Treatment was statistically significant ($p<0.01$). The reduction in stem weight was highest at PTB (46% reduction over control) centre followed by NRRI (24.8% over control). Minimum reduction was observed at RANCHI (10% reduction over control). However, a minor improvement in mean stem weight was observed at RPR.

No. of tillers per plant is an important factor which will determine the final yield in rice crop. The mean tiller number (mean of all genotypes and locations) was not influenced by the water regimes. Under irrigated conditions the mean tiller no. is 10.7 where as under rainfed condition the same is 10.3 per plant. However, the interaction between Location x Treatment was highly significant ($p<0.01$) indicating that the drought effect was not uniform across the location, which is dependent on the rain fall and its distribution throughout the crop growth period *(Table 6.2.2).* The interaction between Location x Genotype was also found to be significant ($p<0.01$). However, the differences between the genotypes were found to be non-significant. The interaction between Treatment x Genotype is also found to be non-significant. However, the three way interaction between Treatment x Genotype x Location was significant ($p<0.01$). The tiller No./plant was reduced under rain fed conditions in Samaleshwari, IET 27509, IET 27523, 27530 and 27515 (10% over irrigated control). In

the remaining entries the % change is less than 10%. A marginal but non-significant increase in tiller number was observed at some locations (Fig.2).

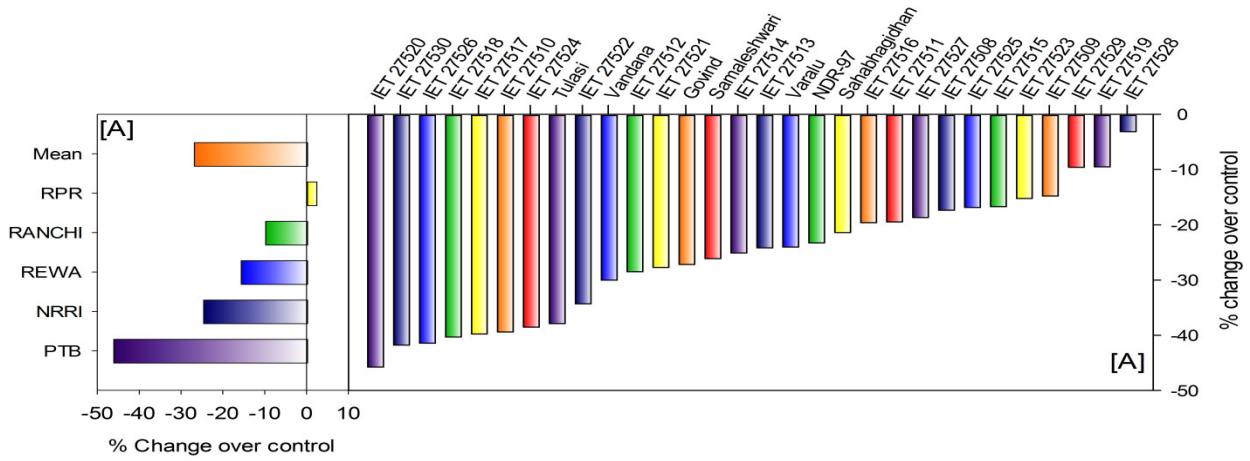


Fig. 1 Influence of water regimes on stem weight (g/plant) in different rice genotypes and locations during kharif 2018. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all locations and treatments. [B] Mean of all genotypes and treatments

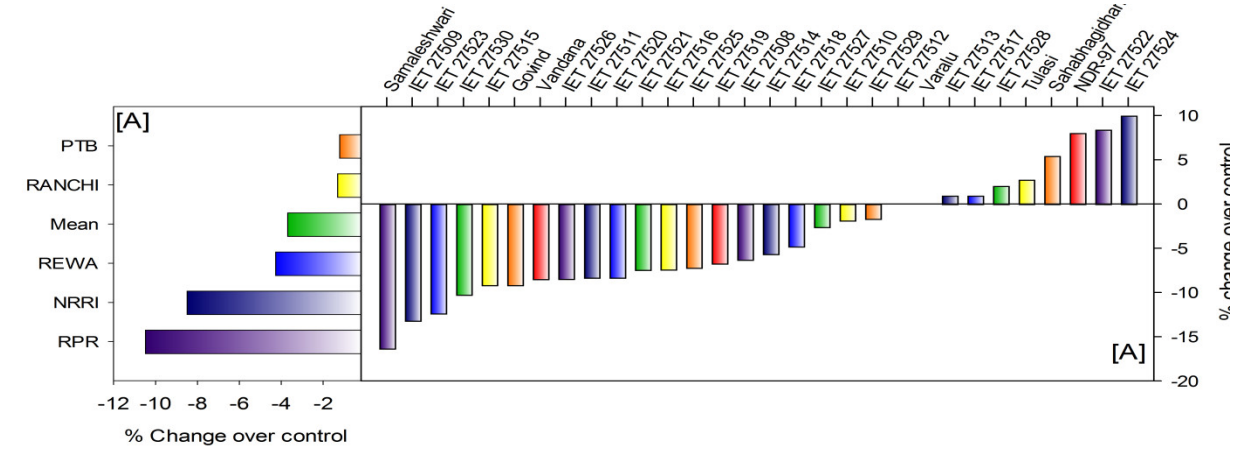


Fig. 2 Influence of water regimes on Tiller No./Plant in different rice genotypes and locations during kharif 2018. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all genotypes and treatments. [B] Mean of all locations and treatments

Table 6.2.3 present the data shoot weight (g m^{-2}) recorded at maturity. Analysis of variation revealed that treatments had no significant effect on this trait. However, the interaction between Location x Treatment was found to be significant ($p<0.01$) indicating that the treatment effect differs from location to location, which could mainly due to rain fall and its distribution. The mean stem weight was reduced by 44.3% under rainfed condition. The differences amongst the genotypes for mean (mean of all treatments and locations) is non-significant. However, the interaction Location x Genotype was found to be significant ($p<0.01$). The reduction in shoot weight was very high at PTB centre followed by Ranchi (46% over control) and RPR (37%). At NRRI and REWA the reduction in shoot weight is only 15% over irrigated control. Maximum reduction in mean shoot weight (mean of all

locations) in IET 27522 (60% reduction over control) and Samaleswari (59% over control) minimum reduction was observed in IET27523 (21% over control) (Fig.3).

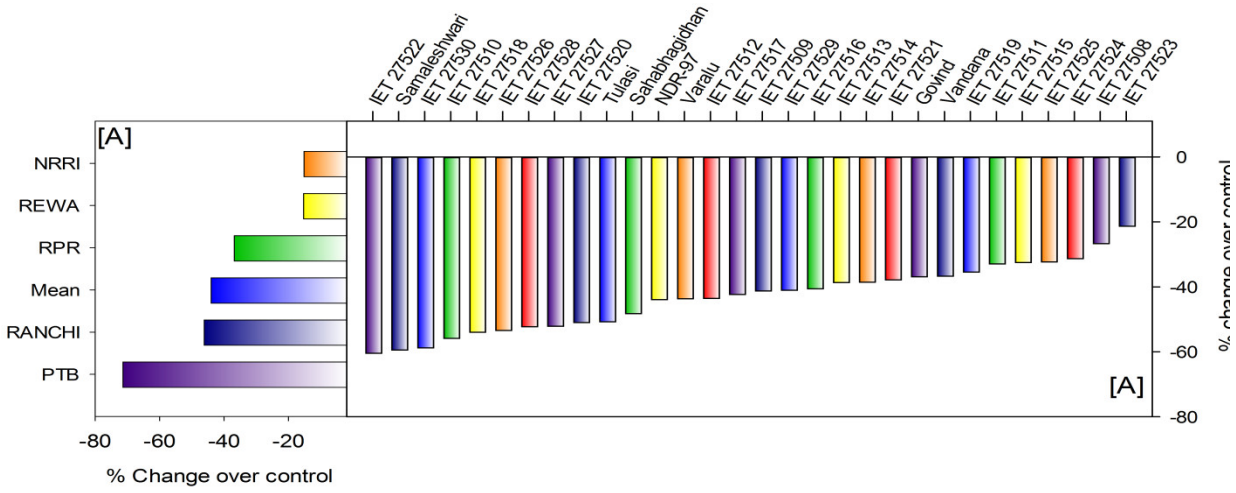


Fig. 3 Influence of water regimes on Shoot weight/m^2 in different rice genotypes and locations during kharif 2018. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all genotypes and treatments. [B] Mean of all locations and treatments

No. of grains per panicle is one of the important trait which influence the final grain yield. Analysis of variance revealed that the water regimes had a significant ($p<0.01$) effect on number of grains/panicle. The mean grain number under irrigated control condition was 107 which was reduced to 71 grains/panicle under rain fed condition (33.6% reduction over control). The interaction between Location x Treatment was non-significant (Table 6.2.4). The differences amongst the genotypes was non-significant for grain No./panicle. However, the interaction Location x Genotype was found to be significant ($p<0.01$).

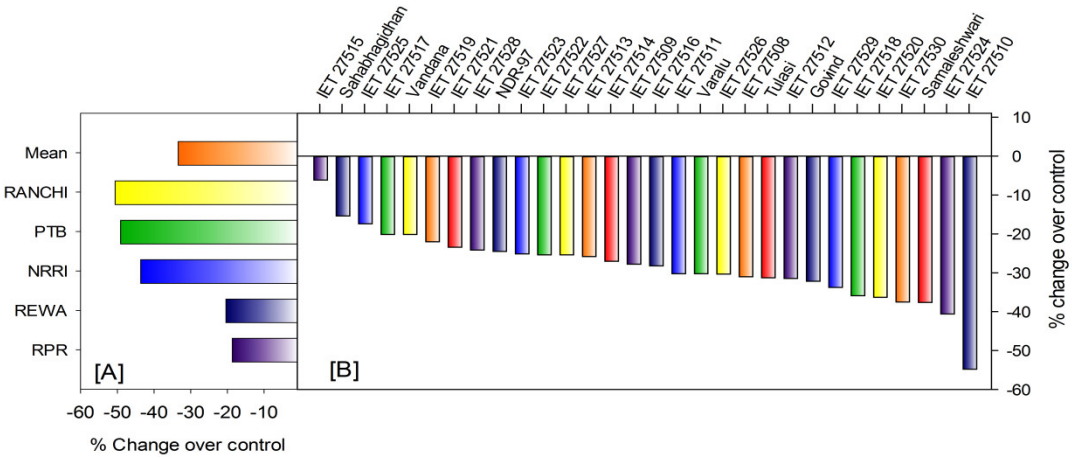


Fig.4 Influence of water regimes on No. of Grains. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all genotypes and treatments. [B] Mean of all locations and treatments

Maximum reduction in grain No./panicle was observed at Ranchi and PTB centres (50 and 49% reduction over irrigated control). Minimum reduction was observed in RPR (18%

reduction over control). The three way interaction between Location x Genotype x Treatment was found to be significant ($p<0.01$). Significant variation was observed in the extent of reduction in No.grains/panicle. Maximum reduction was observed in IET 27510 (>50% over control) followed by IET 27524 (>40% over control). Minimum reduction was observed in IET 27515 (6% over control) followed by Sahabhagidhan (15% over control).

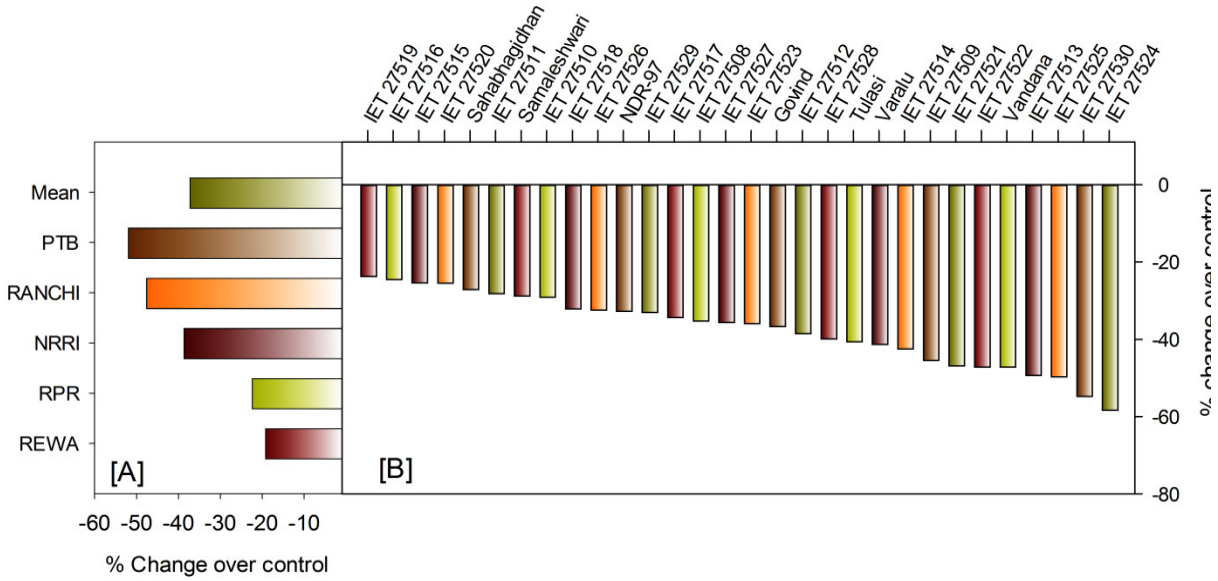


Fig. 5 Influence of water regimes on HI(%) different rice genotypes and locations during kharif 2018. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all genotypes and treatments. [B] Mean of all locations and treatments.

Water regimes show significant effect on HI (%). The mean HI for all genotypes and locations was 42.2 under irrigated condition which was reduced to 26.4 under rain fed condition (>37% reduction over control) (Table 6.2.8). The interaction between Location x Treatment was statistically significant ($p<0.01$). The reduction in HI under rain fed condition is maximum at PTB centre (52% reduction over control) followed by Ranchi (48% over control). The reduction in HI was relatively lower at REWA (19% over control) and RPR (22% over control) centres. The reduction in mean HI varied between a maximum of 58% (IET 27524) followed by IET 27530 (54% over control) and the reduction is relatively lower in IET 27519 (23% over control) followed by IET 27516, IET 27515 and IET 27520 (Table 6.2.8). However, the interaction between Treatment x Genotype was found to be non-significant. The three factor interaction between Location x Genotype x Treatment was highly significant ($p<0.01$) which indicate that the response of genotypes varied from location depending on the water regimes at that centre which is in turn dependent on the rain fall and its distribution during crop growth period.

The 1000 grain weight is another important trait which contributes to the grain yield. The mean test weight (mean of genotypes and locations) was 22.1g under irrigated control condition which was reduced to 17.9g under rain fed condition (>19% reduction) (Table 6.2.9). However, the effect of treatment was reported to be non-significant. Nevertheless, the interaction between Location x Treatment was statistically significant ($p<0.01$) implying that the treatment varied from one location to another location, which is mainly due to different

rain fall and its distribution across the locations. The variation observed between the genotypes for test weight is highly significant ($p<0.01$). The mean test weight was reduced in all genotypes under rain fed condition. The reduction varied from a maximum of >35% over irrigated control (IET 27524) followed by Govind (>29% over control) and minimum reduction was observed in IET 27509 (3.8% over control). The reduction in test weight was <10% in Samaleswari and IET 27529. The reduction in mean test weight was maximum at Ranchi (32% over control) followed by PTB (29% over control) and relatively lower reduction was observed in NRRI centre (>6% over control).

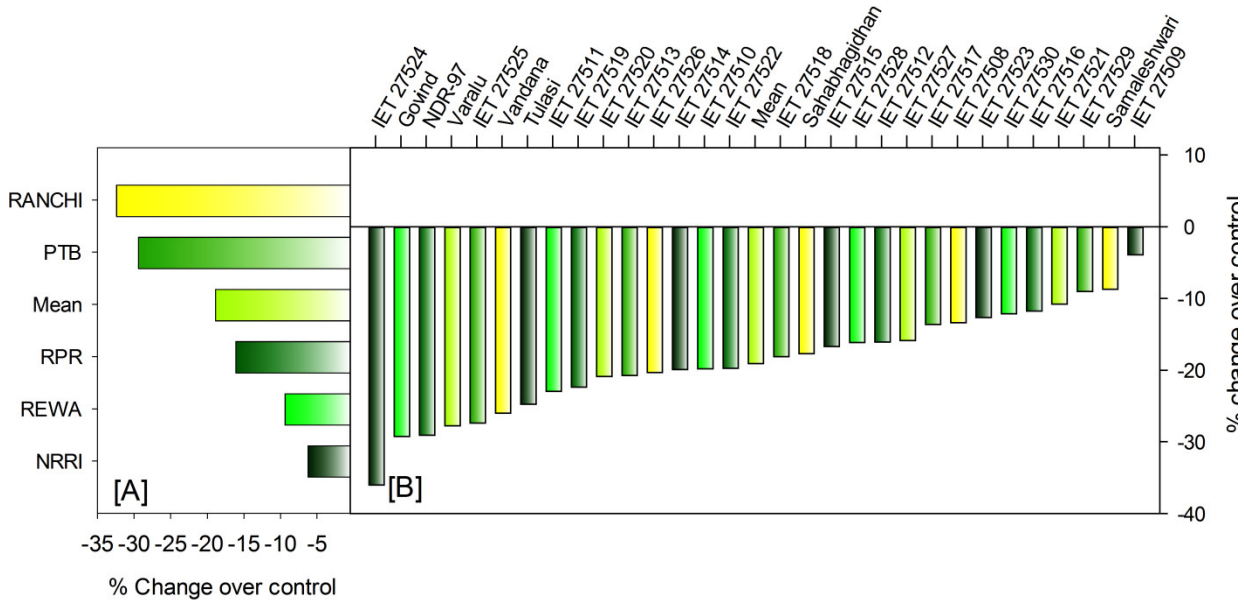


Fig. 6 Influence of water regimes on 1000 grain weight(g) different rice genotypes and locations during kharif 2018. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all genotypes and treatments. [B] Mean of all locations and treatments.

The data pertaining to Grain yield (g m^{-2}) was presented in Table 6.2.10. The results of Analysis of Variance indicated that grain yield was significantly ($p<0.01$) affected by the water regimes. The grain yield was reduced by >55% under rain fed condition in comparison to the irrigated control. The interaction between Location x Treatment was highly significant ($p<0.01$). Significant differences were observed in mean grain yield (mean of genotypes and locations) amongst the locations. Maximum reduction was observed at PTB centre where in a substantial reduction in grain yield was observed (>85% reduction over control) followed by Ranchi (<74% over control), NRRI (>57% over control). The mean grain yield reduction at REWA and RPR is <50% over control. All the tested genotypes suffered substantial yield losses under rain fed condition (Table 6.2.10). The reduction in grain yield was highest in IET 27524, Tulasi, IET27510 and IET 27509. In fact, very few entries show like IET 27515, Sahabhagidhan and IET 27525 show yield reduction <50% over irrigated control. All other entries suffered substantial yield losses under rain fed condition.

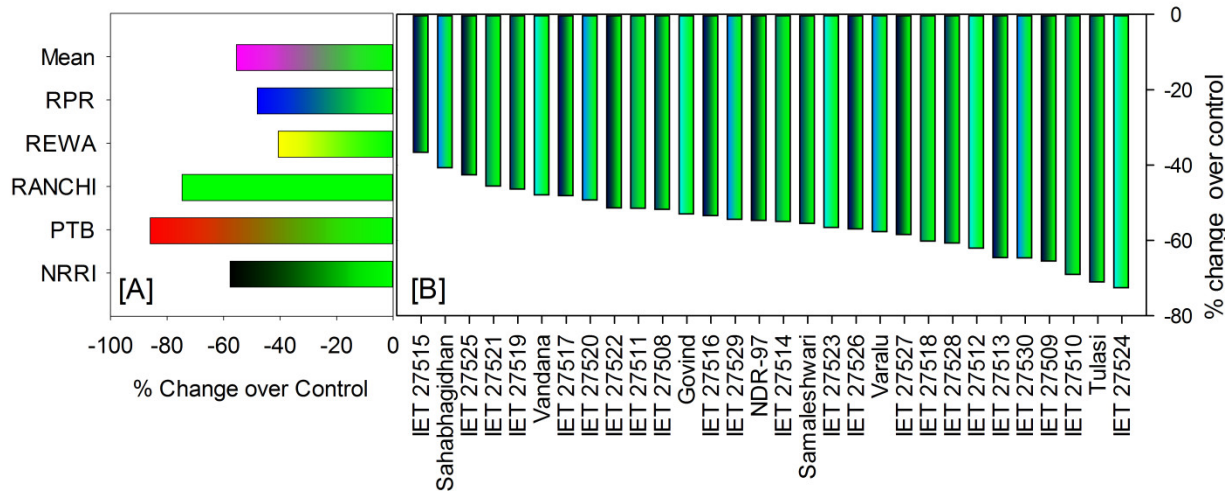


Fig. 7: *6 Influence of water regimes on Grain Yield (g m^{-2}) different rice genotypes and locations during kharif 2018. Each bar represents % change in rain fed crop over irrigated control.[A] Mean of all genotypes and treatments. [B] Mean of all locations and treatments*

Drought Tolerance Indices: Loss of yield is the main concern of plant breeders and they hence emphasize on yield performance under stress conditions. Thus, drought indices which provide a measure of drought based on loss of yield under drought-conditions in comparison to normal conditions have been used for screening drought/tolerant genotypes. In order to identify genotypes tolerant to drought, different indices were computed based on the grain yield recorded under ambient and elevated conditions. Different Drought tolerance indices including Drought susceptibility index (DSI), Relative Drought index (RDI), Drought tolerance index (DTI), Geometric mean productivity (GMP), Tolerance (TOL), Mean production (MP), Yield index (YI), Heatt resistance index (HI), Yield stability index (YSI), Modified stress tolerance index (KiSTI), were calculated using the relationships of (Fischer and Maurer, 1978; Fischer et al., 1998; Fernandez, 1992; Rosielle and Hamblin, 1981; Bouslama and Schapaugh, 1984; Blum, 1988; Moosavi et al., 2008; Farshadfar and Sutka, 2002). For calculating different drought indices, the means of all locations were used.

The results of Drought tolerance indices were presented on Table 6.2.12. The data revealed that significant variation was observed amongst the genotypes for different drought indices. The variety Govind produced highest yield followed by IET 27514, 27522, 27520, 27525, 27519 and Sammaleswari under rainfed condition and may be considered as relatively suitable for rainfed condition. Based on different drought indices individual entries were ranked. The rank sum and mean rank was calculated for each entry and standard error was computed. The genotype having high Mean Rank ±low SEm was considered as most suitable for rain fed conditions as they have relative tolerance to water stressed conditions. The data pertaining to the drought indices and their ranks were presented in Table. 6.2.12. The data revealed that Govind, IET 27514, IET 27522IET 27515, IET 27517, IET 27519, IET 27520

and IET 27525 have high Mean Rank with low SEm and they may be considered as relatively drought tolerant and are suitable for rain fed cultivation. Multiple correlation was performed between yield, measured rain fed condition and drought tolerance indices. The correlation analysis between grain yield and tolerance indices can be a good criterion for screening the best cultivars and indices used. A suitable index must have a significant association with yield recorded under stress condition Table 6.2.12 presents the results of correlation analysis which indicate that the indices like GMP (Geometric Mean Production), HM (Hormonic Mean), K2STI (Modified Stress Tolerance Index), Yield index (YI) showed highly significant positive association with grain yield recorded under stress condition. These indices are useful in selecting suitable genotypes for drought tolerance. These indices show strong association with the yield recorded under control conditions also. The susceptibility indices show negative association with grain yield recorded under drought stress conditions (Table 6.2.12).

Summary & Conclusion

A trial to study the drought tolerance traits of rice cultures with respect to yield and other attributes under dry spells was conducted with 22 AVT entries and 8 released varieties at 5 AICRIP centres. The treatments consisted of two irrigation regimes a. Irrigated as per the recommended schedule and one totally rain fed condition without any supplementary irrigation. The reduction in grain yield was highest in IET 27524, Tulasi, IET27510 and IET 27509. In fact, very few entries show like IET 27515, Sahabhagidhan and IET 27525 show yield reduction <50% over irrigated control. All other entries suffered substantial yield losses under rain fed condition. The variety Govind produced highest yield followed by IET 27514, IET 27522, IET 27520, IET 27525, IET 27519 and Sammaleswari under rainfed condition and may be considered as relatively suitable for rainfed condition. The data revealed that Govind, IET 27514, IET 27522, IET 27515, IET 27517, IET 27519, IET 27520 and IET 27525 have high Mean Rank with low SEm and they may be considered as relatively drought tolerant and are suitable for rain fed cultivation.

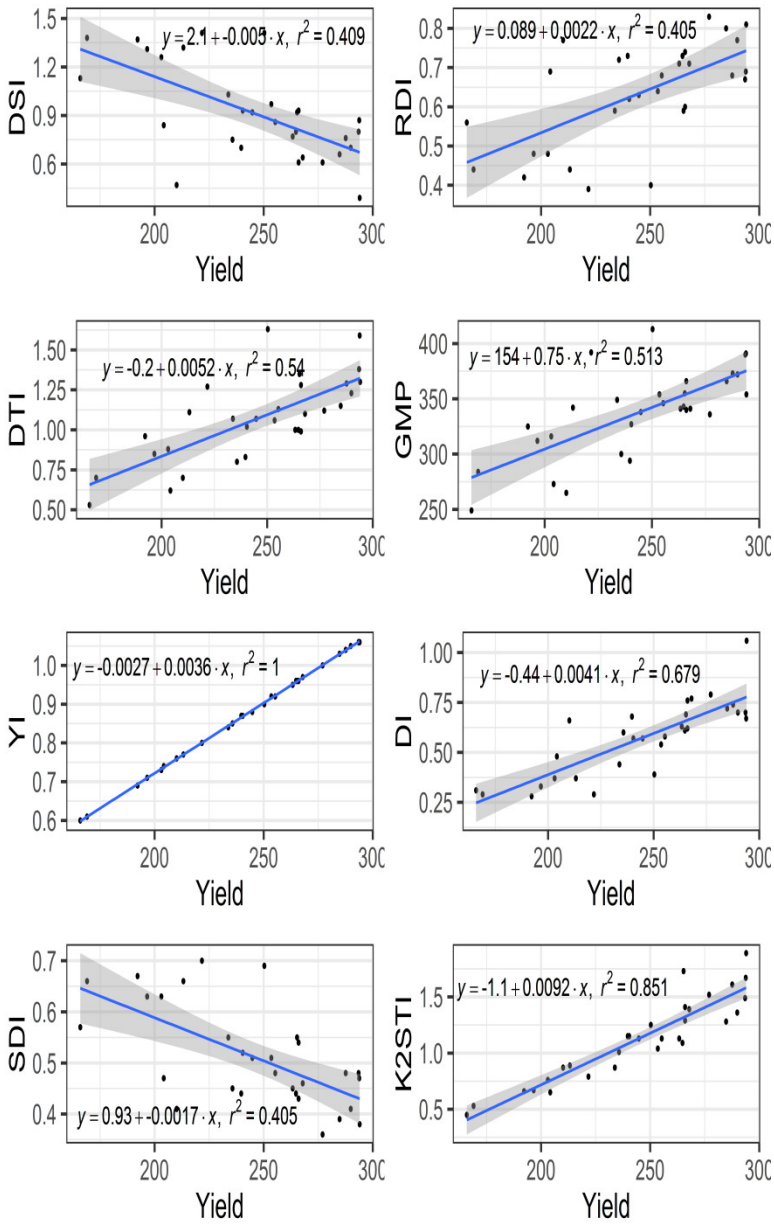


Fig. 8: Relationship between important drought indices and grain yield recorded under drought condition (Rainfed). The mean values for all the locations were used for computing the drought indices.

Table 6.2.1 Screening for elite rice culture for drought tolerance stem weight/plant (g) at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	36.7	33.3	8.8	9.8	17.0	21.1	49.3	44.0	6.2	10.9	16.9	25.5
2	IET 27509	29.4	27.7	12.7	8.1	15.1	18.6	37.6	37.7	9.9	8.7	15.3	21.8
3	IET 27510	38.2	24.3	7.4	8.1	13.1	18.2	68.2	46.3	7.7	14.6	13.1	30.0
4	IET 27511	34.9	41.0	8.1	12.0	18.4	22.9	52.2	49.7	8.1	13.0	19.0	28.4
5	IET 27512	37.0	44.0	7.2	6.7	16.1	22.2	71.3	52.3	8.5	8.2	14.8	31.0
6	IET 27513	47.7	45.7	7.3	11.7	18.8	26.2	76.9	54.3	9.0	14.0	18.3	34.5
7	IET 27514	40.7	23.0	9.0	10.3	14.6	19.5	41.7	52.3	8.5	13.1	14.1	26.0
8	IET 27515	44.8	30.0	8.1	10.0	10.2	20.6	53.2	39.0	8.0	13.5	9.8	24.7
9	IET 27516	42.1	28.0	6.2	9.2	13.3	19.8	49.3	40.3	8.6	11.6	13.1	24.6
10	IET 27517	44.1	14.3	10.2	12.3	17.2	19.6	63.5	59.0	10.6	13.6	15.9	32.5
11	Sahabhagidhan	38.2	18.7	7.2	10.7	15.7	18.1	40.5	37.7	8.2	13.8	15.0	23.0
12	IET 27518	40.4	16.7	8.4	10.9	20.2	19.3	56.5	59.0	11.9	13.7	20.6	32.3
13	IET 27519	37.2	25.3	8.5	12.4	13.1	19.3	36.9	34.7	8.9	13.0	13.0	21.3
14	IET 27520	37.0	8.7	8.3	13.0	15.0	16.4	48.2	65.3	8.4	13.3	15.7	30.2
15	IET 27521	57.2	18.0	6.6	11.8	10.0	20.7	55.9	55.0	9.4	12.8	9.8	28.6
16	IET 27522	54.1	21.0	6.7	7.6	11.7	20.2	53.1	69.7	9.0	9.6	12.4	30.7
17	IET 27523	42.2	32.7	7.3	10.2	16.9	21.9	49.0	43.3	8.3	11.7	16.8	25.8
18	IET 27524	37.0	39.7	8.5	11.5	15.5	22.4	87.7	58.0	8.2	12.6	15.2	36.4
19	IET 27525	33.5	22.0	7.4	9.1	25.0	19.4	36.6	39.7	7.3	9.8	22.8	23.3
20	Vandana	32.2	21.0	8.4	9.3	21.8	18.5	55.7	36.0	8.1	9.6	22.4	26.4
21	IET 27526	36.0	26.0	7.2	13.8	15.8	19.7	71.2	56.7	10.5	14.2	15.7	33.6
22	IET 27527	46.1	32.0	9.6	8.3	17.8	22.8	53.3	48.0	10.8	11.3	16.5	28.0
23	IET 27528	50.8	49.3	7.6	7.3	30.4	29.1	52.9	46.0	8.0	12.7	30.4	30.0
24	IET 27529	38.2	30.0	7.7	10.3	23.6	22.0	42.8	37.0	8.2	10.9	22.6	24.3
25	IET 27530	58.0	13.3	7.7	12.5	17.6	21.8	80.5	65.7	11.6	12.6	16.4	37.4
26	Tulasi	36.7	27.7	7.5	9.6	20.5	20.4	64.1	61.7	8.2	11.0	19.0	32.8
27	NDR-97	38.1	12.7	10.3	10.1	18.5	17.9	38.5	37.0	13.2	10.5	17.2	23.3
28	Govind	35.8	9.0	8.1	9.5	34.9	19.4	39.7	37.0	9.3	13.4	33.5	26.6
29	Samaleshwari	40.5	13.0	6.7	9.1	31.6	20.2	51.4	31.7	9.7	12.7	30.8	27.3
30	Varalu	33.0	17.0	8.7	8.7	21.5	17.8	42.8	31.7	9.0	10.2	23.3	23.4
	Mean	**40.6**	**25.5**	**8.1**	**10.1**	**18.4**	**20.5**	**54.0**	**47.5**	**9.0**	**12.0**	**18.0**	**28.1**
	LSD (Treatment)			ns				LSD (Treatment x Genotype)			ns		
	LSD (Location x Treatment)			8.6**				*LSD (Location x Treatment x Genotype)*			17.3**		
	LSD (Genotype)			ns				*CD Error Treat (%)*			29.5		
	LSD (Location x Genotype)			12.3**				*CD Residual (%)*			24		

Table 6.2.2 Screening for elite rice culture for drought tolerance tiller number/plant at flowering at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	6.5	9.3	7.3	14.0	14.7	10.4	8.7	10.3	5.0	14.7	17.0	11.1
2	IET 27509	8.5	7.0	11.0	7.0	12.7	9.2	9.3	9.3	8.7	10.0	15.7	10.6
3	IET 27510	7.6	12.7	7.0	9.7	15.3	10.5	8.1	9.7	6.7	12.3	17.0	10.7
4	IET 27511	5.5	9.0	6.7	11.3	17.0	9.9	7.2	8.7	7.0	12.3	18.7	10.8
5	IET 27512	6.7	14.3	5.7	11.3	15.0	10.6	8.0	9.3	7.0	11.3	17.3	10.6
6	IET 27513	8.3	12.0	6.3	11.0	16.0	10.7	8.5	8.0	6.7	12.3	17.7	10.6
7	IET 27514	6.5	7.7	7.3	10.0	18.3	10.0	6.7	8.3	6.3	10.3	21.3	10.6
8	IET 27515	7.0	8.3	7.0	11.0	16.3	9.9	7.7	8.3	6.7	12.7	19.0	10.9
9	IET 27516	6.9	10.0	5.7	10.0	17.3	10.0	7.3	10.0	4.0	13.7	19.0	10.8
10	IET 27517	6.9	9.0	9.0	13.0	15.0	10.6	7.1	10.0	8.3	11.0	16.0	10.5
11	Sahabhagidhan	6.8	10.0	6.3	13.0	12.3	9.7	6.9	8.0	6.7	11.0	13.7	9.2
12	IET 27518	6.5	9.3	7.7	13.3	12.7	9.9	6.2	8.7	8.7	12.7	15.7	10.4
13	IET 27519	6.0	9.3	8.0	11.0	14.0	9.7	6.7	9.0	6.3	15.7	14.3	10.4
14	IET 27520	7.7	7.7	7.7	13.7	18.3	11.0	8.1	9.3	6.7	16.3	19.3	12.0
15	IET 27521	6.7	9.0	5.3	8.7	14.0	8.7	7.5	9.0	6.0	10.0	14.7	9.4
16	IET 27522	10.2	12.3	5.7	14.3	15.7	11.6	10.3	8.7	6.7	10.7	17.0	10.7
17	IET 27523	6.9	9.3	7.3	11.0	14.7	9.9	7.1	9.3	6.0	13.7	20.3	11.3
18	IET 27524	6.0	11.7	7.7	13.0	11.0	9.9	5.6	11.3	6.3	8.7	13.0	9.0
19	IET 27525	5.6	9.0	7.0	11.3	18.3	10.3	6.1	10.7	5.3	12.0	21.3	11.1
20	Vandana	7.0	8.7	7.7	9.0	16.0	9.7	7.5	11.3	7.0	10.0	17.3	10.6
21	IET 27526	6.5	14.7	5.7	9.0	18.3	10.8	8.2	10.3	9.3	10.0	21.3	11.8
22	IET 27527	9.4	11.0	9.3	11.0	15.3	11.2	9.6	9.7	8.3	12.3	17.7	11.5
23	IET 27528	7.5	12.7	7.3	10.0	12.3	10.0	8.1	8.7	6.3	11.3	14.3	9.8
24	IET 27529	11.4	9.7	7.0	13.7	16.7	11.7	12.4	8.0	6.0	10.0	14.7	10.2
25	IET 27530	7.8	8.7	7.7	10.0	18.3	10.5	10.3	8.0	9.3	11.3	19.7	11.7
26	Tulasi	8.2	10.3	6.3	11.7	19.3	11.2	8.8	9.0	6.7	10.0	20.0	10.9
27	NDR-97	9.5	16.3	9.7	12.3	12.7	12.1	10.8	10.0	10.7	11.3	13.0	11.2
28	Govind	6.6	8.3	7.3	10.3	16.7	9.9	10.6	9.3	8.0	8.7	18.0	10.9
29	Samaleshwari	8.5	7.7	6.7	10.0	13.3	9.2	9.2	9.7	9.0	11.3	16.0	11.0
30	Varalu	8.9	9.7	7.7	9.3	12.0	9.5	9.0	10.0	5.3	11.0	12.0	9.5
	Mean	**7.5**	**10.2**	**7.3**	**11.1**	**15.3**	**10.3**	**8.2**	**9.3**	**7.0**	**11.6**	**17.1**	**10.7**
	LSD (Treatment)			*ns*				LSD (Treatment x Genotype)			*ns*		
	LSD (Location x Treatment)			*1.19***				*LSD (Location x Treatment x Genotype)*			*3.6***		
	LSD (Genotype)			*ns*				*CD Error Treat (%)*			*24.2*		
	LSD (Location x Genotype)			*2.56***				*CD Residual (%)*			*16.2*		

Table 6.2.3 Screening for elite rice culture for drought tolerance shoot weight (g/m2) maturity at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	408	644	288	492	265	419	486	800	477	547	543	570
2	IET 27509	416	328	333	404	187	334	475	1067	616	433	242	567
3	IET 27510	455	516	254	405	178	362	627	1835	531	729	369	818
4	IET 27511	492	476	318	602	227	423	561	923	576	649	438	629
5	IET 27512	567	428	321	334	216	373	651	1301	553	410	381	659
6	IET 27513	584	392	300	587	341	441	647	1120	604	700	512	717
7	IET 27514	416	496	301	517	259	398	438	1147	552	657	435	646
8	IET 27515	457	468	281	498	303	402	511	912	486	673	387	594
9	IET 27516	566	436	324	462	155	389	631	1163	476	581	296	653
10	IET 27517	726	348	269	613	261	443	760	1440	572	679	378	766
11	Sahabhagidhan	354	276	301	537	302	354	521	1211	597	692	391	682
12	IET 27518	599	272	334	547	305	412	685	1989	623	684	484	893
13	IET 27519	314	288	302	619	214	347	374	677	542	649	439	536
14	IET 27520	330	184	287	650	181	326	428	1381	523	666	317	663
15	IET 27521	463	516	336	590	169	415	556	1179	577	641	377	666
16	IET 27522	462	192	297	380	187	304	554	1979	531	478	287	766
17	IET 27523	393	488	258	511	268	384	445	571	493	584	343	487
18	IET 27524	636	768	320	574	275	515	827	1264	511	632	507	748
19	IET 27525	387	360	249	456	553	401	441	1003	485	491	537	591
20	Vandana	296	162	303	465	399	325	523	565	532	478	463	512
21	IET 27526	584	324	300	688	206	420	668	2117	630	709	371	899
22	IET 27527	471	416	306	417	254	373	533	1760	602	567	422	777
23	IET 27528	389	428	313	367	272	354	494	1717	565	635	287	740
24	IET 27529	429	228	307	517	201	337	515	853	513	546	423	570
25	IET 27530	535	268	291	627	225	389	574	2373	579	631	547	941
26	Tulasi	589	292	328	482	196	377	681	1579	620	550	385	763
27	NDR-97	364	180	318	503	318	337	409	923	656	525	482	599
28	Govind	417	216	239	475	556	381	512	619	568	672	638	602
29	Samaleshwari	560	124	278	455	266	337	644	1755	620	637	486	829
30	Varalu	404	230	291	435	181	308	485	800	493	510	379	545
	Mean	**469**	**358**	**298**	**507**	**264**	**379**	**555**	**1267**	**557**	**601**	**420**	**681**
	LSD (Treatment)				*ns*			LSD (Treatment x Genotype)				*ns*	
	LSD (Location x Treatment)				*404***			*LSD (Location x Treatment x Genotype)*				*475***	
	LSD (Genotype)				*ns*			*CD Error Treat (%)*				*31.2*	
	LSD (Location x Genotype)				*336***			*CD Residual (%)*				*26.9*	

Table 6.2.4 Screening for elite rice culture for drought tolerance grain number/panicle at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	84	49	31	139	123	85	182	61	64	153	155	123
2	IET 27509	51	34	31	110	115	68	88	51	45	140	144	94
3	IET 27510	43	23	30	74	122	58	129	129	0	98	156	128
4	IET 27511	57	28	31	111	166	79	115	61	70	135	182	113
5	IET 27512	49	29	33	77	152	68	89	71	62	106	166	99
6	IET 27513	69	52	0	80	124	81	96	148	45	108	148	109
7	IET 27514	56	59	36	109	173	87	110	74	62	135	214	119
8	IET 27515	84	43	0	97	153	94	97	41	66	112	183	100
9	IET 27516	66	30	31	118	163	82	141	73	42	128	187	114
10	IET 27517	43	18	0	107	150	80	120	53	44	114	169	100
11	Sahabhagidhan	81	35	0	133	107	89	91	85	60	145	142	105
12	IET 27518	36	36	0	103	142	79	140	93	55	136	192	123
13	IET 27519	69	53	29	124	102	75	75	65	72	134	135	96
14	IET 27520	122	41	33	114	107	83	134	138	60	168	148	130
15	IET 27521	83	27	0	86	121	79	118	51	70	118	158	103
16	IET 27522	61	42	0	80	102	71	96	67	65	118	130	95
17	IET 27523	93	61	33	114	135	87	106	71	70	160	172	116
18	IET 27524	48	60	0	86	95	72	217	139	0	114	135	121
19	IET 27525	89	38	0	124	131	96	105	73	78	138	187	116
20	Vandana	66	27	0	71	110	68	96	33	70	88	140	85
21	IET 27526	55	24	29	94	168	74	121	50	73	86	198	106
22	IET 27527	57	49	32	71	145	71	87	38	65	107	177	95
23	IET 27528	80	56	0	91	154	95	134	100	70	146	175	125
24	IET 27529	55	50	27	89	145	73	101	74	72	116	186	110
25	IET 27530	44	39	0	80	106	67	140	124	40	100	131	107
26	Tulasi	48	25	29	83	178	73	89	72	68	101	202	106
27	NDR-97	38	22	28	85	120	59	71	35	68	67	148	78
28	Govind	46	25	24	95	157	70	99	36	70	108	202	103
29	Samaleshwari	86	15	30	112	131	75	143	83	49	170	157	120
30	Varalu	72	49	11	134	93	72	104	55	29	219	106	103
	Mean	**64**	**38**	**29**	**100**	**133**	**71**	**114**	**75**	**59**	**126**	**164**	**107**
	LSD (Treatment)			*7.3***				LSD (Treatment x Genotype)			*ns*		
	LSD (Location x Treatment)			*ns*				*LSD (Location x Treatment x Genotype)*			*37.7***		
	LSD (Genotype)			*ns*				*CD Error Treat (%)*			*29.3*		
	LSD (Location x Genotype)			*26.7***				*CD Residual (%)*			*20.1*		

Table 6.2.5 Screening for elite rice culture for drought tolerance spikelet number/panicle at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	157	73	59	172	36	99	224	80	89	194	44	126
2	IET 27509	98	56	59	177	30	84	145	75	62	181	35	100
3	IET 27510	103	70	59	131	40	81	162	163	0	136	41	126
4	IET 27511	132	40	58	174	42	89	146	64	96	180	45	106
5	IET 27512	109	43	64	144	41	80	154	104	83	149	43	107
6	IET 27513	139	162	0	144	30	119	173	146	65	157	40	116
7	IET 27514	121	88	59	153	38	92	141	82	90	174	55	108
8	IET 27515	125	64	0	142	37	92	129	58	93	147	46	94
9	IET 27516	126	71	60	170	39	93	173	81	59	180	47	108
10	IET 27517	81	42	0	152	43	79	147	60	68	157	41	95
11	Sahabhagidhan	107	71	0	191	22	98	112	93	84	202	29	104
12	IET 27518	126	88	0	181	39	109	180	119	82	191	42	123
13	IET 27519	122	93	62	106	27	82	135	72	83	204	30	105
14	IET 27520	146	76	66	193	32	103	163	152	73	211	47	129
15	IET 27521	117	68	0	150	24	90	139	58	78	176	28	96
16	IET 27522	119	64	0	157	23	91	119	88	79	181	36	101
17	IET 27523	141	87	71	183	28	102	134	76	90	195	48	109
18	IET 27524	111	112	0	153	27	101	239	161	0	158	33	118
19	IET 27525	121	79	0	173	42	104	126	78	90	200	58	110
20	Vandana	103	61	0	130	34	82	121	38	86	137	42	85
21	IET 27526	90	67	65	115	41	76	163	74	90	125	52	101
22	IET 27527	113	78	63	141	42	88	128	51	86	153	43	92
23	IET 27528	151	93	0	194	38	119	155	109	97	223	41	125
24	IET 27529	105	86	59	145	38	87	130	89	93	165	43	104
25	IET 27530	112	60	0	117	33	80	180	148	64	138	47	116
26	Tulasi	110	58	60	132	47	81	118	81	84	136	52	94
27	NDR-97	87	72	57	96	31	68	96	38	85	102	36	72
28	Govind	118	72	41	150	34	83	140	53	91	152	44	96
29	Samaleshwari	136	50	60	217	28	98	180	125	77	225	36	129
30	Varalu	131	92	25	228	26	100	185	65	44	256	34	117
	Mean	**119**	**75**	**58**	**157**	**34**	**84**	**151**	**89**	**78**	**173**	**42**	**106**
	LSD (Treatment)		*3.5**					LSD (Treatment x Genotype)			*ns*		
	LSD (Location x Treatment)		*11.15***					*LSD (Location x Treatment x Genotype)*			*43.4***		
	LSD (Genotype)		*ns*					*CD Error Treat (%)*			*24.8*		
	LSD (Location x Genotype)		*30.7***					*CD Residual (%)*			*21.7*		

Table 6.2.6 Screening for elite rice culture for drought tolerance grain number/m2 at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Drought					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	16557	15340	9210	25653	45250	22402	44044	16629	19540	33473	65933	35924
2	IET 27509	13959	8816	10539	21889	36333	18307	26410	20053	10832	33514	56633	29489
3	IET 27510	8333	3912	9707	10085	46625	15732	34055	60389	0	18156	66300	44725
4	IET 27511	14061	8128	10534	13536	70725	23397	27957	24747	20313	30416	85050	37697
5	IET 27512	11261	9312	10284	4124	57142	18425	22067	27824	15091	9401	71875	29252
6	IET 27513	13217	18275	0	5007	49450	21487	22997	41620	12436	11348	65225	30725
7	IET 27514	12135	16268	10229	8963	79433	25406	25847	24037	19317	21984	114267	41090
8	IET 27515	15845	9099	0	12293	62633	24968	23383	14496	19700	20239	86750	32914
9	IET 27516	14789	4996	9389	15039	70583	22959	31709	18368	12651	28995	88917	36128
10	IET 27517	10177	892	0	20339	56167	21894	30785	19888	13345	25121	67800	31388
11	Sahabhagidhan	16723	7268	0	14541	32892	17856	25982	32187	16417	28355	48508	30290
12	IET 27518	7320	7452	0	10483	44867	17530	35463	42779	15612	26717	75175	39149
13	IET 27519	13722	12932	10896	11367	35775	16939	17555	29408	16902	24085	48233	27237
14	IET 27520	26283	7388	9935	13116	49000	21144	29384	70661	13697	33678	71458	43776
15	IET 27521	20904	6804	0	9403	42217	19832	29847	14267	16047	22156	57750	28013
16	IET 27522	21590	9100	0	8616	39800	19776	35073	38821	16258	23512	55308	33795
17	IET 27523	21037	13824	9943	6744	49500	20210	24641	23781	19987	18324	86883	34723
18	IET 27524	11142	10768	0	9897	26183	14497	40395	28949	0	26131	43942	34854
19	IET 27525	19482	10672	0	11874	60067	25524	23202	22645	17470	25591	99833	37748
20	Vandana	13444	5700	0	4112	44133	16847	23642	7392	18105	7688	65950	24555
21	IET 27526	10504	6052	10081	5018	76933	21718	25147	19367	18916	7561	98825	33963
22	IET 27527	17152	19100	11152	4293	55650	21469	27250	16437	16338	10806	78017	29770
23	IET 27528	18737	14240	0	9538	47483	22499	33145	41461	21413	30345	62917	37856
24	IET 27529	16324	13444	9630	8967	60275	21728	31037	36469	19161	23112	68092	35574
25	IET 27530	11561	8740	0	7396	51883	15916	38884	68693	11741	19306	64733	40671
26	Tulasi	11319	6368	9515	5630	86050	23776	22933	28315	16588	9630	101000	35693
27	NDR-97	10836	7812	11052	5937	38033	14734	24466	18021	18531	9031	48050	23620
28	Govind	11825	7836	8087	12435	65567	21150	28852	14464	21073	25197	90825	36082
29	Samaleshwari	20692	4605	11204	10612	43808	18184	35244	55168	15116	29240	62542	39462
30	Varalu	14519	9750	3299	12405	28083	13611	29472	19387	9190	35162	31650	24972
	Mean	**14848**	**9496**	**9705**	**10644**	**51751**	**18513**	**29029**	**29891**	**16492**	**22276**	**70948**	**33507**
	LSD (Treatment)		*2264***					LSD (Treatment x Genotype)			*ns*		
	LSD (Location x Treatment)		*5063***					*LSD (Location x Treatment x Genotype)*			*16290***		
	LSD (Genotype)		*ns*					*CD Error Treat (%)*			*31*		
	LSD (Location x Genotype)		*11518***					*CD Residual (%)*			*29.2*		

Table 6.2.7 Screening for elite rice culture for drought tolerance spikelet number/m2 at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	31425	22641	11451	31701	13083	22060	54461	22304	18260	43250	18733	31402
2	IET 27509	27066	14536	12591	35168	9617	19796	43203	33557	8333	46942	13792	29165
3	IET 27510	19915	13323	11107	17947	15533	15565	42398	75211	0	25224	17567	40100
4	IET 27511	32170	11517	12006	21182	17642	18904	35598	25691	17928	39610	21017	27969
5	IET 27512	24491	13795	12647	7657	15300	14778	37749	40165	12817	13164	18583	24496
6	IET 27513	26871	36984	0	9028	12158	21260	41225	51312	9812	15912	17967	27246
7	IET 27514	25859	24699	12090	12645	17567	18572	32984	26629	16173	26494	29183	26293
8	IET 27515	23700	14500	0	17850	15092	17785	31272	20795	16996	26758	21700	23504
9	IET 27516	27938	10300	11104	21691	16867	17580	39099	20384	11460	39796	22175	26583
10	IET 27517	19194	3680	0	28771	16108	16938	37770	22827	10428	33906	16558	24298
11	Sahabhagidhan	22193	12593	0	20861	6858	15626	31735	35568	14051	37835	9767	25791
12	IET 27518	25630	14769	0	18477	12300	17794	45776	54667	13044	36111	16133	33146
13	IET 27519	24249	19308	12124	9723	9567	14994	31430	32528	14832	36877	10708	25275
14	IET 27520	31978	12200	12196	22239	14683	18659	36051	77872	12019	39663	22525	37626
15	IET 27521	29301	13986	0	16499	8333	17030	35351	16293	14250	32408	10383	21737
16	IET 27522	43299	12175	0	16903	9008	20346	43779	51019	14738	35218	15375	32026
17	IET 27523	31914	20068	11791	10839	10400	17003	31314	25248	17042	23340	24858	24360
18	IET 27524	25899	17331	0	17492	7525	17062	44421	33771	0	35159	10575	30982
19	IET 27525	26585	16723	0	16517	19442	19816	27919	24080	15297	37619	30742	27131
20	Vandana	21054	9516	0	7541	13533	12911	29767	8416	15673	11896	18183	16787
21	IET 27526	17400	13752	11401	6142	18725	13484	33836	27723	15929	11072	25975	22907
22	IET 27527	34044	26313	11910	8610	16267	19429	40189	23189	14234	14403	19158	22235
23	IET 27528	35750	23920	0	20315	11583	22892	38250	45355	18092	45680	14492	32374
24	IET 27529	31723	21240	11344	14701	15675	18937	39772	45088	17594	30863	15517	29767
25	IET 27530	29272	16336	0	10792	16375	18194	49823	81109	10110	26084	23133	38052
26	Tulasi	26575	12988	10783	8913	22783	16408	30535	32261	13932	12400	25833	22992
27	NDR-97	24587	19476	12181	6712	9767	14544	32793	19696	15727	13204	11775	18639
28	Govind	30011	14948	9697	19496	14150	17661	40873	22384	18710	34772	19867	27321
29	Samaleshwari	32468	3964	13097	20567	9500	15919	44479	84763	13371	37416	14558	38917
30	Varalu	26731	17692	3989	21096	7550	15412	52557	22549	8717	42560	9950	27267
	Mean	**27643**	**16176**	**11306**	**16602**	**13433**	**16128**	**38547**	**36748**	**14270**	**30188**	**18226**	**27406**
	LSD (Treatment)			*2667**				LSD (Treatment x Genotype)				*ns*	
	LSD (Location x Treatment)			*5965***				*LSD (Location x Treatment x Genotype)*				*20321***	
	LSD (Genotype)			*ns*				*CD Error Treat (%)*				*28.01*	
	LSD (Location x Genotype)			*14361***				*CD Residual (%)*				*24.24*	

Table 6.2.8 Screening for elite rice culture for drought tolerance harvest index (%) at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	23.0	13.7	19.3	37.6	39.5	26.6	47.1	26.0	46.6	39.7	45.5	41.0
2	IET 27509	19.8	17.0	18.9	25.0	24.0	20.9	35.3	27.3	37.9	40.7	49.8	38.2
3	IET 27510	14.4	11.3	34.8	26.9	46.5	26.8	37.2	28.0	0.0	37.0	48.7	37.7
4	IET 27511	26.9	10.7	27.1	23.8	46.6	27.0	35.6	26.3	45.0	34.3	46.3	37.5
5	IET 27512	11.9	15.7	26.3	24.2	50.5	25.7	32.7	39.0	43.5	32.6	60.7	41.7
6	IET 27513	13.6	11.3	0.0	24.2	36.4	21.4	29.3	39.7	54.8	36.3	50.5	42.1
7	IET 27514	19.3	12.7	26.0	29.4	51.5	27.8	43.9	27.7	64.4	40.1	64.7	48.2
8	IET 27515	30.5	17.7	0.0	37.4	43.5	32.3	45.2	29.7	43.5	38.4	59.2	43.2
9	IET 27516	16.8	14.3	24.4	45.7	57.1	31.7	34.9	37.3	28.8	45.3	63.3	41.9
10	IET 27517	14.6	14.0	0.0	39.9	43.9	28.1	42.2	31.7	51.0	41.7	47.2	42.7
11	Sahabhagidhan	33.0	15.7	0.0	40.2	32.3	30.3	37.7	30.3	50.8	40.2	48.7	41.5
12	IET 27518	12.2	25.0	0.0	24.0	46.1	26.8	36.4	31.0	33.1	38.3	58.3	39.4
13	IET 27519	36.1	17.0	24.7	42.8	40.1	32.1	34.3	25.7	53.8	43.2	53.2	42.0
14	IET 27520	29.2	12.0	32.6	43.8	51.8	33.9	43.2	32.3	52.0	44.3	55.3	45.4
15	IET 27521	29.7	11.0	0.0	31.1	49.1	24.2	42.9	25.7	60.9	40.3	57.2	45.4
16	IET 27522	25.2	12.7	0.0	41.8	44.1	24.7	39.0	25.0	60.8	48.5	59.5	46.6
17	IET 27523	33.1	14.3	29.6	24.6	30.4	26.4	42.7	22.7	46.2	39.5	54.5	41.1
18	IET 27524	14.6	10.7	0.0	27.4	38.4	18.2	43.0	30.7	0.0	44.7	56.0	43.6
19	IET 27525	32.9	14.0	0.0	39.9	31.2	23.6	41.9	27.3	66.8	43.5	54.3	46.8
20	Vandana	33.4	14.7	0.0	34.4	37.2	23.9	35.8	27.0	62.8	41.8	58.3	45.1
21	IET 27526	18.2	8.7	22.0	32.4	51.4	26.5	31.1	35.3	44.2	35.7	48.9	39.1
22	IET 27527	28.5	13.0	23.8	31.6	39.7	27.3	36.9	30.7	46.4	41.8	55.6	42.3
23	IET 27528	32.5	17.7	0.0	34.6	37.5	30.6	45.1	31.7	71.9	45.0	60.1	50.8
24	IET 27529	24.6	13.7	25.4	35.8	44.8	28.8	32.5	33.3	57.4	46.5	45.0	42.9
25	IET 27530	10.4	13.3	0.0	28.4	45.5	19.5	31.9	31.0	54.6	44.9	52.4	43.0
26	Tulasi	10.9	13.0	20.0	23.7	59.1	25.3	33.1	32.3	51.7	44.3	51.3	42.5
27	NDR-97	19.7	18.3	17.4	32.9	32.7	24.2	35.8	17.0	31.5	42.8	52.3	35.9
28	Govind	28.5	13.3	22.0	44.3	27.4	27.1	35.9	30.7	57.7	42.2	47.0	42.7
29	Samaleshwari	20.0	15.0	29.8	39.3	38.0	28.4	32.1	26.0	42.8	41.2	57.1	39.8
30	Varalu	22.7	10.3	10.3	26.3	37.0	21.3	30.5	27.0	25.5	39.9	58.0	36.2
	Mean	**22.9**	**14.1**	**24.1**	**33.1**	**41.8**	**26.4**	**37.5**	**29.5**	**46.2**	**41.1**	**54.0**	**42.2**
	LSD (Treatment)			*1.24**				LSD (Treatment x Genotype)				*ns*	
	LSD (Location x Treatment)			*3.97***				*LSD (Location x Treatment x Genotype)*				*14.6***	
	LSD (Genotype)			*ns*				*CD Error Treat (%)*				25.07	
	LSD (Location x Genotype)			*10.34***				*CD Residual (%)*				*20.7*	

Table 6.2.9 Screening for elite rice culture for drought tolerance 1000 grain weight (g) at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	21.3	19.3	12.6	24.1	17.2	18.9	22.3	20.0	21.8	24.6	20.3	21.8
2	IET 27509	16.9	20.3	13.6	19.5	18.2	17.7	18.7	13.3	16.5	22.3	21.4	18.4
3	IET 27510	15.8	18.7	17.4	12.7	16.9	16.3	16.7	30.0	0.0	15.7	18.6	20.3
4	IET 27511	22.0	18.3	16.7	25.1	17.4	19.9	25.5	30.0	28.1	26.0	19.3	25.8
5	IET 27512	22.2	16.7	14.4	18.1	17.9	17.9	21.5	20.0	22.2	21.1	21.7	21.3
6	IET 27513	15.6	16.7	0.0	17.6	17.9	16.9	20.8	26.7	18.4	19.1	21.4	21.3
7	IET 27514	22.3	16.7	13.7	26.1	20.3	19.8	23.8	26.7	23.6	26.4	23.1	24.7
8	IET 27515	22.2	13.3	0.0	27.5	15.4	19.6	24.1	23.3	24.3	28.2	17.8	23.5
9	IET 27516	19.1	18.3	14.5	23.8	15.3	18.2	21.6	23.3	13.9	25.9	18.4	20.6
10	IET 27517	17.7	17.7	0.0	22.0	14.2	17.9	23.2	23.3	18.5	22.2	16.4	20.7
11	Sahabhagidhan	20.9	17.7	0.0	21.9	14.3	18.7	21.2	30.0	21.5	22.5	18.3	22.7
12	IET 27518	21.7	15.3	0.0	24.0	15.3	19.1	23.4	26.7	22.1	24.7	19.4	23.3
13	IET 27519	26.4	16.7	15.8	22.1	15.1	19.2	26.7	20.0	23.2	35.1	18.4	24.7
14	IET 27520	18.8	15.0	15.4	24.3	17.8	18.3	21.1	30.0	20.1	25.0	19.4	23.1
15	IET 27521	22.5	15.0	0.0	24.9	17.4	20.0	23.1	20.0	21.4	25.9	21.5	22.4
16	IET 27522	22.1	14.7	0.0	22.7	17.4	19.2	22.3	30.0	21.5	24.9	20.9	23.9
17	IET 27523	23.1	16.7	14.9	24.2	15.1	18.8	22.6	16.7	23.2	27.6	17.4	21.5
18	IET 27524	17.6	17.7	0.0	18.2	15.8	13.9	20.4	26.7	0.0	21.5	18.4	21.7
19	IET 27525	24.8	18.0	0.0	26.9	16.8	17.3	24.3	23.3	24.9	27.4	19.3	23.8
20	Vandana	20.8	20.0	0.0	23.2	16.2	16.0	22.3	20.0	22.5	25.7	17.7	21.6
21	IET 27526	22.6	18.7	14.0	24.1	17.0	19.3	25.6	23.3	25.2	26.6	20.3	24.2
22	IET 27527	22.5	22.3	15.5	18.9	16.8	19.2	22.9	26.7	21.2	23.5	19.6	22.8
23	IET 27528	21.6	20.0	0.0	21.9	16.3	19.9	21.8	26.7	24.0	25.3	20.9	23.7
24	IET 27529	21.4	16.7	18.1	24.5	16.1	19.4	18.8	20.0	23.7	24.6	19.7	21.3
25	IET 27530	16.7	16.7	0.0	14.5	16.6	16.1	15.9	23.3	15.3	15.5	21.4	18.3
26	Tulasi	25.6	10.0	15.3	23.9	16.8	18.3	28.9	23.3	21.4	27.5	20.3	24.3
27	NDR-97	19.2	10.0	13.2	21.9	15.2	15.9	19.1	26.7	21.5	25.3	19.4	22.4
28	Govind	19.6	13.0	10.0	23.1	16.7	16.5	22.7	20.0	22.3	27.2	24.0	23.3
29	Samaleshwari	19.1	13.7	17.0	19.2	15.8	17.0	19.1	16.7	19.6	19.4	18.1	18.6
30	Varalu	15.9	16.0	4.8	15.1	14.7	13.3	18.1	23.3	12.1	19.2	19.4	18.4
	Mean	**20.6**	**16.7**	**14.3**	**21.9**	**16.5**	**17.9**	**22.0**	**23.7**	**21.2**	**24.2**	**19.7**	**22.1**
	LSD (Treatment)			*ns*				LSD (Treatment x Genotype)			*ns*		
	LSD (Location x Treatment)			*1.68***				*LSD (Location x Treatment x Genotype)*			*7.04***		
	LSD (Genotype)			*2.3***				*CD Error Treat (%)*			18.15		
	LSD (Location x Genotype)			*4.9**				*CD Residual (%)*			*17.75*		

Table 6.2.10 Screening for elite rice culture for drought tolerance grain yield (g/m2) at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	146	115	54	574	276	233	509	443	230	747	471	480
2	IET 27509	129	53	62	254	227	145	314	486	236	650	395	416
3	IET 27510	91	64	88	288	370	180	440	623	0	687	552	575
4	IET 27511	225	105	89	326	403	230	371	448	249	691	597	471
5	IET 27512	91	109	83	211	375	174	376	551	244	474	629	455
6	IET 27513	102	56	0	334	277	192	332	791	332	640	589	537
7	IET 27514	127	97	79	385	600	257	415	375	352	712	982	567
8	IET 27515	239	90	0	525	393	312	490	299	218	711	730	490
9	IET 27516	139	55	78	667	335	255	390	652	173	875	632	544
10	IET 27517	122	38	0	728	225	278	551	729	300	746	340	533
11	Sahabhagidhan	217	67	0	594	195	268	381	416	302	762	391	450
12	IET 27518	92	72	0	323	515	250	486	782	208	671	971	623
13	IET 27519	245	82	75	726	216	269	272	315	294	1034	579	499
14	IET 27520	179	56	93	802	367	300	417	580	269	1043	631	588
15	IET 27521	249	61	0	447	354	278	472	398	364	726	578	508
16	IET 27522	218	63	0	473	419	293	435	455	322	935	850	599
17	IET 27523	273	81	76	293	170	179	400	357	223	617	448	409
18	IET 27524	131	113	0	331	312	222	695	702	0	941	861	800
19	IET 27525	251	128	0	536	304	304	378	339	326	798	797	527
20	Vandana	185	59	0	434	343	255	335	427	342	620	709	487
21	IET 27526	154	39	65	502	266	205	349	680	278	645	412	473
22	IET 27527	256	85	72	384	289	217	379	584	275	774	579	518
23	IET 27528	226	102	0	386	220	234	474	653	405	954	472	591
24	IET 27529	195	42	78	504	217	207	315	421	295	871	352	451
25	IET 27530	84	52	0	383	333	213	338	817	311	915	605	597
26	Tulasi	87	54	67	253	282	149	378	710	329	706	416	508
27	NDR-97	110	37	53	434	277	182	281	201	204	671	640	399
28	Govind	188	33	53	687	269	246	356	476	338	853	578	520
29	Samaleshwari	168	35	78	559	346	237	366	403	269	863	744	529
30	Varalu	143	114	32	319	263	174	278	300	153	661	647	408
	Mean	**169**	**72**	**71**	**455**	**315**	**231**	**399**	**514**	**280**	**766**	**606**	**518**
	LSD (Treatment)			*38.9***				LSD (Treatment x Genotype)				*ns*	
	LSD (Location x Treatment)			*87.05***				*LSD (Location x Treatment x Genotype)*				*152.4***	
	LSD (Genotype)			*ns*				*CD Error Treat (%)*				*21.19*	
	LSD (Location x Genotype)			*107.8***				*CD Residual (%)*				*20.06*	

Table 6.2.11 Screening for elite rice culture for drought tolerance panicle weight (g/m2) maturity at different AICRIP centres during Kharif 2018

S.No.	Entries	Drought					Grand Mean	Irrigated					Grand Mean
		NRRI	PTB	RANCHI	REWA	RPR		NRRI	PTB	RANCHI	REWA	RPR	
1	IET 27508	234	260	173	716	434	363	595	341	276	1036	491	548
2	IET 27509	229	159	157	378	453	275	416	485	307	887	571	533
3	IET 27510	171	124	138	424	618	295	553	1067	0	852	764	809
4	IET 27511	336	188	162	546	639	374	481	400	337	994	850	613
5	IET 27512	193	224	166	278	527	278	498	837	312	581	656	577
6	IET 27513	170	179	0	453	421	306	488	715	237	795	655	578
7	IET 27514	231	200	174	492	906	401	501	496	301	818	1083	640
8	IET 27515	325	195	0	625	600	436	571	347	235	888	845	577
9	IET 27516	260	121	177	757	434	350	488	315	87	1083	674	529
10	IET 27517	159	99	0	867	254	345	559	560	343	866	342	534
11	Sahabhagidhan	306	173	0	688	304	368	503	405	336	856	412	502
12	IET 27518	179	224	0	446	811	415	649	923	202	797	1183	751
13	IET 27519	362	260	166	827	324	388	423	411	302	1450	650	647
14	IET 27520	279	132	165	925	527	406	536	667	298	1423	824	749
15	IET 27521	375	173	0	598	552	424	541	373	215	873	634	527
16	IET 27522	405	155	0	534	762	464	561	645	289	1159	1143	759
17	IET 27523	450	188	180	385	290	299	490	357	216	662	478	441
18	IET 27524	276	324	0	363	537	375	784	645	0	1155	1030	904
19	IET 27525	378	202	0	590	423	398	459	448	231	1029	929	619
20	Vandana	263	154	0	561	522	375	418	139	241	783	753	467
21	IET 27526	267	159	190	540	313	294	441	869	206	768	472	551
22	IET 27527	400	194	178	495	477	349	489	736	274	960	619	616
23	IET 27528	332	252	0	507	316	352	554	805	269	1152	498	656
24	IET 27529	337	160	171	648	285	320	451	885	250	1067	360	603
25	IET 27530	207	209	0	487	508	353	482	1099	187	1088	607	692
26	Tulasi	213	176	176	314	282	232	461	624	277	835	427	525
27	NDR-97	218	181	151	597	527	335	375	256	294	800	742	493
28	Govind	280	179	85	851	424	364	474	331	278	1052	594	546
29	Samaleshwari	291	119	179	666	644	380	491	517	252	1099	818	636
30	Varalu	222	182	55	453	531	289	422	475	324	823	704	549
	Mean	**278**	**185**	**158**	**567**	**488**	**353**	**505**	**572**	**263**	**954**	**694**	**606**
	LSD (Treatment)			*54***				LSD (Treatment x Genotype)				*ns*	
	LSD (Location x Treatment)			*122***				*LSD (Location x Treatment x Genotype)*				*208***	
	LSD (Genotype)			*ns*				*CD Error Treat (%)*				*26.3*	
	LSD (Location x Genotype)			*147***				*CD Residual (%)*				*21.5*	

Table 6.2.12 Drought tolerance indices of different Rice Genotypes. The indices were computed from the grain yield measured under both irrigated and rainfed water regimes

S.No.	Genotype	Yield_S	DSI	RDI	DTI	GMP	TOL	MP	YI	YSI	DI	SDI	HM	K1STI	K2STI	Rank sum	Mean Rank	SEm
1	**Govind**	**294**	**0.39**	**0.81**	**1.3**	**354**	**220**	**404**	**1.06**	**0.62**	**1.06**	**0.38**	**325**	**2.49**	**1.89**	**294**	**23**	**2.2**
2	IET 27508	266	0.61	0.74	0.99	340	213	372	0.96	0.57	0.76	0.43	314	1.79	1.29	222	17	1.9
3	IET 27509	165.9	1.13	0.56	0.53	249	254	293	0.6	0.43	0.31	0.57	221	1.45	0.45	79	6	1.9
4	IET 27510	203.1	1.26	0.48	0.88	316	357	381	0.73	0.37	0.37	0.63	274	2.52	0.76	119	9	1.6
5	IET 27511	264.8	0.8	0.73	1	343	201	365	0.96	0.56	0.61	0.44	326	1.74	1.09	205	16	1.6
6	IET 27512	196.6	1.31	0.48	0.85	312	330	362	0.71	0.37	0.33	0.63	274	2.29	0.67	105	8	1.4
7	IET 27513	192.2	1.37	0.42	0.96	325	434	409	0.69	0.33	0.28	0.67	275	3.41	0.66	120	9	2.6
8	**IET 27514**	**293.8**	**0.87**	**0.69**	**1.59**	**391**	**261**	**424**	**1.06**	**0.53**	**0.67**	**0.47**	**366**	**2.89**	**1.67**	**283**	**22**	**1.6**
9	**IET 27515**	**289.9**	**0.7**	**0.77**	**1.23**	**372**	**209**	**394**	**1.05**	**0.59**	**0.7**	**0.41**	**354**	**2.12**	**1.36**	**272**	**21**	**1.8**
10	IET 27516	266	0.93	0.6	1.28	366	316	424	0.96	0.46	0.62	0.54	332	2.84	1.41	236	18	1.5
11	**IET 27517**	**265.3**	**0.92**	**0.59**	**1.35**	**355**	**336**	**434**	**0.96**	**0.45**	**0.69**	**0.55**	**317**	**3.04**	**1.73**	**241**	**19**	2
12	IET 27518	250.3	1.41	0.4	1.63	413	505	503	0.9	0.31	0.39	0.69	353	4.62	1.25	218	17	3.4
13	**IET 27519**	**277**	**0.61**	**0.83**	**1.12**	**336**	**162**	**358**	**1**	**0.64**	**0.79**	**0.36**	**318**	**1.73**	**1.52**	**247**	**19**	**2.8**
14	IET 27520	287.6	0.76	0.68	1.29	373	265	420	1.04	0.52	0.74	0.48	343	2.48	1.61	266	20	1.3
15	IET 27521	263.3	0.77	0.71	1	341	211	369	0.95	0.55	0.63	0.45	321	1.78	1.13	201	15	1.2
16	**IET 27522**	**293.5**	**0.8**	**0.67**	**1.38**	**390**	**271**	**429**	**1.06**	**0.52**	**0.7**	**0.48**	**362**	**2.67**	**1.49**	**275**	**21**	1.5
17	IET 27523	204.2	0.84	0.69	0.62	273	188	298	0.74	0.53	0.48	0.47	254	1.21	0.65	121	9	2.2
18	IET 27524	221.7	1.41	0.39	1.27	392	518	481	0.8	0.3	0.29	0.7	327	4.25	0.79	179	14	3.4
19	**IET 27525**	**284.8**	**0.66**	**0.8**	**1.15**	**366**	**211**	**390**	**1.03**	**0.61**	**0.72**	**0.39**	**345**	**2.16**	**1.28**	**266**	**20**	1.9
20	IET 27526	240.4	0.93	0.62	1.02	327	290	385	0.87	0.48	0.57	0.52	296	2.36	1.15	169	13	0.7
21	IET 27527	253.5	0.97	0.64	1.06	354	286	397	0.92	0.49	0.54	0.51	325	2.35	1.04	188	14	0.9
22	IET 27528	233.8	1.03	0.59	1.07	349	329	398	0.84	0.45	0.44	0.55	312	2.84	0.87	173	13	1.4
23	IET 27529	239.7	0.7	0.73	0.83	294	174	327	0.87	0.56	0.68	0.44	275	1.38	1.15	175	13	2.4
24	IET 27530	213.2	1.32	0.44	1.11	342	431	429	0.77	0.34	0.37	0.66	292	3.47	0.89	164	13	2.4
25	NDR-97	210.1	0.47	0.77	0.7	265	160	290	0.76	0.59	0.66	0.41	245	1.28	0.87	155	12	3.1
26	Sahabhagidhan	235.7	0.75	0.72	0.8	300	187	329	0.85	0.55	0.6	0.45	281	1.41	1.01	163	13	2.1
27	Samaleshwari	267.9	0.64	0.71	1.1	341	228	382	0.97	0.54	0.77	0.46	314	2.07	1.39	228	18	1.5
28	Tulasi	169	1.38	0.44	0.7	284	385	361	0.61	0.34	0.29	0.66	235	2.55	0.53	84	6	2
29	Vandana	255.3	0.86	0.68	1.13	346	262	386	0.92	0.52	0.58	0.48	320	2.56	1.13	207	16	0.5

Table 6.2.13 Correlation between Drought tolerance indices and mean grain yield recorded under rain fed conditions

Correlation Matrix														
Variable	Yield													
Yield	1.000	DI												
DI	**0.823**	1.000	DSI											
DSI	**-0.638**	**-0.918**	1.000	DTI										
DTI	**0.734**	0.341	-0.020	1.000	GMP									
GMP	**0.716**	0.252	0.046	**0.953**	1.000	HM								
HM	**0.886**	0.481	-0.237	**0.906**	**0.946**	1.000	K1STI							
K1STI	0.025	-0.373	**0.655**	**0.673**	**0.679**	0.414	1.000	K2STI						
K2STI	**0.922**	**0.852**	**-0.606**	**0.747**	**0.631**	**0.760**	0.087	1.000	MP					
MP	0.395	-0.053	0.391	**0.873**	**0.899**	**0.717**	**0.916**	0.410	1.000	RDI				
RDI	**0.637**	**0.864**	**-0.971**	-0.012	-0.052	0.255	**-0.708**	**0.551**	-0.437	1.000	SDI			
SDI	**-0.638**	**-0.864**	**0.969**	0.012	0.049	-0.258	**0.706**	**-0.550**	0.435	**-1.000**	1.000	TOL		
TOL	-0.370	**-0.688**	**0.886**	0.318	0.358	0.043	**0.907**	-0.295	**0.707**	**-0.932**	**0.931**	1.000	YI	
YI	**1.000**	**0.823**	**-0.638**	**0.734**	**0.716**	**0.886**	0.025	**0.922**	0.395	**0.637**	**-0.638**	-0.370	1.000	YSI
YSI	**0.638**	**0.864**	**-0.969**	-0.012	-0.049	0.258	**-0.706**	**0.550**	-0.435	**1.000**	**-1.000**	**-0.931**	**0.638**	1.000

DSI = Drought Susceptibility Index; RDI = Relative Drought Index; DTI = Drought Tolerance Index; GM = Geometric Mean Productivity; TOL = Tolerance; MP = Mean Production; YI = Yield Index; DI = Drought Resistance Index; YSI = Yield Stability Index; K2STI = Modified Stress Tolerance Index (2); K1STI = Modified Stress Tolerance (1); SDI = Sensitivity ;Drought Index; Yield =Yield under rainfed condition

6.3 Evaluation of rice genotypes for terminal heat stress tolerance suitable for future climate

Locations: IIRR, PNR, PTB, REWA, MTU, TTB, HAT and CHN

Climate change impacts cereal production mainly through heat and water stress but is also associated with water logging, frost, and disease and pest dynamics. Under climate change scenarios, and without adaptation, yields of wheat, maize and rice are predicted to decrease in both tropical and temperate regions. Not only are temperatures predicted to increase generally short periods of extreme heat are expected to become more frequent. Some models estimate that by the end of the 21st Century, a current 1-in-20 year hottest day will become a 1-in-10 year event, or even occur annually or bi-annually in many regions. Frequent short episodes of high temperature stress could have adverse effects on seed number, seed weight, and thus cereal yields. This can have devastating effects on crop production, as seen in Russia during 2010 when the hottest summer experienced in 130 years contributed to a 30% reduction in the predicted grain harvest. Supra-optimal temperatures occurring at any plant growth stage that can result in Z10% yield loss. This is typically characterized by accelerated plant development resulting in reduced photosynthetic area, plant biomass, and seed set. It may also result in reduced harvest index (HI) where heat stress inhibits reproductive success by affecting gametogenesis, pollination-related processes, and grain set. Where heat stress occurs during grain-filling, reduced grain weight (and therefore HI) will result from inhibition of starch synthesis, increased starch breakdown, and/or premature and rapid increase in senescence.

In view of the importance of high temperature tolerance in rice a trial was initiated for field screening of elite rice genotypes in 2010 Kharif season and being continued to date. During Kharif 2018 season the trial was conducted at IIRR, CHN, PNR, TTB, REWA and MTU centers with 30 rice genotypes comprising of 23 IVT-E-TP entries and 6 popular varieties. The trial was conducted in split-plot RCBD design with 3 replication as temperature regimes as main plot and genotypes and locations as sub-plot treatments. High temperature treatment was imposed in field grown plants by covering with polythene sheet (>92% transmittance) immediately after panicle initiation stage.

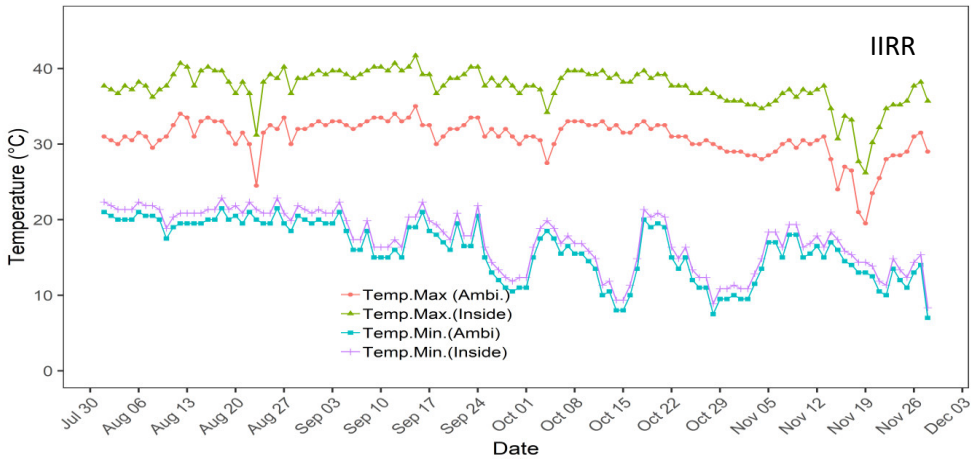


Fig. 1: Temperatures recorded at IIRR inside and outside the polythene tunnel.

The ambient mean maximum temperature recorded during the reproductive phase is 31.5 °C where as inside the polythene tunnel the mean maximum temperature is 37.5 °C. Covering the field grown rice crop with polythene sheet supported by metal poles has resulted in 6.0 °C increase in maximum temperature at IIRR, Hyderabad (Fig.1). Similarly the ambient mean minimum temperature was 16.01 °C where as inside the polythene tunnel the mean minimum temperature was 17.4°C, an increase of 1.35°C. At PTB centre the mean maximum temperature from July to December is 31.3°C and inside the polythene tunnel the mean maximum temperature was recorded as 37.9°C which is 6.6°C higher than the ambient temperature during the same period. The mean minimum temperature recorded at PTB 21.9 °C where as it is 23.9 °C which is 2.0 °C higher than the ambient mean minimum temperature.

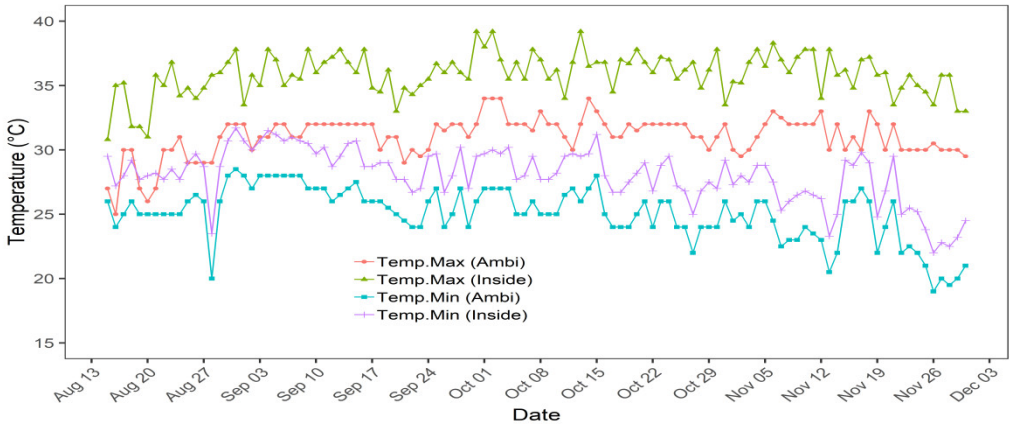


Fig 2: Temperatures recorded at MTU center during kharif 2018 season inside and outside the polythene tunnel

At Maruteru center the mean maximum temperature during crop reproductive phase under ambient condition was 31.0°C where as inside the polythene tunnel the mean maximum temperature was 35.9 °C, an increase of 4.8 °C. Similarly, the mean minimum temperature under ambient condition was 25.1 °C where as the mean minimum temperature inside the polythene tunnel was 27.3 °C which is 2.2 °C higher than ambient condition (Fig.2). At TTB centre the mean maximum temperature recorded during reproductive is 35.8 °C under ambient condition where as inside the polythene tunnel the mean maximum temperature is 31.7 °C, an increase of 4.1° C than ambient condition (Fig.3).

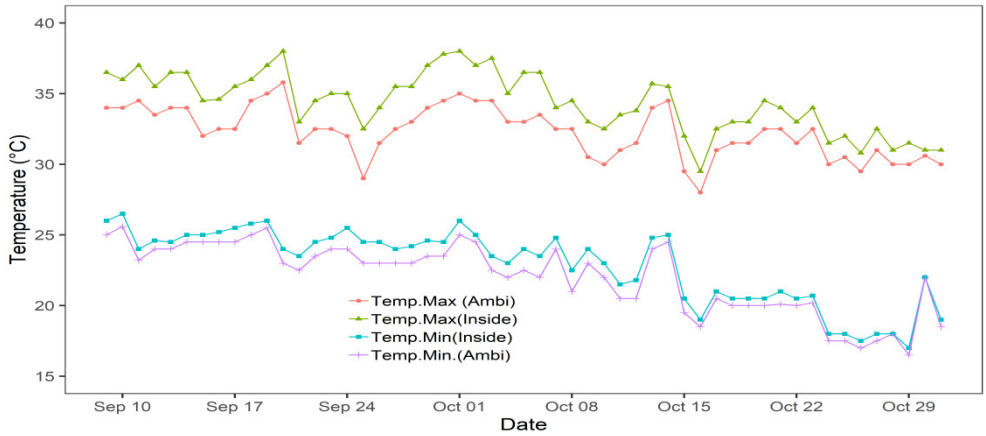


Fig 3: Temperatures recorded at TTB (Titabar) center during kharif 2018 season inside and outside the polythene tunnel

At Pantnagar (PNR) center the mean maximum temperature during crop reproductive phase under ambient condition was 31.5 °C where as inside the polythene tunnel the mean maximum temperature was 40.7 °C, an increase of 9.2 °C. Similarly, the mean minimum temperature under ambient condition was 20.5 °C where as the mean minimum temperature inside the polythene tunnel was 21.3 °C which is 0.8 °C higher than ambient condition (Fig.4).

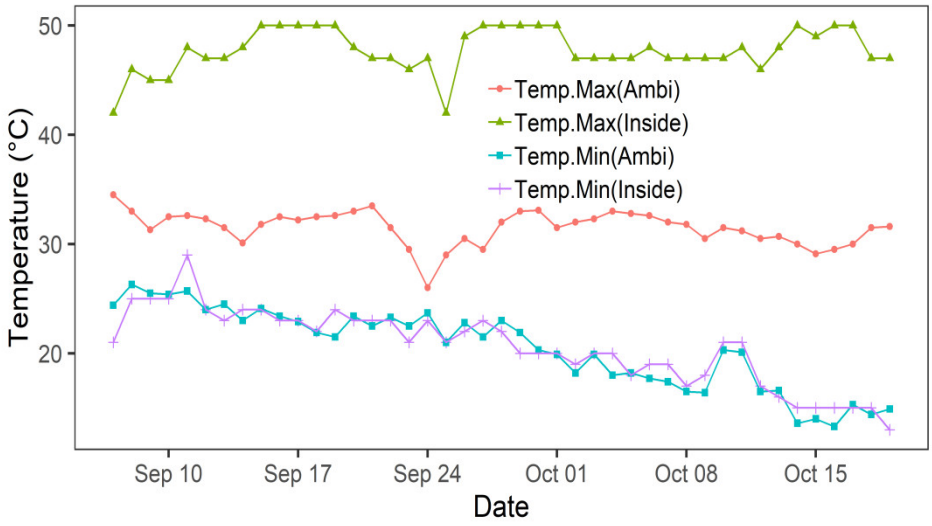


Fig 4: Temperatures recorded at PNR (Pantnagar) center during kharif 2018 season inside and outside the polythene tunnel

At REWA center the mean maximum temperature during crop reproductive phase under ambient condition was 32.4 °C where as inside the polythene tunnel the mean maximum temperature was 35.7 °C, an increase of 3.3 °C. Similarly, the mean minimum temperature under ambient condition was 17.5 °C where as the mean minimum temperature inside the polythene tunnel was 18.7 °C which is 1.2 °C higher than ambient condition (Fig.5).

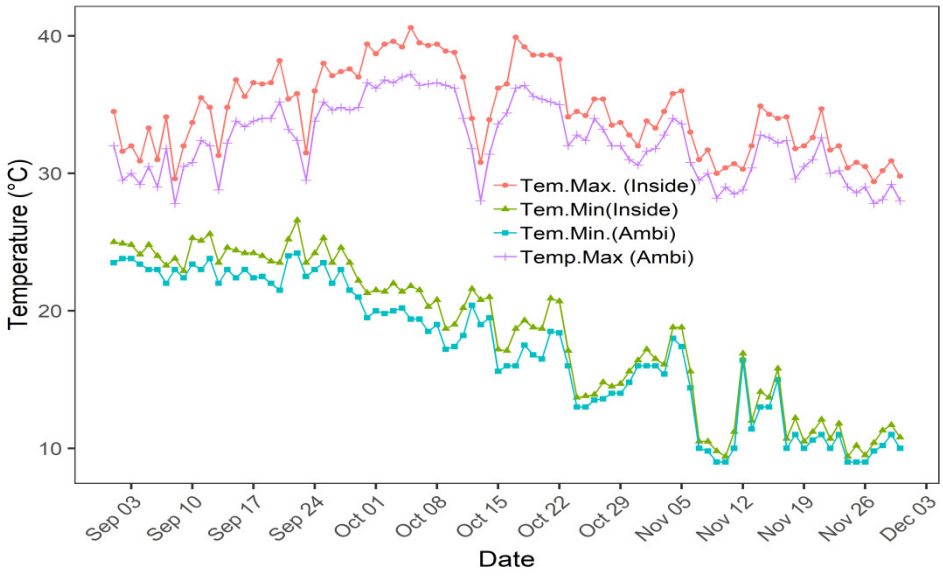


Fig 5: Temperatures recorded at REWA center during kharif 2018 season inside and outside the polythene tunnel

Elevated temperature exposure did not influenced the Days to 50% flowering (DF). However, significant ($p<0.01$) differences were observed among the tested entries (Table). The mean DF varied between 90.6 (IET 26763) to 71.1(CO-51) under ambient condition and under elevated temperature regime it varied between 88.6(IET 26763) to 71.0(CO-51). The interaction between Genotype x Treatment is found to be non-significant indicating that the temperature difference had not resulted in any change in DF. However, significant interaction was observed between Location x Treatment and Location x Entry ($p<0.01$) (Tab;le). Similarly, the mean days to maturity (DM) was not affected by elevated temperature. However, DM differed significantly amongst the tested genotypes. The mean (mean of all locations) varied between the genotypes and it varied between 98 (CO-1) to 121 (IET26763) days. The interaction between Location x Treatment was found to be significant ($p<0.01$) and the interaction between Location X entry was also significant ($p<0.01$). The mean DM for all varieties varied between the locations and it varied between 101 (PNR) to 127 (PTB) days under ambient condition where as it varied between 100 (TTB) to 127 (PTB) followed by 126 days at IIRR under elevated condition (Table 6.3.1).

Plant height did not show any significant difference between the two temperature treatments. The interaction between treatment and entry was also found to be non-significant. Significant ($p<0.01$) differences were observed in plant height amongst the entries. The mean Plant height varied between locations as indicated by the significant ($p<0.05$) interaction between location and entries (Table 6.3.5). The mean plant height varied between 88.5 (HAT) to 125.6 cm (MTU) with a mean of 104.5 cm under ambient temperature regime. Under elevated temperature maximum plant height as recorded at MTU (126 cm) and the mean plant height was minimum at HAT (83.9 cm).

The total dry weight (TDM) was recorded at harvest. The mean TDM (mean of all genotypes and locations) was reduced by >12% over ambient control under elevated temperature condition (Table 6.3.11). The TDM under ambient condition varied between 740 g m^{-2} (Narendra-97) to 1300 g m^{-2} (IET 24911) with a mean of 998 g m^{-2} . Similarly under elevated temperature treatment the TDM varied between 671 g m^{-2} (Narendra-97) to 1158 g m^{-2} (IET 24911) with a mean of 874 g m^{-2}. Maximum reduction (>23% over control) in TDM was observed in IET 26756 and minimum reduction (<1%) was noticed in IET 26464 Nevertheless, the interaction between Location x genotype was significant ($p<0.01$) (Fig.6). Significant differences were observed between locations in terms of reduction in mean TDM (mean of all genotypes). Maximum reduction (>30% reduction over control) was observed at REWA centre where as minimum reduction in TDM (<1.0% over control) was observed at PTB centre (Fig.6).

Table 6.3.3 presents the data on chlorophyll content measured in terms of SPAD reading at flowering stage. No significant differences were observed in mean SPAD value *(mean of all locations and genotypes)* between ambient control and elevated temperature treatments. Except the interaction between Location x Treatment, all other interactions are non-significant.

Leaf are index (LAI) was measured at flowering stage in some locations. The data was presented in Table 6.3.4. The mean LAI was not significantly affected by elevated temperature

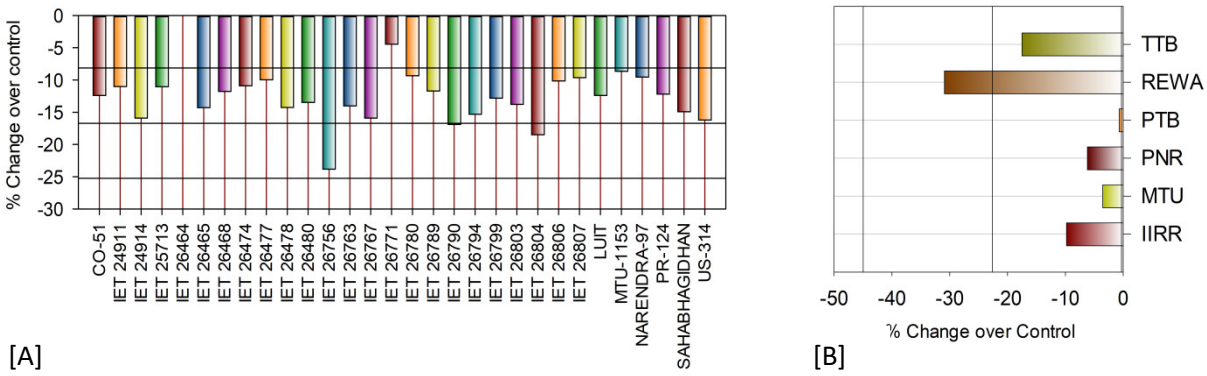


Fig. 6 *Influence of high temperature stress on TDM (g m^{-2}). Each bar represents the % change TDM over ambient control.(A) Mean of all locations (B) Mean of all genotypes*

However, the mean of all genotypes and locations recorded at both ambient and elevated temperature treatments show that a minor reduction of >6% was noticed under heat treatments. Differences were observed between different locations. The mean LAI was reduced by >21% at PNR centre where as at REWA and PTB centres the reduction was moderate. However, at IIRR an increase in LAI was observed (Fig.7 & Table.6.3.4)

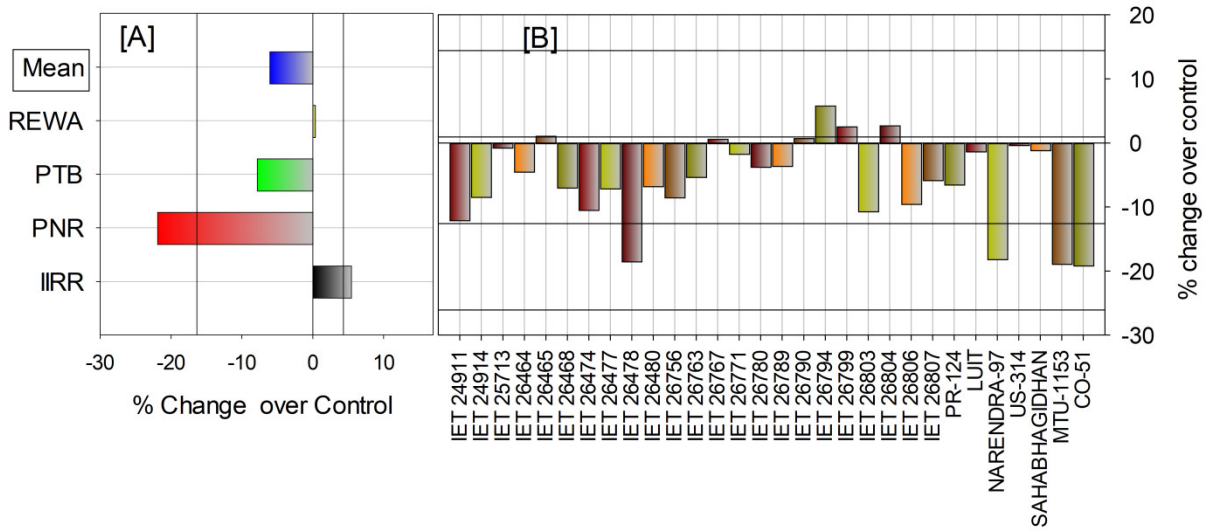


Fig. 7 *Influence of high temperature stress on LAI. Each bar represents the % change LAI over ambient control.(A) Mean of all locations (B) Mean of all genotypes*

Number of grains per panicle is an important yield contributing character which is affected by high temperature stress. The mean number of grains per panicle was reduced by >21% over control under elevated temperature conditions (Table 6.3.6 & Fig. 8). Maximum reduction in mean *(mean of all genotypes)* No. of grains/panicle was observed at REWA (64% reduction over control) followed by PNR (>34% reduction) and IIRR (>24% reduction) (Fig. 8(A)). Differences were observed amongst the centres in No. of grains/panicle. Maximum reduction was observed in IET24919 (>41% reduction) and minimum IET 26477(3% reduction) followed by IET 26771 (>5% reduction) and IET 26474 (>7% reduction) (Table 6.3.6 & Fig.8(B)).

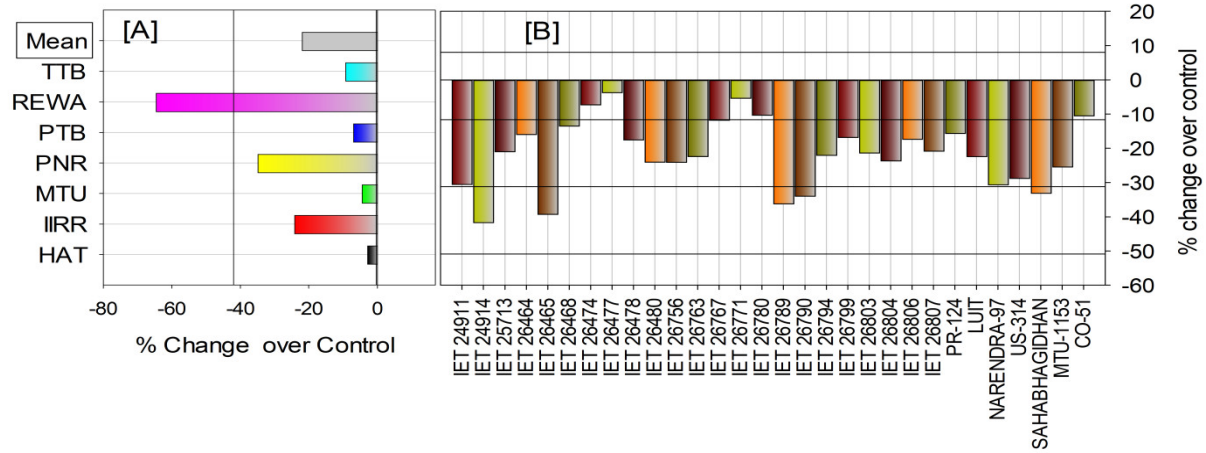


Fig. 8 *Influence of high temperature stress on No. of grains Panicle^{-1}. Each bar represents the % change over ambient control.(A) Mean of all locations (B) Mean of all genotypes*

The grain yield was expressed as g m^{-2} and the data was presented in Table 6.3.10. The mean grain yield for all genotypes and locations under ambient condition was 517 g m^{-2}

where as under elevated temperature condition it was 387 g m^{-2} a reduction of >25% over ambient control (Fig. 10). Under ambient control condition the grain yield varied between Narendra-97 (400 g m^{-2}) to 582 g m^{-2} (IET 26465) where as under elevated temperature the grain yield varied between 315 g m^{-2} (IET 26790) to 472 g m^{-2} (IET 25713). The mean grain yield *(mean of all genotypes)* varied between locations. The percent reduction in grain yield under elevated temperature is minimum (>5% over control) at HAT where as the reduction in grain yield was highest at REWA (>66% over control) followed by PTB (>60% reduction over control) Fig. 10.

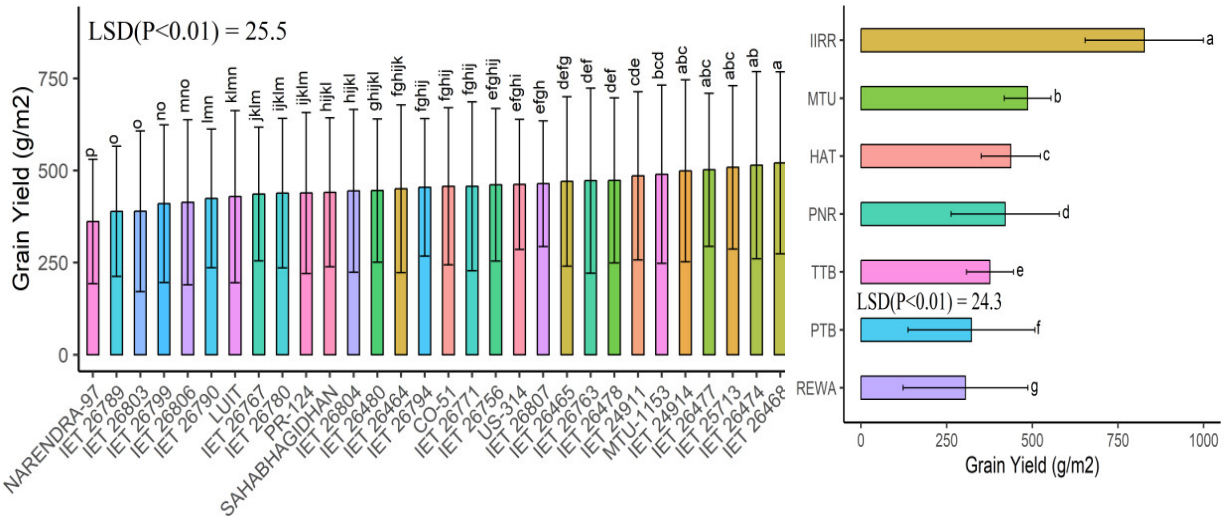


Fig. 9: Differences in mean grain yield of different genotypes during kharif 2018 (A) Mean of all locations and treatments (B) Mean of all varieties and treatments. Bars with similar letters are not statistically significant

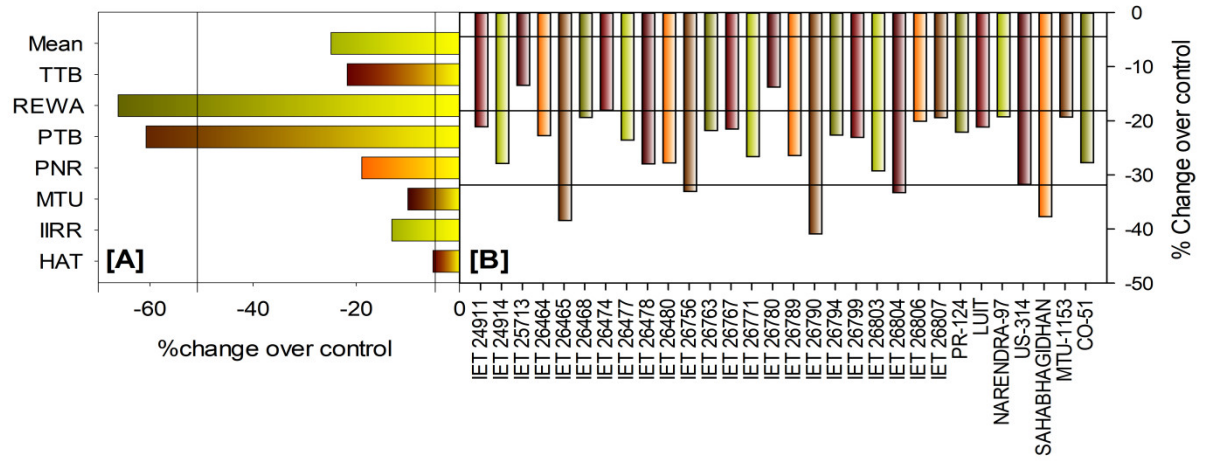


Fig. 10 *Influence of high temperature stress on grain yield . Each bar represents the % change over ambient control.(A) Mean of all locations (B) Mean of all genotypes*

High temperature exposure during reproductive phase resulted in spikelet sterility represented by an increase in unfilled grains (UFG). In the present investigation also exposure to elevated temperature had significantly increased ($p<0.01$) the mean unfilled grain number. Significant differences were observed between tested genotypes. The mean (mean of all locations and treatments) varied between 16.9(CO-51) to 57 (IET26807) with a mean of 31.4 under ambient control condition. Under elevated temperature treatment the UFG varied between 32.3 (Narendra-97) to 94 (IET 26477) with a mean of 55. The interaction between Genotype x treatment was found to be significant ($p<0.05$) indicating that the genotypes differ in their reaction to elevated temperature. The interaction between Location x Genotype and Treatment x genotype x location was found to be highly significant ($p<0.01$).

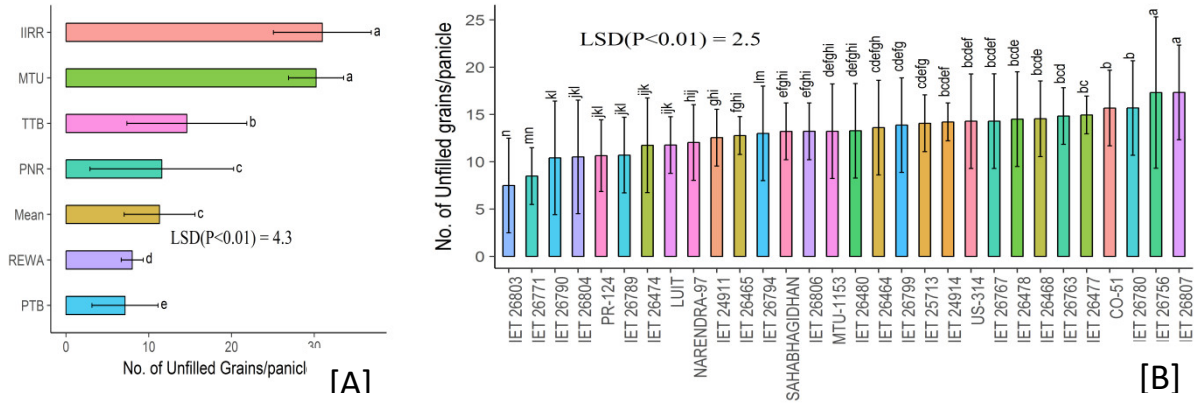


Fig. 11 *Influence of high temperature stress on No. of unfilled grains per panicle. (A) Mean of all locations (B) Mean of all genotypes. Bars marked with similar letters are statistically non-significant.*

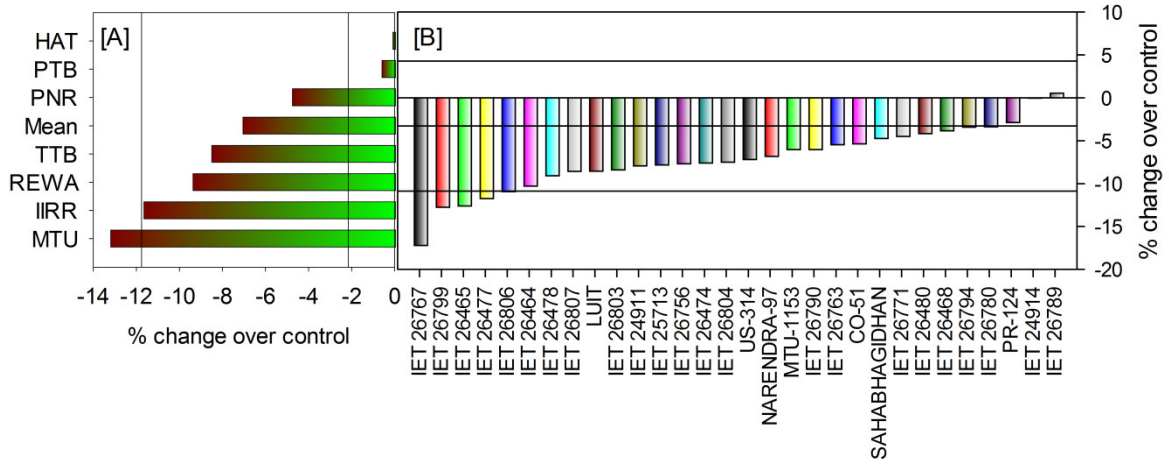


Fig. 12 : Influence of high temperature stress on 1000 grain weight (g) in rice genotypes. Each bar represents % change in test weight over ambient control (A) Mean of all genotypes and treatments, (B) Mean of all locations and treatments)

In order to identify genotypes tolerant to high temperature, different indices were computed based on the grain yield recorded under ambient and elevated conditions. Different heat tolerance indices including Heat susceptibility index (HSI), Relative Heat index (RHI), Heat tolerance index (HTI), Geometric mean productivity (GMP), Tolerance (TOL), Mean production (MP), Yield index (YI), Heat resistance index (HI), Yield stability index (YSI), Modified stress tolerance index (KiSTI), were calculated using the following relationships (Fischer and Maurer, 1978; Fischer et al., 1998; Fernandez, 1992; Rosielle and Hamblin, 1981; Bouslama and Schapaugh, 1984; Blum, 1988; Moosavi et al., 2008; Farshadfar and Sutka, 2002). The indices were computed using mean yield recorded for all the centers under both ambient and elevated temperature treatments. The results are presented in Table 6.3.13. Significant Variation was observed amongst the genotypes for most of the indices.

Multiple correlations was performed between yield, measured under ambient as well as high temperature conditions, and other heat tolerance indices (Fig. 13) The correlation analysis between grain yield and heat tolerance indices can be a good criterion for screening the best cultivars and indices used. A suitable index must have a significant association with yield recorded under stress condition Fig. 14 presents the results of correlation analysis which indicate that the indices like GMP(Geometric Mean Production),HM (Hormonic Mean), K2STI (Modified Stress Tolerance Index), Yield index (YI) showed highly significant positive association with grain yield recorded under stress condition. These indices are useful in selecting suitable genotypes for heat tolerance. These indices show strong association with the yield recorded under control conditions also. The susceptibility indices show negative association with grain yield recorded under high temperature stress conditions.

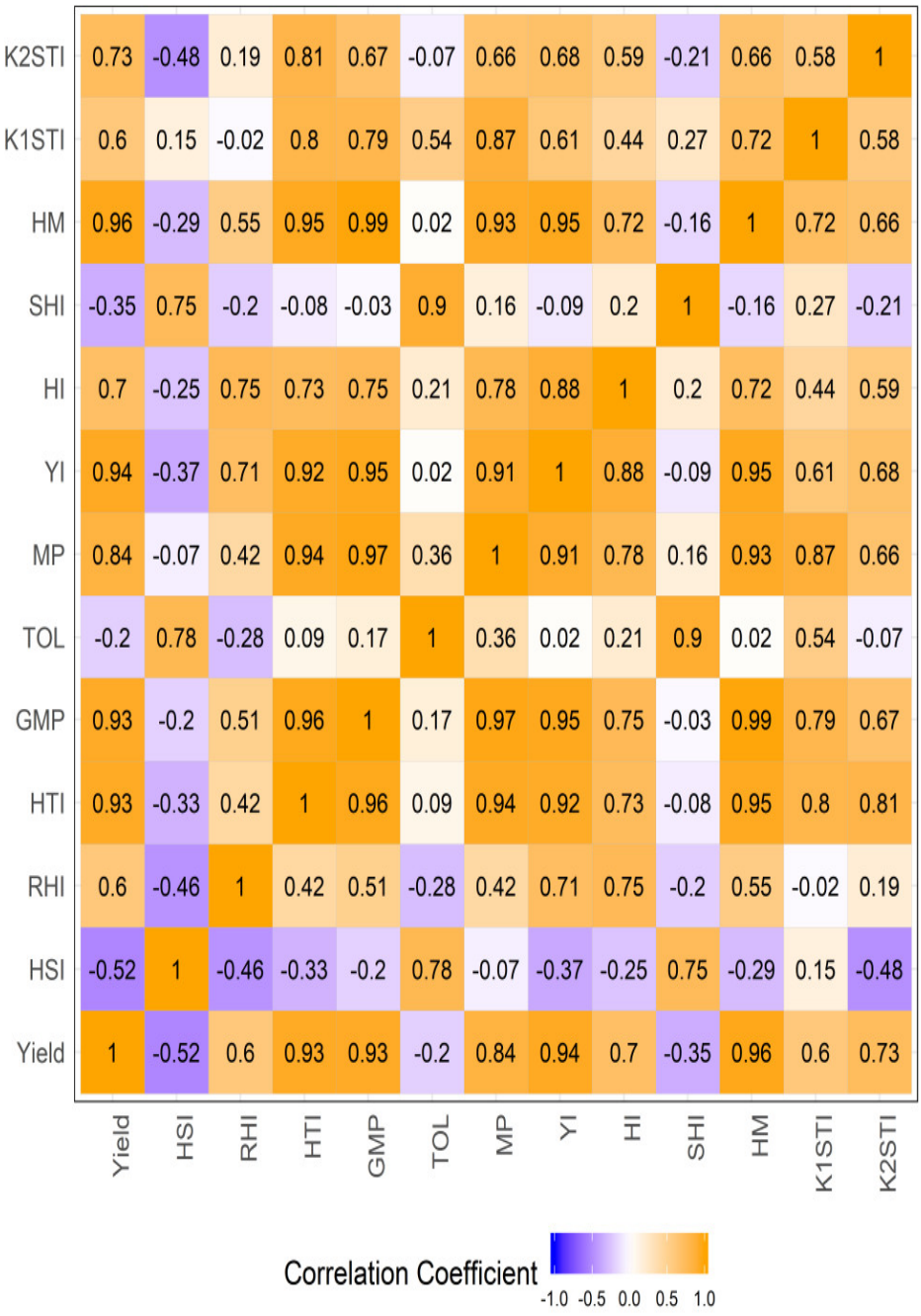


Fig.13: Correlation between Heat indices and grain yield (Mean of all locations) under elevated temperature condition.

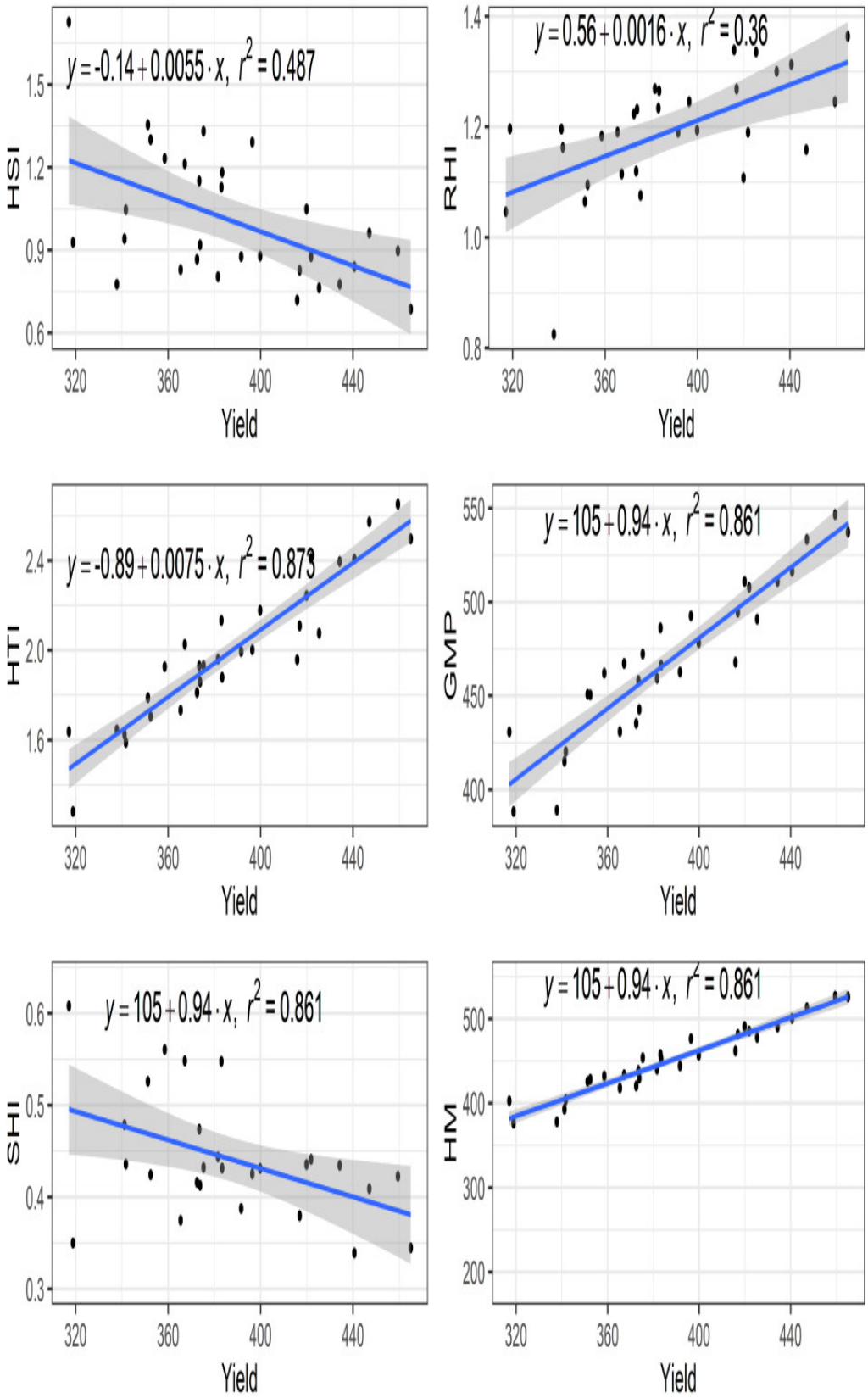


Fig.14 Relationship between grain yield (mean of all locations) recorded under elevated temperature and heat indices during Kharif 2018

AMMI Biplot analysis for stability of grain yield under elevated temperature:

Variance analysis showed that both the main effects genotype (G) and environment (E) were highly significant ($p<0.01$). The large sum of square for environment indicate strong environmental influence on grain yield. In our trial the grain yield recorded under elevated temperature condition

was subjected to AMMI analysis and differences in temperature between the locations resulted in major variation in mean grain yield. Similarly significant genotypic effect also suggested that the Variation in grain yield amongst the genotypes is in part are due to genetic differences among the tested entries. Highly significant ($p<0.01$) interaction effect between G X E was also noticed.

Table 6.3.14: Combine variance analysis of Grain yield in 30 rice genotypes grown at 7 locations during Kharif 2018 season.

	Df	SS	MS	F value	Pr(>F)
ENV	5	25863807	5172761	595.4267	6.11E-14***
REP(ENV)	12	104250	8687	1.4218	0.1515 ns
GEN	29	903344	31150	5.098	2.28E-15***
ENV:GEN	145	5413804	37337	6.1106	< 2.2e-16***
Residuals	528	3226164	6110		
Mean Yield = 415.7 (g m^{-2}), CV(%) = 18.9					

Table 6.3.15 : Analysis of variance of principle components of biplot genotype x location of 30 rice genotypes grown at 7 locations during Kharif 2018 season

Principle component	percent	acum	Df	Sum.Sq	Mean.Sq	F.value	Pr.F
PC1	44.1	44.1	33	2103923	63755.24	10.43	0
PC2	29	73.1	31	1383647	44633.77	7.3	0
PC3	14.7	87.8	29	701458.5	24188.22	3.96	0
PC4	7.8	95.6	27	370398.3	13718.45	2.25	0.0004
PC5	4.4	100	25	211136.8	8445.47	1.38	0.1049

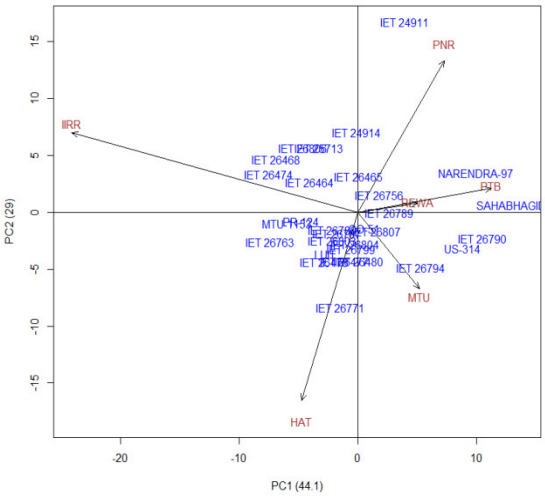


Fig. 15 Ammi Biplot for grain yield (g/m2) of 30 rice genotypes and 7 environments using genotype and environment scores

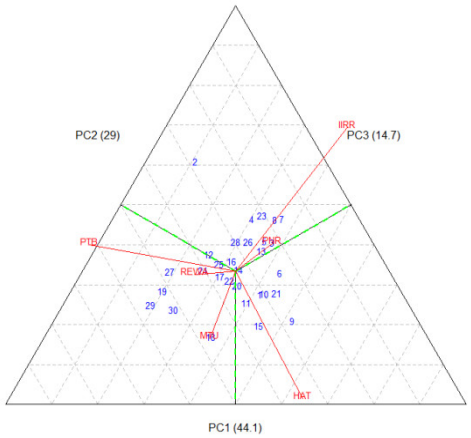


Fig.16 Ammi triplot for grain yield (g/m2) of 30 rice genotypes and 7 environments using genotype and environments scores

Table 6.3.16. Mean grain yield, AMMI Stability values (ASV), Stability index(YSI) and ranking orders of 30 rice genotypes # *Crops with improved stability according AMMI*

S.No	Genotype	ASV	YSI	rASV	rYSI	Mean Grain Yield (g m^{-2})
1	CO-51	1.63	25	1	24	404.3
2	IET 26804	2.81	18	2	16	428.1
3	IET 26807	2.91	11	3	8	466.2
4	IET 26465	3.15	16	4	12	447.1
5	IET 26756	3.15	28	5	23	411.4
6	IET 26767	3.18	24	6	18	425.0
7	IET 26799	3.31	29	7	22	412.2
8	IET 26780	3.61	19	8	11	454.6
9	IET 26789	4.08	38	9	29	375.1
10	IET 26803	4.12	30	10	20	414.1
11	IET 26480	4.32	36	11	25	398.8
12	IET 26477	4.60	15	12	3	499.8
13	LUIT	5.57	28	13	15	432.3
14	IET 26478	6.12	27	14	13	436.2
15	IET 26464	6.67	34	15	19	417.8
16	IET 24914	7.02	26	16	10	459.7
17	PR-124	7.29	38	17	21	412.4
18	IET 25713	7.55	23	18	5	487.5
19	IET 26771	8.66	28	19	9	465.7
20	IET 26806	9.02	34	20	14	435.0
21	MTU-1153	9.14	27	21	6	485.3
22	IET 26794	9.43	39	22	17	425.8
23	IET 26468	11.48	24	23	1	533.9
24	IET 26763	11.52	31	24	7	473.0
25	IET 26474	11.91	27	25	2	507.5
26	US-314	13.79	56	26	30	374.5
27	NARENDRA-97	15.59	54	27	27	390.2
28	IET 26790	16.19	54	28	26	393.9
29	IET 24911	17.79	33	29	4	498.3
30	SAHABHAGIDHAN	21.21	58	30	28	383.4

In our case, the interaction is significant. The first two components explain 73.1 %; then the biplot can provide information about the interaction genotype-environment. With the triplot, 87.8% would be explained (Table 2). The AMMI Stability Value (ASV) and AMMI stability index (ASI) are calculated as suggested by Zobel et al. 1998 and Purchase et al.(2000). The highest grain yield averaged across the locations was produced by IET26468 (533.9 g/mg2) followed by IET26474 (507.5 g/m2). The genotypes with low ASV are said to be stable and CO-51 followed by IET 26804 and IET 26807 are having low ASV value and can be identified as stable genotypes under elevated temperature. However, CO-51 yield averaged across the locations is less than the mean grand yield where as both IET 26804 and IET 26807 yielded slightly higher than then grand mean yield. In this trial IET 26468 ranked first in stability followed by IET 26468. IET 26477 and IET 24911.

Table 6.3.17. Mean grain yield, AMMI Stability values (ASV), Stability index(YSI) and ranking orders of 30 rice genotypes # ***Crops with better response and improved stability according AMMI***.

S.No	Genotype	ASV	YSI	rASV	rYSI	Mean Grain Yield (g m^{-2})
1	IET 26468	11.5	24	23	1	533.9
2	IET 26474	11.9	27	25	2	507.5
3	IET 26477	4.6	15	12	3	499.8
4	IET 24911	17.8	33	29	4	498.3
5	IET 25713	7.5	23	18	5	487.5
6	MTU-1153	9.1	27	21	6	485.3
7	IET 26763	11.5	31	24	7	473
8	IET 26807	2.9	11	3	8	466.2
9	IET 26771	8.7	28	19	9	465.7
10	IET 24914	7	26	16	10	459.7
11	IET 26780	3.6	19	8	11	454.6
12	IET 26465	3.1	16	4	12	447.1
13	IET 26478	6.1	27	14	13	436.2
14	IET 26806	9	34	20	14	435
15	LUIT	5.6	28	13	15	432.3
16	IET 26804	2.8	18	2	16	428.1
17	IET 26794	9.4	39	22	17	425.8
18	IET 26767	3.2	24	6	18	425
19	IET 26464	6.7	34	15	19	417.8
20	IET 26803	4.1	30	10	20	414.1
21	PR-124	7.3	38	17	21	412.4
22	IET 26799	3.3	29	7	22	412.2
23	IET 26756	3.2	28	5	23	411.4
24	CO-51	1.6	25	1	24	404.3
25	IET 26480	4.3	36	11	25	398.8
26	IET 26790	16.2	54	28	26	393.9
27	NARENDRA-97	15.6	54	27	27	390.2
28	SAHABHAGIDHAN	21.2	58	30	28	383.4
29	IET 26789	4.1	38	9	29	375.1
30	US-314	13.8	56	26	30	374.5

The AMMI biplot, the usual interpretation is that the displacements along the abscissa indicate differences in main(additive) effects, where as displacements along the ordinate indicate differences in interaction effects. Genotypes that group together have similar adaptation while environments which group together includes the genotypes in the same way. Figure 15 showed that genotypes which are on the right side of the perpendicular are less affected by G X E interaction. The genotypes which are close to the centre point indicated that they are stable across environments. All the environments, IRR, PNR, PTB, REWA, MTU and HAT are connected to the origin (Fig.16). The environments REWA, PNR and MTU had short spokes and they do not exert strong interactive forces. The genotypes occur

together in the plot tend to have similar yields in all environments, while the genotypes far part may differ in mean yield or show different pattern of response across environments.

Summary & Conclusions

Covering the field grown crop at PI stage with polythene increased the temperature and crop is exposed to elevated temperature from PI stage to maturity. The mean grain yield recorded for all varieties and locations was reduced by >25% under elevated temperature regime. Under elevated temperature the grain yield varied between 315 g m^{-2} (IET 26790) to 472 g m^{-2} (IET 25713). The mean grain yield *(mean of all genotypes)* varied between locations. The percent reduction in grain yield under elevated temperature is minimum (>5% over control) at HAT where as the reduction in grain yield was highest at REWA (>66% over control) followed by PTB (>60% reduction over control). Based on percent reduction in yield under elevated temperature condition **IET 26780** and **IET 25713** show <15% yield reduction in comparison with ambient control condition, where as IET 26790 and IET 26465 followed by Sahabhagidhan show >35% yield reduction under elevated temperatures. Based on the yield indices computed from yield recorded under control and elevated temperature conditions, the genotypes IET 26804, IET 26799, IET 26756 and MTU 1153 show high rank value and low SE. The genotypes with low ASV are said to be stable and CO-51 followed by IET 26804 and IET 26807 are having low ASV value and can be identified as stable genotypes under elevated temperature. However, CO-51 yield averaged across the locations is less than the mean grand yield where as both IET 26804 and IET 26807 yielded slightly higher than the grand mean yield. In this trial IET 26468 ranked first in stability followed by IET 26468. IET 26477 and IET 24911.

Table 6.3.1 Influence of Heat Stress Days to flowering at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	66	97	89	85	76	90	66	81	67	95	89	87	76	90	66	82
2	IET 24914	74	99	90	82	83	87	79	85	72	98	90	82	83	87	79	84
3	IET 25713	75	97	91	93	81	86	79	86	77	96	88	92	81	87	79	86
4	IET 26464	74	100	91	91	76	86	74	85	74	97	88	93	76	86	74	84
5	IET 26465	74	99	91	88	76	86	84	86	75	98	90	90	76	87	84	86
6	IET 26468	65	105	92	92	79	86	70	84	64	102	89	90	79	86	70	83
7	IET 26474	75	105	93	83	80	90	87	88	75	102	89	88	80	89	87	87
8	IET 26477	63	96	92	90	76	86	70	82	64	95	89	90	76	86	70	81
9	IET 26478	78	97	85	88	74	85	84	84	76	96	88	89	74	86	84	85
10	IET 26480	79	88	86	85	80	83	59	80	79	86	81	85	80	85	59	79
11	IET 26756	77	93	85	87	72	84	81	83	78	91	90	85	72	85	81	83
12	IET 26763	80	102	97	95	76	94	90	91	81	104	96	95	76	79	90	89
13	IET 26767	75	93	90	87	75	89	84	85	73	90	91	89	75	88	84	84
14	IET 26771	77	94	92	88	78	90	78	85	76	91	88	92	78	89	78	85
15	IET 26780	77	97	92	89	75	88	57	82	79	95	92	89	75	89	57	82
16	IET 26789	78	93	91	74	78	87	59	80	80	90	90	74	78	87	59	80
17	IET 26790	79	93	89	90	78	88	81	85	81	90	90	88	78	88	81	85
18	IET 26794	77	97	89	88	81	88	74	85	77	95	92	88	81	88	74	85
19	IET 26799	87	97	86	95	80	89	60	85	87	96	91	95	80	88	60	85
20	IET 26803	61	104	91	87	82	87	65	82	65	104	91	93	82	87	65	84
21	IET 26804	75	102	91	89	81	90	88	88	73	104	92	87	81	91	88	88
22	IET 26806	62	100	84	88	77	88	60	80	63	97	80	89	77	87	60	79
23	IET 26807	81	94	91	89	74	88	79	85	84	91	91	89	74	87	79	85
24	PR-124	84	93	88	92	79	89	90	88	81	90	84	94	79	88	90	87
25	LUIT	88	87	84	72	78	79	55	78	89	87	81	72	78	78	55	77
26	NARENDRA-97	77	87	84	69	76	76	63	76	75	85	80	69	76	77	63	75
27	US-314	88	99	89	92	78	86	53	84	89	97	91	92	78	86	53	84
28	SAHABHAGIDHAN	84	100	88	89	74	84	53	82	83	98	90	90	74	85	53	82
29	MTU-1153	90	105	89	87	74	88	84	88	88	104	91	90	74	86	84	88
30	CO-51	85	92	88	75	77	81	0	71	84	90	92	75	77	79	0	71
	Mean	**77**	**97**	**89**	**87**	**77**	**87**	**70**	**83**	**77**	**95**	**89**	**87**	**77**	**86**	**70**	**83**
	LSD (Treat)			NS						LSD(Treat x Entry)					NS		
	LSD (Location x Treat)			0.32**						LSD (Location x Treat x Entry)					NS		
	LSD (Entry)			0.36*						CV (%)					0.991		
	LSD (Location x Entry)			1.23**													

Table 6.3.2 Influence of Heat Stress Days to maturity at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	95	126	118	101	125	114	100	111	95	126	118	109	125	112	97	112
2	IET 24914	105	129	119	100	130	111	114	116	101	129	120	108	130	110	111	116
3	IET 25713	107	126	120	104	128	112	114	116	106	125	116	107	128	107	81	110
4	IET 26464	103	129	120	99	124	112	109	114	102	128	118	117	124	111	106	115
5	IET 26465	107	128	121	101	130	112	118	117	105	129	120	112	130	111	116	118
6	IET 26468	93	135	122	105	131	112	107	115	93	134	119	110	131	110	102	114
7	IET 26474	104	133	122	104	131	114	123	119	103	133	117	102	131	113	120	117
8	IET 26477	93	124	122	105	125	117	105	113	93	125	118	108	125	115	102	112
9	IET 26478	109	126	115	106	124	117	120	117	106	125	117	110	124	116	117	116
10	IET 26480	107	115	115	99	129	112	95	110	107	118	110	101	129	116	91	110
11	IET 26756	106	121	114	101	122	111	115	113	108	122	120	99	122	109	113	113
12	IET 26763	111	131	127	105	124	124	127	121	112	134	125	114	124	119	122	121
13	IET 26767	105	121	119	100	124	108	120	114	101	121	120	104	124	108	116	113
14	IET 26771	106	122	121	102	124	112	113	114	105	122	118	114	124	109	111	115
15	IET 26780	106	125	121	102	125	110	92	112	107	126	122	102	125	111	88	112
16	IET 26789	108	121	120	98	128	112	95	112	111	119	120	100	128	111	91	111
17	IET 26790	109	123	118	101	125	106	116	114	112	122	119	103	125	108	113	115
18	IET 26794	107	126	118	104	128	113	109	115	107	124	121	110	128	112	105	115
19	IET 26799	115	125	115	105	128	111	97	114	119	127	121	115	128	114	92	117
20	IET 26803	100	133	120	105	134	112	102	115	92	134	121	116	134	115	96	116
21	IET 26804	104	131	120	102	130	110	124	117	102	134	121	105	130	110	121	118
22	IET 26806	92	130	113	101	125	113	100	111	95	128	110	103	125	113	93	110
23	IET 26807	113	122	120	100	125	111	113	115	110	122	121	102	125	110	111	114
24	PR-124	112	123	117	101	128	117	131	118	112	119	114	112	128	115	124	118
25	LUIT	116	115	113	95	127	111	88	109	115	116	110	95	127	109	86	108
26	NARENDRA-97	107	115	114	93	125	112	98	109	104	114	109	92	125	110	94	107
27	US-314	116	127	118	102	125	108	90	112	115	127	121	115	125	105	86	113
28	SAHABHAGIDHAN	113	129	118	103	125	109	91	112	114	129	120	109	125	108	86	113
29	MTU-1153	117	135	119	101	127	119	125	120	115	135	121	105	127	118	119	120
30	CO-51	114	116	117	99	127	113	0	98	112	119	121	96	127	116	0	99
	Mean	**106**	**125**	**119**	**101**	**127**	**113**	**105**	**114**	**106**	**126**	**118**	**107**	**127**	**112**	**100**	**114**
	LSD (Treat)				NS					LSD(Treat x Entry)				NS			
	LSD (Location x Treat)				0.47**					LSD (Location x Treat x Entry)				NS			
	LSD (Entry)				NS					CV (%)				0.99			
	LSD (Location x Entry)				1.58**												

Table 6.3.3 Influence of Heat Stress SPAD value at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	0.0	46.9	0.0	0.0	0.0	24.6	0.0	35.8	0.0	48.4	0.0	0.0	0.0	25.0	0.0	36.7
2	IET 24914	0.0	42.6	0.0	0.0	0.0	31.9	0.0	37.2	0.0	45.6	0.0	0.0	0.0	30.8	0.0	38.2
3	IET 25713	0.0	47.7	0.0	0.0	0.0	27.3	0.0	37.5	0.0	42.9	0.0	0.0	0.0	27.1	0.0	35.0
4	IET 26464	0.0	42.3	0.0	0.0	0.0	23.7	0.0	33.0	0.0	44.4	0.0	0.0	0.0	23.6	0.0	34.0
5	IET 26465	0.0	48.0	0.0	0.0	0.0	23.7	0.0	35.8	0.0	45.2	0.0	0.0	0.0	24.4	0.0	34.8
6	IET 26468	0.0	42.3	0.0	0.0	0.0	27.0	0.0	34.6	0.0	37.5	0.0	0.0	0.0	26.6	0.0	32.1
7	IET 26474	0.0	42.7	0.0	0.0	0.0	22.6	0.0	32.6	0.0	43.2	0.0	0.0	0.0	22.7	0.0	33.0
8	IET 26477	0.0	44.9	0.0	0.0	0.0	24.5	0.0	34.7	0.0	44.7	0.0	0.0	0.0	24.5	0.0	34.6
9	IET 26478	0.0	44.6	0.0	0.0	0.0	27.2	0.0	35.9	0.0	42.5	0.0	0.0	0.0	26.4	0.0	34.4
10	IET 26480	0.0	34.7	0.0	0.0	0.0	34.7	0.0	34.7	0.0	46.2	0.0	0.0	0.0	34.4	0.0	40.3
11	IET 26756	0.0	40.4	0.0	0.0	0.0	27.8	0.0	34.1	0.0	41.3	0.0	0.0	0.0	27.7	0.0	34.5
12	IET 26763	0.0	46.1	0.0	0.0	0.0	29.0	0.0	37.6	0.0	45.6	0.0	0.0	0.0	28.4	0.0	37.0
13	IET 26767	0.0	41.9	0.0	0.0	0.0	25.8	0.0	33.8	0.0	45.0	0.0	0.0	0.0	26.0	0.0	35.5
14	IET 26771	0.0	43.4	0.0	0.0	0.0	27.7	0.0	35.6	0.0	47.6	0.0	0.0	0.0	28.1	0.0	37.8
15	IET 26780	0.0	43.4	0.0	0.0	0.0	26.3	0.0	34.8	0.0	46.7	0.0	0.0	0.0	26.7	0.0	36.7
16	IET 26789	0.0	40.3	0.0	0.0	0.0	24.2	0.0	32.3	0.0	45.8	0.0	0.0	0.0	24.3	0.0	35.0
17	IET 26790	0.0	43.4	0.0	0.0	0.0	29.1	0.0	36.2	0.0	48.2	0.0	0.0	0.0	28.7	0.0	38.4
18	IET 26794	0.0	40.1	0.0	0.0	0.0	26.6	0.0	33.4	0.0	44.2	0.0	0.0	0.0	26.7	0.0	35.4
19	IET 26799	0.0	44.8	0.0	0.0	0.0	28.3	0.0	36.5	0.0	47.9	0.0	0.0	0.0	28.9	0.0	38.4
20	IET 26803	0.0	45.0	0.0	0.0	0.0	26.4	0.0	35.7	0.0	40.1	0.0	0.0	0.0	25.9	0.0	33.0
21	IET 26804	0.0	37.7	0.0	0.0	0.0	31.0	0.0	34.3	0.0	38.0	0.0	0.0	0.0	31.4	0.0	34.7
22	IET 26806	0.0	46.4	0.0	0.0	0.0	28.2	0.0	37.3	0.0	46.6	0.0	0.0	0.0	28.1	0.0	37.3
23	IET 26807	0.0	44.8	0.0	0.0	0.0	28.1	0.0	36.5	0.0	44.5	0.0	0.0	0.0	27.5	0.0	36.0
24	PR-124	0.0	48.5	0.0	0.0	0.0	26.0	0.0	37.2	0.0	48.0	0.0	0.0	0.0	25.6	0.0	36.8
25	LUIT	0.0	36.8	0.0	0.0	0.0	28.6	0.0	32.7	0.0	40.0	0.0	0.0	0.0	28.6	0.0	34.3
26	NARENDRA-97	0.0	46.9	0.0	0.0	0.0	32.2	0.0	39.5	0.0	45.7	0.0	0.0	0.0	31.6	0.0	38.6
27	US-314	0.0	42.9	0.0	0.0	0.0	26.4	0.0	34.6	0.0	46.5	0.0	0.0	0.0	26.1	0.0	36.3
28	SAHABHAGIDHAN	0.0	37.1	0.0	0.0	0.0	25.7	0.0	31.4	0.0	36.9	0.0	0.0	0.0	26.1	0.0	31.5
29	MTU-1153	0.0	44.4	0.0	0.0	0.0	30.0	0.0	37.2	0.0	44.1	0.0	0.0	0.0	29.6	0.0	36.8
30	CO-51	0.0	45.4	0.0	0.0	0.0	28.3	0.0	36.8	0.0	46.4	0.0	0.0	0.0	28.4	0.0	37.4
	Mean	**0.0**	**43.2**	**0.0**	**0.0**	**0.0**	**27.4**	**0.0**	**35.3**	**0.0**	**44.3**	**0.0**	**0.0**	**0.0**	**27.3**	**0.0**	**35.8**
	LSD (Treat)				NS					LSD(Treat x Entry)				NS			
	LSD (Location x Treat)				0.38**					LSD (Location x Treat x Entry)				NS			
	LSD (Entry)				NS					CV (%)				9.7			
	LSD (Location x Entry)				NS												

Table 6.3.4 Influence of Heat Stress LAI at flowering different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	0.00	4.59	0.00	5.00	4.13	5.31	0.00	4.76	0.00	3.51	0.00	4.28	3.57	5.38	0.00	4.18
2	IET 24914	0.00	5.06	0.00	6.59	3.07	6.66	0.00	5.34	0.00	6.81	0.00	3.91	2.67	6.20	0.00	4.90
3	IET 25713	0.00	4.50	0.00	4.13	2.23	6.09	0.00	4.24	0.00	5.45	0.00	3.58	1.87	5.95	0.00	4.21
4	IET 26464	0.00	5.28	0.00	5.03	3.93	5.20	0.00	4.86	0.00	5.61	0.00	3.81	3.87	5.29	0.00	4.64
5	IET 26465	0.00	5.29	0.00	3.64	3.93	5.80	0.00	4.67	0.00	5.04	0.00	4.16	3.83	5.85	0.00	4.72
6	IET 26468	0.00	4.68	0.00	4.71	4.30	4.26	0.00	4.49	0.00	4.05	0.00	4.17	4.13	4.35	0.00	4.18
7	IET 26474	0.00	5.15	0.00	6.18	5.20	5.49	0.00	5.51	0.00	3.37	0.00	6.00	4.80	5.56	0.00	4.93
8	IET 26477	0.00	5.10	0.00	5.29	4.43	4.16	0.00	4.75	0.00	4.25	0.00	5.23	3.93	4.23	0.00	4.41
9	IET 26478	0.00	6.31	0.00	4.49	4.30	6.90	0.00	5.50	0.00	3.65	0.00	3.27	4.03	6.98	0.00	4.48
10	IET 26480	0.00	2.99	0.00	5.12	4.87	5.44	0.00	4.60	0.00	4.10	0.00	2.97	4.60	5.51	0.00	4.29
11	IET 26756	0.00	3.15	0.00	4.37	4.73	5.78	0.00	4.51	0.00	3.80	0.00	2.36	4.50	5.84	0.00	4.13
12	IET 26763	0.00	3.11	0.00	4.49	4.27	5.66	0.00	4.38	0.00	3.65	0.00	3.98	4.07	4.90	0.00	4.15
13	IET 26767	0.00	3.98	0.00	5.46	3.00	2.27	0.00	3.68	0.00	5.64	0.00	4.05	2.77	2.36	0.00	3.70
14	IET 26771	0.00	4.24	0.00	4.62	3.33	4.82	0.00	4.25	0.00	5.54	0.00	3.26	3.07	4.87	0.00	4.19
15	IET 26780	0.00	4.41	0.00	3.33	3.80	5.67	0.00	4.30	0.00	3.85	0.00	3.33	3.63	5.75	0.00	4.14
16	IET 26789	0.00	3.34	0.00	4.93	3.39	4.01	0.00	3.92	0.00	5.12	0.00	3.44	2.47	4.08	0.00	3.78
17	IET 26790	0.00	2.88	0.00	4.11	4.17	3.56	0.00	3.68	0.00	4.36	0.00	2.88	3.97	3.62	0.00	3.71
18	IET 26794	0.00	4.63	0.00	3.25	4.07	5.01	0.00	4.24	0.00	5.47	0.00	3.59	3.80	5.08	0.00	4.49
19	IET 26799	0.00	3.32	0.00	4.34	3.57	5.28	0.00	4.12	0.00	4.14	0.00	3.98	3.47	5.35	0.00	4.23
20	IET 26803	0.00	4.83	0.00	6.22	4.23	5.06	0.00	5.09	0.00	4.77	0.00	4.29	4.00	5.12	0.00	4.55
21	IET 26804	0.00	4.12	0.00	7.03	2.23	5.89	0.00	4.82	0.00	4.74	0.00	7.27	1.83	5.97	0.00	4.95
22	IET 26806	0.00	5.76	0.00	3.89	3.87	4.84	0.00	4.59	0.00	4.37	0.00	3.68	3.63	4.93	0.00	4.15
23	IET 26807	0.00	2.93	0.00	5.24	3.83	5.63	0.00	4.41	0.00	3.32	0.00	4.02	3.60	5.68	0.00	4.15
24	PR-124	0.00	3.05	0.00	4.42	3.10	5.92	0.00	4.12	0.00	3.69	0.00	2.92	2.80	6.01	0.00	3.86
25	LUIT	0.00	2.81	0.00	2.60	2.70	5.71	0.00	3.46	0.00	2.97	0.00	2.43	2.47	5.78	0.00	3.41
26	NARENDRA-97	0.00	3.33	0.00	3.87	3.13	3.49	0.00	3.46	0.00	2.49	0.00	2.37	2.90	3.55	0.00	2.83
27	US-314	0.00	4.04	0.00	5.03	3.50	5.38	0.00	4.49	0.00	4.99	0.00	4.52	2.93	5.46	0.00	4.47
28	SAHABHAGIDHAN	0.00	4.58	0.00	4.64	2.50	6.57	0.00	4.57	0.00	6.89	0.00	2.28	2.30	6.63	0.00	4.52
29	MTU-1153	0.00	3.20	0.00	5.35	3.80	6.08	0.00	4.61	0.00	2.54	0.00	2.70	3.57	6.15	0.00	3.74
30	CO-51	0.00	4.31	0.00	3.66	4.40	4.30	0.00	4.17	0.00	3.55	0.00	1.40	4.17	4.37	0.00	3.37
	Mean	0.00	4.17	0.00	4.70	3.73	5.21	0.00	4.45	0.00	4.39	0.00	3.67	3.44	5.23	0.00	4.18
	LSD (Treat)				NS					LSD(Treat x Entry)				NS			
	LSD (Location x Treat)				0.29**					LSD (Location x Treat x Entry)				NS			
	LSD (Entry)				NS					CV (%)				20.67			
	LSD (Location x Entry)				1.12**												

Table 6.3.5 Influence of Heat Stress Plant height (cm) at flowering different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	85.0	110.2	127.0	115.0	99.0	122.0	111.3	109.3	89.7	101.8	133.5	122.0	91.3	122.0	111.0	109.6
2	IET 24914	91.3	102.8	132.0	114.0	80.3	137.7	109.7	109.7	93.0	105.2	132.5	113.0	77.0	137.7	111.3	110.0
3	IET 25713	95.0	102.0	131.5	111.3	124.7	116.0	105.3	112.3	95.0	104.0	132.5	112.7	119.3	116.0	115.7	113.6
4	IET 26464	81.7	92.5	123.5	111.0	103.7	108.3	103.3	103.4	85.0	114.3	123.0	108.7	99.3	108.3	97.7	105.2
5	IET 26465	80.3	99.3	145.0	121.7	91.7	123.3	116.0	111.0	90.0	117.0	147.5	122.7	88.0	123.3	112.3	114.4
6	IET 26468	93.0	105.3	129.0	111.3	110.0	103.3	109.3	108.8	85.0	103.0	127.5	116.3	107.0	103.3	110.7	107.5
7	IET 26474	70.0	95.7	130.5	115.7	111.0	104.0	103.3	104.3	75.3	103.3	130.0	112.3	110.0	104.0	105.7	105.8
8	IET 26477	94.7	98.3	127.5	110.7	119.7	120.7	98.7	110.0	90.3	101.8	126.0	109.3	114.7	120.7	95.3	108.3
9	IET 26478	85.0	104.5	144.0	126.0	107.3	122.0	109.7	114.1	75.0	104.0	132.5	126.0	100.0	122.0	102.3	108.8
10	IET 26480	79.7	90.7	109.0	104.3	118.7	112.0	95.3	101.4	85.3	88.2	116.5	105.7	113.0	112.0	97.3	102.6
11	IET 26756	85.7	95.0	135.0	117.0	128.7	120.0	108.0	112.8	79.7	98.2	137.5	116.3	126.3	120.0	103.7	111.7
12	IET 26763	84.3	99.2	128.0	103.0	108.0	112.0	97.7	104.6	85.0	96.8	134.0	95.7	103.3	112.0	112.7	105.6
13	IET 26767	85.0	84.8	123.0	102.0	110.7	105.3	99.0	101.4	83.0	91.5	127.0	112.7	102.0	105.3	98.0	102.8
14	IET 26771	95.0	87.7	122.5	101.7	92.0	97.0	98.3	99.2	86.0	93.2	126.0	96.7	85.7	97.0	100.0	97.8
15	IET 26780	90.3	101.7	120.0	100.7	108.7	122.0	94.7	105.4	84.0	95.5	120.5	102.0	109.7	122.0	101.7	105.0
16	IET 26789	95.0	89.7	128.5	101.3	88.0	100.0	105.0	101.1	80.0	95.3	121.0	101.3	82.3	100.0	117.0	99.6
17	IET 26790	92.3	94.2	121.5	109.0	105.7	102.3	94.3	102.8	85.0	89.3	128.5	111.3	100.0	102.3	98.3	102.1
18	IET 26794	85.0	100.7	125.0	118.0	101.3	112.7	98.7	105.9	87.0	106.2	125.5	108.3	95.7	112.7	105.7	105.9
19	IET 26799	80.0	100.0	122.0	105.0	98.0	104.0	94.0	100.4	75.0	103.8	120.5	105.3	92.3	104.0	97.3	99.8
20	IET 26803	110.0	97.8	141.0	116.0	109.0	115.0	101.0	112.8	95.0	101.5	130.0	113.0	100.7	115.0	96.0	107.3
21	IET 26804	95.0	97.5	126.5	107.3	90.0	110.7	92.3	102.8	75.3	97.5	122.0	97.7	87.0	110.7	105.7	99.4
22	IET 26806	105.0	97.7	121.0	102.3	89.3	106.0	98.3	102.8	91.0	106.8	124.5	107.7	84.0	106.0	101.3	103.0
23	IET 26807	99.7	97.3	123.5	117.3	103.0	102.0	100.3	106.2	85.0	91.3	125.5	108.7	99.3	102.0	106.3	102.6
24	PR-124	85.0	84.8	119.5	106.7	89.0	100.3	92.0	96.8	84.0	98.3	121.5	102.7	81.3	100.3	107.3	99.4
25	LUIT	90.7	84.0	110.0	104.3	110.7	104.0	83.3	98.1	85.0	86.3	113.0	97.3	103.7	104.0	107.0	99.5
26	NARENDRA-97	80.3	80.3	95.0	91.0	85.7	104.0	78.0	87.8	79.7	77.3	101.5	89.3	80.0	104.0	86.0	88.3
27	US-314	85.0	94.5	128.0	108.7	99.0	114.0	109.7	105.5	74.7	106.7	126.5	111.7	94.7	114.0	111.3	105.6
28	SAHABHAGIDHAN	80.3	93.8	144.5	115.7	107.7	127.7	105.0	110.7	85.0	123.7	139.5	111.7	101.3	127.7	112.3	114.5
29	MTU-1153	99.7	103.5	126.5	109.7	99.7	117.7	111.0	109.7	71.3	106.0	117.0	103.7	94.0	117.7	102.7	101.8
30	CO-51	75.3	86.8	115.0	100.3	95.7	102.0	0.0	82.2	84.0	87.5	116.5	101.0	90.3	102.0	0.0	83.0
	Mean	**88.5**	**95.7**	**125.8**	**109.3**	**102.9**	**111.5**	**97.4**	**104.4**	**83.9**	**99.9**	**126.0**	**108.1**	**97.8**	**111.5**	**101.0**	**104.0**
	LSD (Treat)									LSD(Treat x Entry)							
	LSD (Location x Treat)									LSD (Location x Treat x Entry)							
	LSD (Entry)									CV (%)							
	LSD (Location x Entry)																

Table 6.3.6 Influence of Heat Stress grain number per panicle at different AICRIP centres Kh 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	74	130	126	250	156	165	240	163	89	133	116	71	152	35	198	114
2	IET 24914	102	158	111	427	124	129	191	177	102	99	106	86	105	30	199	104
3	IET 25713	127	127	119	218	72	137	168	138	122	105	116	201	59	58	106	109
4	IET 26464	85	129	107	197	30	118	161	118	112	108	100	173	41	21	141	99
5	IET 26465	145	175	112	213	84	153	144	146	134	86	107	50	76	23	148	89
6	IET 26468	109	111	124	128	253	146	158	147	121	84	117	119	255	38	157	127
7	IET 26474	88	87	120	190	83	134	208	130	112	115	114	197	78	49	179	121
8	IET 26477	128	163	123	109	114	165	133	134	134	117	117	231	111	12	181	129
9	IET 26478	113	155	119	285	152	141	126	156	113	146	115	227	149	20	131	129
10	IET 26480	143	97	105	138	61	125	184	122	126	93	101	94	54	51	131	93
11	IET 26756	123	121	125	172	114	151	165	139	130	95	115	135	88	40	134	105
12	IET 26763	120	121	118	157	67	139	142	123	110	79	113	81	57	74	158	96
13	IET 26767	112	106	115	147	96	131	157	124	105	90	113	143	82	100	132	109
14	IET 26771	87	88	114	102	117	112	116	105	144	64	107	80	110	82	110	100
15	IET 26780	67	120	129	159	83	104	123	112	85	119	126	125	80	98	72	101
16	IET 26789	109	139	117	220	84	147	166	140	97	100	113	109	72	55	81	90
17	IET 26790	110	119	94	203	72	145	148	127	97	52	92	103	65	23	158	84
18	IET 26794	130	96	122	173	114	133	202	139	125	81	118	114	100	41	179	108
19	IET 26799	90	142	115	150	102	102	154	122	125	99	108	124	101	38	117	102
20	IET 26803	111	85	115	124	91	92	115	105	131	71	108	53	88	25	102	83
21	IET 26804	137	84	103	120	56	85	137	103	125	73	99	84	43	30	99	79
22	IET 26806	108	145	115	141	114	65	164	122	102	121	110	131	96	34	111	101
23	IET 26807	145	184	117	277	111	148	195	168	150	131	114	126	117	91	204	133
24	PR-124	110	114	110	127	98	203	183	135	103	102	103	124	109	71	187	114
25	LUIT	120	79	116	175	84	113	94	112	115	67	111	85	71	56	104	87
26	NARENDRA-97	89	76	114	286	106	103	118	127	95	47	110	109	84	43	133	89
27	US-314	144	147	122	181	89	154	159	142	132	82	119	76	91	23	188	102
28	SAHABHAGIDHAN	122	131	120	173	95	136	142	131	108	49	113	87	83	33	143	88
29	MTU-1153	121	178	114	189	109	138	151	143	110	124	109	129	114	22	140	107
30	CO-51	110	134	113	167	116	129	0	110	113	105	109	178	104	80	0	99
	Mean	**113**	**125**	**116**	**187**	**102**	**131**	**151**	**132**	**116**	**95**	**111**	**122**	**95**	**47**	**137**	**103**
	LSD (Treat)		NS							LSD(Treat x Entry)				NS			
	LSD (Location x Treat)		5.16**							LSD (Location x Treat x Entry)				NS			
	LSD (Entry)		7.57**							CV (%)				11.5			
	LSD (Location x Entry)		20.01**														

Table 6.3.7 Influence of Heat Stress spikelet number per panicle at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	0.0	160	136	281	205	195	289	181	0.0	179	131	157	187	192	240	155
2	IET 24914	0.0	207	121	502	171	161	227	198	0.0	160	120	167	158	165	259	147
3	IET 25713	0.0	175	129	261	99	174	201	148	0.0	148	131	242	72	175	161	133
4	IET 26464	0.0	202	117	259	68	156	198	143	0.0	149	114	245	57	135	177	125
5	IET 26465	0.0	246	120	253	116	187	177	157	0.0	157	120	210	127	186	185	141
6	IET 26468	0.0	148	134	162	287	176	197	158	0.0	128	135	163	370	184	234	173
7	IET 26474	0.0	130	130	225	111	166	248	144	0.0	156	129	256	92	157	230	146
8	IET 26477	0.0	218	132	129	182	198	163	146	0.0	206	132	274	267	202	251	190
9	IET 26478	0.0	188	129	338	212	177	147	170	0.0	261	131	303	245	172	198	187
10	IET 26480	0.0	137	115	201	127	157	215	136	0.0	127	115	164	147	162	187	129
11	IET 26756	0.0	148	134	236	147	187	196	150	0.0	121	134	174	132	181	196	134
12	IET 26763	0.0	142	128	214	83	169	180	131	0.0	113	128	120	69	169	224	118
13	IET 26767	0.0	147	124	182	107	163	190	130	0.0	126	127	175	92	163	179	123
14	IET 26771	0.0	121	123	132	132	149	147	115	0.0	97	122	133	126	148	154	111
15	IET 26780	0.0	149	138	215	100	142	157	128	0.0	186	139	236	89	129	91	124
16	IET 26789	0.0	189	126	274	109	181	197	154	0.0	187	127	165	89	182	115	123
17	IET 26790	0.0	167	104	237	102	175	177	137	0.0	113	104	145	90	175	233	123
18	IET 26794	0.0	125	132	236	136	165	239	148	0.0	121	134	181	162	165	253	145
19	IET 26799	0.0	193	125	167	130	135	184	133	0.0	134	123	170	128	139	169	123
20	IET 26803	0.0	108	126	156	111	128	137	109	0.0	100	128	120	112	132	135	104
21	IET 26804	0.0	93	113	160	84	117	167	105	0.0	86	112	119	56	116	146	91
22	IET 26806	0.0	177	121	180	138	101	199	131	0.0	140	122	144	140	99	165	116
23	IET 26807	0.0	260	125	398	183	178	231	196	0.0	234	126	240	286	174	267	190
24	PR-124	0.0	136	119	163	120	226	207	139	0.0	125	117	172	128	222	267	147
25	LUIT	0.0	89	126	221	105	146	108	114	0.0	101	126	157	90	147	143	109
26	NARENDRA-97	0.0	80	122	328	134	139	141	135	0.0	52	122	119	106	142	177	103
27	US-314	0.0	232	131	224	108	186	195	154	0.0	168	133	112	110	187	238	135
28	SAHABHAGIDHAN	0.0	155	130	205	135	172	164	137	0.0	126	128	178	95	171	192	127
29	MTU-1153	0.0	203	124	231	147	168	183	151	0.0	175	125	261	124	167	173	146
30	CO-51	0.0	146	121	188	145	161	0	109	0.0	131	122	221	135	162	0	110
	Mean	**0.0**	**162**	**125**	**232**	**134**	**165**	**182**	**143**	**0.0**	**144**	**125**	**184**	**136**	**163**	**188**	**134**
	LSD (Treat)			NS						LSD(Treat x Entry)			NS				
	LSD (Location x Treat)			6.87**						LSD (Location x Treat x Entry)			NS				
	LSD (Entry)			10.1**						CV (%)			12.8				
	LSD (Location x Entry)			26.6**													

Table 6.3.8 Influence of Heat Stress grain number/m2 at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	11693	41633	41569	41967	94533	34572	68879	47835	9397	33828	39556	16400	81725	5628	58179	34959
2	IET 24914	19163	44623	52514	93367	43408	21413	52302	46684	20611	36664	42262	16867	33467	2798	50561	29033
3	IET 25713	19960	41033	56375	50800	55917	19317	44412	41116	27747	39642	49742	40167	44400	4593	21379	32524
4	IET 26464	15958	45377	43516	39400	19075	19683	44068	32440	18751	42031	37554	40833	26383	2083	36336	29139
5	IET 26465	19308	51612	50589	42533	32975	30562	40590	38310	19761	35763	43208	10067	28517	2787	29500	24229
6	IET 26468	16928	48779	55726	32300	65342	28033	32348	39922	22430	46957	49082	30000	57375	4917	23067	33404
7	IET 26474	15494	40207	53900	41100	21375	27887	60886	37264	21804	40382	40095	39467	22200	7508	45658	31016
8	IET 26477	22694	40328	51359	18267	71525	26167	34881	37889	28697	32262	47498	46483	71392	1100	39972	38201
9	IET 26478	17624	54890	45760	57067	44367	24685	28952	39049	24351	38235	44495	38083	46133	3050	19446	30542
10	IET 26480	16422	35632	44088	29617	11633	21913	43059	28909	29377	26510	40128	23867	10783	6042	14153	21551
11	IET 26756	21736	57284	57618	59333	32717	40147	40943	44254	26734	35992	52019	29183	26433	8587	27517	29495
12	IET 26763	21291	60482	53394	36633	10050	35792	25412	34722	25323	39438	48323	19067	8642	13943	20884	25088
13	IET 26767	21065	43623	51942	34300	21092	29583	29431	33005	25846	36452	44814	28667	17750	17020	21701	27464
14	IET 26771	17524	32743	45122	22267	56400	23292	20764	31159	26838	25177	38588	15933	47375	12927	15472	26044
15	IET 26780	20479	48926	53922	45967	18000	24400	25787	33926	23898	40470	49709	31167	18142	18540	13111	27862
16	IET 26789	13595	41877	43637	43933	12025	28213	43856	32448	17058	32217	40887	21800	12158	6083	15255	20780
17	IET 26790	24318	38129	40348	44250	12083	30258	35572	32137	17086	17027	38500	24317	11342	3073	32297	20520
18	IET 26794	24425	40404	55231	31917	37650	22225	57954	38544	19259	24297	52074	24483	26700	5020	36368	26886
19	IET 26799	17545	53573	49346	32567	60225	22120	33958	38476	21886	36331	41668	30917	53700	5663	18450	29802
20	IET 26803	17486	42169	49148	26783	31850	23890	23528	30693	23543	33408	44132	10767	23292	4833	13646	21946
21	IET 26804	21088	41390	35013	36000	14783	19933	36484	29242	17065	32089	32604	25183	12283	5100	16911	20177
22	IET 26806	21416	43763	44253	30400	62975	13417	40504	36675	18463	43174	33715	28333	61775	4725	20327	30073
23	IET 26807	21032	62611	38511	88133	61450	36855	53841	51776	19719	49277	36245	35717	66250	18045	52390	39663
24	PR-124	21542	40248	46959	20950	67550	40613	49623	41069	21065	35637	42999	20800	70750	11202	43306	35108
25	LUIT	23510	42380	51172	35067	26608	29117	17049	32129	20705	34185	40370	17317	22458	12200	12380	22802
26	NARENDRA-97	15981	26398	49082	118767	66150	25767	21792	46277	15658	23172	42196	47017	50333	7280	23485	29877
27	US-314	29603	50816	49489	36200	25258	26980	36065	36344	24052	23260	43131	14033	24975	2167	25183	22400
28	SAHABHAGIDHAN	22828	53075	48972	34533	18142	23672	37370	34084	18880	17744	42229	23300	13217	3608	31030	21430
29	MTU-1153	21099	46175	42636	47250	25550	26533	29808	34150	20065	45689	39666	37917	21725	3525	26195	27826
30	CO-51	28907	59834	49874	49717	88042	30117	0	43784	24351	43071	40656	65083	77317	12283	0	37537
	Mean	**20057**	**45667**	**48369**	**44046**	**40292**	**26905**	**37004**	**37477**	**21681**	**34679**	**42605**	**28441**	**36300**	**7211**	**26805**	**28246**
	LSD (Treat)			842*						LSD(Treat x Entry)			NS				
	LSD (Location x Treat)			2228**						LSD (Location x Treat x Entry)			NS				
	LSD (Entry)			NS						CV (%)			17.61				
	LSD (Location x Entry)			8630**													

Table 6.3.9 Influence of Heat Stress spikelet number/m2 at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	0	51134	44781	47433	123525	40885	82865	55803	0	46197	44638	36333	100658	31925	70500	47179
2	IET 24914	0	58371	57134	110000	59933	26741	62392	53510	0	59766	47564	33033	50183	15158	66265	38853
3	IET 25713	0	56379	60764	60667	76500	24608	53314	47462	0	55984	56012	48283	54342	14600	32556	37397
4	IET 26464	0	72128	47553	51867	42633	26000	53974	42022	0	57740	42680	58267	35150	15767	45404	36430
5	IET 26465	0	72364	54219	50600	45708	37410	49953	44322	0	65488	48719	41933	47450	24857	36338	37826
6	IET 26468	0	64519	60258	40733	74033	33783	40431	44823	0	71485	56408	40350	83325	22958	34311	44120
7	IET 26474	0	59857	58399	48717	28783	34560	72750	43295	0	56132	45320	51133	26050	23847	58562	37292
8	IET 26477	0	54663	55121	21600	112550	31325	42490	45393	0	55647	53724	55050	171483	20217	55515	58805
9	IET 26478	0	66455	49577	67600	61533	31058	33539	44252	0	68239	50644	50833	75492	21510	29265	42283
10	IET 26480	0	51268	47982	42883	24492	27537	49615	34825	0	36197	45672	41050	29442	20283	20065	27530
11	IET 26756	0	70469	61941	81633	41633	49698	48461	50548	0	45978	60291	37550	39550	36195	40419	37140
12	IET 26763	0	71030	57761	49917	12400	43575	32098	38111	0	56657	54802	28167	10450	30958	29663	30100
13	IET 26767	0	60229	56188	42933	23208	36808	35569	36419	0	51114	50424	35067	19967	28567	29313	30636
14	IET 26771	0	44359	48708	28800	63917	31000	26471	34751	0	37729	44110	26600	54650	23375	21582	29721
15	IET 26780	0	60860	57673	60567	21667	33133	33178	38154	0	61887	55099	58917	20150	23517	16690	33751
16	IET 26789	0	57267	46915	54733	15417	34703	52196	37319	0	61168	46035	33000	15317	21182	21663	28338
17	IET 26790	0	53401	44517	51600	17117	36442	42474	35079	0	37292	43395	34017	15950	23233	47505	28770
18	IET 26794	0	53247	59433	43183	44375	27583	68326	42307	0	36436	58894	39183	43217	19250	51219	35457
19	IET 26799	0	73152	53515	36250	77075	29298	40778	44296	0	48873	47190	42500	68033	23105	26824	36646
20	IET 26803	0	53337	54175	33600	38733	32895	28161	34415	0	47107	51920	23900	29725	27275	18072	28286
21	IET 26804	0	46117	38412	48100	22267	27477	44393	32395	0	38087	36905	35817	15883	18342	24955	24284
22	IET 26806	0	53229	46750	38933	76625	21000	49030	40795	0	49705	37543	31033	89850	13225	30188	35935
23	IET 26807	0	90334	41272	126483	103133	44412	63718	67050	0	87533	40271	67950	162067	34802	68730	65907
24	PR-124	0	47887	50820	27100	82017	45118	56055	44142	0	43695	48851	28583	83350	33263	62046	42827
25	LUIT	0	47497	55264	44267	33200	37618	19465	33902	0	50590	45496	31817	28483	30548	17145	29154
26	NARENDRA-97	0	27667	52250	136133	83917	34817	26043	51547	0	26076	47047	51700	63375	24875	31032	34872
27	US-314	0	80647	53438	44867	30600	32610	44351	40930	0	47102	48191	20483	30233	18612	31799	28060
28	SAHABHAGIDHAN	0	62895	52767	41000	25817	30003	43437	36560	0	45325	47729	48133	15108	21367	41709	31339
29	MTU-1153	0	52417	46112	57750	34375	32267	36114	37005	0	64359	45243	77883	23658	23675	32279	38157
30	CO-51	0	65161	53031	56167	110117	37613	0	46013	0	53696	45551	80317	100333	25733	0	43661
	Mean	**0**	**59278**	**52224**	**54871**	**53577**	**33733**	**44388**	**42581**	**0**	**52109**	**48212**	**42963**	**53431**	**23741**	**36387**	**36692**
	LSD (Treat)			911*						LSD(Treat x Entry)			ns				
	LSD (Location x Treat)			3132**						LSD (Location x Treat x Entry)			ns				
	LSD (Entry)			3530*						CV (%)			20.1				
	LSD (Location x Entry)			12285**													

Table 6.3.10 Influence of Heat Stress grain yield (g/m2) at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	251	963	492	573	329	682	509	543	193	878	423	491	378	212	424	428
2	IET 24914	419	927	459	806	346	642	460	580	398	817	419	671	130	92	403	418
3	IET 25713	404	912	468	763	335	492	443	545	491	937	430	588	192	365	300	472
4	IET 26464	350	890	394	618	504	318	484	508	404	851	348	467	74	186	421	393
5	IET 26465	397	891	540	550	703	547	448	582	407	767	470	359	82	42	385	359
6	IET 26468	346	997	526	628	518	600	423	577	440	1059	461	540	214	175	367	465
7	IET 26474	320	920	607	588	684	367	473	566	471	1055	548	515	160	142	354	464
8	IET 26477	486	834	541	619	407	675	421	569	626	778	508	423	86	267	356	435
9	IET 26478	367	992	471	540	538	542	400	550	462	785	429	482	103	151	364	396
10	IET 26480	372	811	512	553	431	534	410	517	582	680	464	312	69	152	358	374
11	IET 26756	422	976	437	497	519	567	449	552	527	716	359	281	249	152	307	370
12	IET 26763	431	997	513	301	569	508	392	530	520	974	462	351	192	77	328	415
13	IET 26767	413	806	404	453	389	550	407	489	560	772	313	286	185	308	261	384
14	IET 26771	382	871	624	332	682	442	360	527	531	758	575	306	145	71	324	387
15	IET 26780	463	905	480	363	304	425	358	471	512	831	424	308	220	308	241	406
16	IET 26789	300	722	513	421	284	458	441	448	366	647	484	312	120	144	239	330
17	IET 26790	544	807	607	565	426	372	412	533	322	430	545	314	141	56	400	315
18	IET 26794	469	936	556	483	306	367	470	512	422	627	512	447	359	126	283	397
19	IET 26799	403	909	515	271	275	467	404	463	419	731	480	235	111	178	343	357
20	IET 26803	412	815	466	217	547	350	385	456	476	754	412	273	96	63	185	323
21	IET 26804	461	940	537	462	589	346	399	533	361	752	477	387	217	35	263	356
22	IET 26806	478	829	481	341	326	375	390	460	406	924	419	318	144	85	278	368
23	IET 26807	458	822	474	478	548	338	480	514	417	757	434	424	316	145	408	414
24	PR-124	439	931	454	292	490	429	418	493	416	870	418	342	142	150	352	384
25	LUIT	477	917	602	253	356	433	322	480	422	835	554	221	191	142	285	379
26	NARENDRA-97	321	556	466	105	652	317	385	400	339	512	426	203	281	167	335	323
27	US-314	612	888	518	640	395	350	442	549	509	473	448	427	224	252	293	375
28	SAHABHAGIDHAN	431	1003	536	344	656	375	459	543	418	388	480	286	304	132	361	339
29	MTU-1153	496	906	611	549	326	492	417	542	473	979	570	414	204	75	348	438
30	CO-51	640	903	570	359	474	325	0	467	580	700	513	308	106	158	0	338
	Mean	**425**	**886**	**513**	**465**	**464**	**456**	**408**	**517**	**449**	**768**	**460**	**376**	**181**	**154**	**319**	**387**
	LSD (Treat)		8.3*							LSD(Treat x Entry)		ns					
	LSD (Location x Treat)		2221**							LSD (Location x Treat x Entry)		ns					
	LSD (Entry)		ns							CV (%)		12.77					
	LSD (Location x Entry)		86.04**														

Table 6.3.11 Influence of Heat Stress total dry matter (g/m2) at maturity different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	0	1797	974	1256	2153	1696	1222	1300	0	1632	899	1250	2130	1154	1042	1158
2	IET 24914	0	1776	919	1699	860	1603	1025	1126	0	1617	849	1506	850	876	938	948
3	IET 25713	0	1664	936	1635	1412	1275	1218	1163	0	1686	878	1250	1440	1029	966	1036
4	IET 26464	0	1653	843	1250	535	1115	949	906	0	1733	813	1442	526	921	922	908
5	IET 26465	0	1644	988	1250	1412	1409	1349	1150	0	1596	909	1186	1400	805	1013	987
6	IET 26468	0	1854	989	1378	1079	1639	1003	1135	0	1972	923	1314	1076	808	921	1002
7	IET 26474	0	1871	1161	1218	339	1452	1233	1039	0	1921	1117	1154	325	1059	913	927
8	IET 26477	0	1565	1023	1314	1433	1440	985	1109	0	1531	1003	1314	1424	909	813	999
9	IET 26478	0	1890	920	1314	740	1575	1112	1079	0	1580	893	1250	730	976	1052	926
10	IET 26480	0	1460	961	1250	1422	1332	930	1051	0	1239	905	1058	1408	901	860	910
11	IET 26756	0	1848	871	1058	426	1460	937	943	0	1341	807	833	411	886	754	719
12	IET 26763	0	1891	978	1026	222	1202	1075	913	0	1797	957	994	209	725	823	786
13	IET 26767	0	1502	794	1026	282	1260	1267	876	0	1481	732	769	273	1048	858	737
14	IET 26771	0	1574	1203	897	1580	1063	944	1037	0	1417	1211	962	1568	868	919	992
15	IET 26780	0	1723	889	994	880	1145	808	920	0	1547	886	897	872	936	705	835
16	IET 26789	0	1425	965	1282	96	1252	1109	875	0	1375	983	1218	79	844	919	774
17	IET 26790	0	1485	1180	1218	265	1130	957	891	0	1106	1129	994	253	752	955	741
18	IET 26794	0	1720	1032	1314	927	1265	1183	1063	0	1268	1005	1282	910	882	960	901
19	IET 26799	0	1775	966	801	1067	1394	932	991	0	1480	980	865	1055	891	782	865
20	IET 26803	0	1645	926	1026	642	1289	1290	974	0	1551	868	1122	632	843	868	840
21	IET 26804	0	1732	1012	1250	332	1496	1066	984	0	1474	968	1186	325	855	813	803
22	IET 26806	0	1524	933	865	1484	1126	1121	1008	0	1647	862	833	1477	711	814	906
23	IET 26807	0	1522	876	1090	1849	1280	1211	1118	0	1388	902	1026	1840	897	1028	1011
24	PR-124	0	1668	887	929	1064	1446	1130	1018	0	1627	859	865	1054	866	990	894
25	LUIT	0	1643	1173	705	362	1235	1081	885	0	1538	1118	673	351	1061	695	777
26	NARENDRA-97	0	1100	895	609	332	1285	963	740	0	1035	882	673	419	975	709	671
27	US-314	0	1630	964	1378	462	1088	1016	934	0	1022	916	1186	451	949	960	783
28	SAHABHAGIDHAN	0	1823	997	929	158	1078	1032	859	0	1131	992	962	154	1056	828	732
29	MTU-1153	0	1637	1151	1186	289	1357	1180	971	0	1767	1161	1058	282	938	1014	888
30	CO-51	0	1643	1087	962	1356	1105	0	879	0	1299	1030	865	1346	855	0	771
	Mean	**0**	**1656**	**983**	**1137**	**849**	**1316**	**1044**	**998**	**0**	**1493**	**948**	**1066**	**842**	**909**	**861**	**874**
	LSD (Treat)				ns					LSD(Treat x Entry)				ns			
	LSD (Location x Treat)				32.3**					LSD (Location x Treat x Entry)				ns			
	LSD (Entry)				ns					CV (%)				8.98			
	LSD (Location x Entry)				125.0**												

Table 6.3.12 Influence of Heat Stress 1000 grain wt (g) at different AICRIP centres Kharif 2018

S.No.	Genotypes	Control							Grand Mean	Heat Stress							Grand Mean
		HAT	IIRR	MTU	PNR	PTB	REWA	TTB		HAT	IIRR	MTU	PNR	PTB	REWA	TTB	
1	IET 24911	23.1	23.3	21.2	29.0	16.7	27.7	27.0	24.0	23.4	25.9	17.7	27.9	16.7	22.7	25.3	22.8
2	IET 24914	22.5	20.8	20.4	28.4	10.0	25.7	24.0	21.7	22.0	22.2	18.3	30.3	16.7	21.3	23.7	22.1
3	IET 25713	22.3	22.2	21.4	27.0	16.7	27.9	27.7	23.6	22.5	23.7	18.3	28.3	10.0	26.5	25.7	22.1
4	IET 26464	23.1	19.7	18.0	27.5	16.7	24.6	27.3	22.4	23.4	20.4	15.2	25.6	10.0	23.4	24.0	20.3
5	IET 26465	22.8	17.3	20.4	35.4	13.3	25.2	24.3	22.7	23.1	21.5	18.7	25.6	16.7	17.0	24.0	20.9
6	IET 26468	23.2	20.5	26.0	27.8	13.3	25.1	27.0	23.3	23.4	22.6	22.1	27.7	20.0	21.9	23.0	23.0
7	IET 26474	22.8	22.8	20.4	30.1	13.3	29.4	27.3	23.7	22.2	26.1	16.8	30.1	10.7	27.7	26.3	22.8
8	IET 26477	23.1	20.7	22.3	28.3	20.0	26.2	24.0	23.5	23.6	24.2	19.3	28.0	16.7	19.1	21.0	21.7
9	IET 26478	23.1	18.1	22.5	24.0	16.7	22.1	20.3	21.0	22.9	20.5	18.5	23.4	13.3	22.1	17.3	19.7
10	IET 26480	24.1	22.8	22.2	26.2	10.0	27.6	24.3	22.5	23.8	25.7	19.2	27.4	13.3	27.1	19.7	22.3
11	IET 26756	22.5	17.0	19.9	24.8	16.7	19.1	22.3	20.3	22.6	19.9	18.4	24.5	13.3	17.9	20.3	19.6
12	IET 26763	21.2	16.5	20.3	22.6	10.0	18.5	22.3	18.8	21.4	24.8	16.8	22.3	18.3	17.3	19.3	20.0
13	IET 26767	21.8	18.5	20.8	36.1	20.0	24.0	23.3	23.5	21.8	21.1	17.8	24.3	13.3	21.3	21.3	20.1
14	IET 26771	22.6	26.4	26.1	31.7	16.7	29.3	31.3	26.3	22.1	30.2	20.8	32.0	20.0	29.1	29.0	26.2
15	IET 26780	23.1	18.7	19.6	22.1	13.3	23.1	21.0	20.1	23.5	20.4	16.0	20.2	16.7	22.8	20.0	19.9
16	IET 26789	23.6	17.2	20.3	22.9	10.0	21.9	28.0	20.5	23.1	20.0	18.5	24.4	16.7	21.3	26.3	21.5
17	IET 26790	25.6	21.2	22.3	31.5	16.7	23.6	26.7	23.9	25.2	25.2	19.9	26.5	20.0	23.5	25.0	23.6
18	IET 26794	23.1	23.3	25.2	32.3	13.3	29.3	28.3	25.0	23.0	25.8	20.4	31.6	18.3	28.8	26.0	24.8
19	IET 26799	23.8	17.0	19.6	25.0	16.7	20.3	21.0	20.5	23.5	20.2	18.2	22.7	10.0	17.5	19.0	18.7
20	IET 26803	24.1	19.4	22.7	24.9	16.7	22.0	28.3	22.6	23.6	22.6	20.4	24.6	11.7	21.7	26.3	21.6
21	IET 26804	26.4	22.7	21.3	30.3	16.7	23.9	26.7	24.0	26.6	23.5	19.8	28.8	16.7	17.5	24.0	22.4
22	IET 26806	26.1	19.0	20.6	25.0	16.7	22.3	23.3	21.9	26.2	21.4	18.7	23.3	13.3	17.2	20.7	20.1
23	IET 26807	23.7	13.1	21.5	19.6	16.7	22.8	18.3	19.4	23.4	15.3	18.2	19.2	11.7	23.2	17.3	18.3
24	PR-124	23.6	23.1	23.4	26.3	19.3	27.5	26.0	24.2	23.6	24.4	19.5	25.5	21.7	27.8	24.3	23.8
25	LUIT	24.0	21.6	21.9	27.1	16.7	26.1	26.3	23.4	23.6	24.4	19.1	26.5	13.3	24.1	24.0	22.1
26	NARENDRA-97	25.5	21.2	23.0	24.1	16.7	23.7	20.3	22.1	25.2	22.2	20.4	23.0	16.7	21.8	16.7	20.8
27	US-314	25.2	17.5	21.1	24.7	16.7	21.8	23.7	21.5	25.2	20.4	18.6	23.6	16.7	19.2	21.7	20.8
28	SAHABHAGIDHAN	24.2	18.9	21.4	30.2	16.7	21.8	22.7	22.3	24.8	21.9	18.1	28.9	20.0	19.6	21.0	22.0
29	MTU-1153	24.5	19.7	21.8	26.0	13.3	24.4	24.0	22.0	24.7	21.4	19.3	25.7	13.3	19.7	23.7	21.1
30	CO-51	23.5	15.1	19.1	16.7	16.7	18.1	0.0	15.6	23.8	16.3	18.0	16.7	14.0	16.8	0.0	15.1
	Mean	**23.6**	**19.8**	**21.5**	**26.9**	**15.4**	**24.2**	**23.9**	**22.2**	**23.6**	**22.5**	**18.7**	**25.6**	**15.3**	**21.9**	**21.9**	**21.3**
	LSD (Treat)				NS					LSD(Treat x Entry)				NS			
	LSD (Location x Treat)				1.01**					LSD (Location x Treat x Entry)				5.18**			
	LSD (Entry)				1.324**					CV (%)				10.5			
	LSD (Location x Entry)				3.66**												

Table: 6.3.13 Heat tolerance indices calculated from grain yield recorded under ambient temperature and elevated temperature condition. Each value represents the mean of all locations.

S.No.	Genotypes	HSI	RHI	HTI	GMP	TOL	MP	YI	HI	SHI	HM	K1STI	K2STI	Rank Sum	Mean Rank	SE±
1	CO-51	0.78	0.83	1.65	389	129	403	1.25	1.07	0.26	378	2.15	4.92	179	15	4
2	IET 24911	0.84	1.31	2.41	516	187	534	1.34	2.33	0.34	501	2.6	4.8	175	15	3
3	IET 25713	0.69	1.19	2.41	508	230	537	1.46	2.16	0.44	486	2.88	4.51	141	12	3
4	IET 26464	0.88	1.36	2.5	537	168	549	1.49	2.42	0.34	526	2.62	4.79	194	16	3
5	IET 26465	1.21	1.12	1.99	463	189	486	1.49	1.99	0.39	444	2.27	3.91	145	12	2
6	IET 26468	0.9	1.25	2.03	467	307	521	1.51	2.15	0.55	434	2.79	4.11	124	10	2
7	IET 26474	0.96	1.16	2.65	547	216	569	1.52	2.34	0.42	527	3	4.99	186	16	3
8	IET 26477	1.05	1.11	2.57	533	221	557	1.53	2.12	0.41	513	3.04	4.68	185	15	3
9	IET 26478	1.13	1.23	2.24	511	229	534	1.57	1.87	0.44	491	2.83	3.82	154	13	2
10	IET 26480	1.35	1.07	2.13	486	276	521	1.59	2.43	0.55	458	2.68	4.37	150	13	2
11	IET 24914	0.88	1.19	1.93	472	236	493	1.55	1.55	0.43	454	2.63	3.02	104	9	1
12	IET 26763	0.88	1.19	2.18	478	211	506	1.69	2.01	0.43	457	2.6	4.02	191	16	2
13	IET 26767	1.18	1.27	1.88	466	195	481	1.66	1.97	0.43	453	2.13	3.51	117	10	2
14	IET 26771	1.23	1.18	1.93	462	283	500	1.61	2.11	0.56	433	2.65	3.64	101	8	2
15	IET 26756	1.33	1.08	1.79	451	260	481	1.6	1.76	0.53	426	2.37	3.22	228	19	2
16	IET 26780	0.72	1.34	1.96	468	117	474	1.65	1.93	0.29	462	2.04	3.52	165	14	2
17	IET 26789	1.05	1.16	1.59	420	192	438	1.66	1.82	0.44	405	1.8	3.16	140	12	2
18	IET 26790	1.73	1.05	1.64	431	294	464	1.69	1.83	0.61	403	2.25	3.16	170	14	2
19	IET 26794	0.76	1.34	2.08	491	159	505	1.71	2.21	0.3	478	2.24	4.04	184	15	2
20	IET 26799	0.83	1.19	1.73	431	159	445	1.73	1.75	0.37	418	1.96	3.19	242	20	2
21	IET 26803	0.94	1.2	1.63	415	206	444	1.73	1.96	0.48	393	1.9	3.32	186	16	2
22	IET 26804	1.15	1.12	1.93	458	221	484	1.74	1.83	0.47	439	2.38	3.43	258	22	3
23	IET 26806	0.87	1.22	1.81	435	159	452	1.81	1.97	0.42	421	1.88	3.61	175	15	3
24	IET 26807	0.83	1.27	2.11	495	183	508	1.81	2.21	0.38	482	2.21	4.24	209	17	2
25	LUIT	0.92	1.23	1.86	443	166	457	1.81	1.8	0.41	430	2.13	3.28	174	15	3
26	MTU-1153	0.78	1.3	2.4	511	207	537	1.87	2.51	0.43	490	2.59	4.92	227	19	3
27	NARENDRA-97	0.93	1.2	1.28	388	165	401	1.9	1.45	0.35	376	1.65	2.2	179	15	4
28	PR-124	0.8	1.27	1.96	459	200	481	1.9	2.24	0.44	440	2.13	4.08	175	15	3
29	SAHABHAGIDHAN	1.3	1.1	1.71	451	246	475	1.95	1.59	0.42	428	2.55	2.81	141	12	3

6.4 Physiological characterization of selected rice genotypes for multiple abiotic stress tolerance

Locations: CBT, IIRR, KJT, KRK, MTU, PTB, RANCHI, REWA and TTB

Green revolution of the 1970s resulted in remarkable increase in rice production. Since then, the rate of production in most rice growing countries had slowed. Millions of hectors annually have become prone to abiotic stresses such as salinity, submergence, drought and cold stress injury. These abiotic stresses vary in magnitude and interactions over time and place, making the long term adoptability of cultivars dependent on its level of tolerance for all the stresses that occur in its growing environment. Hence multiple abiotic stress (MAS) tolerance traits must be considered as well as high yielding ability and disease resistance. Upon considering the above aspects in view this experiment was initiated under AICRIP Plant Physiology program to screen genetic material available from various states in AVT-I-IME under coordinated efforts of rice improvement for various abiotic stresses such as submergence, salinity, drought (water stress 1% and 2% mannitol) and low temperature. In total 21 genotypes including IET cultures & released varieties were screened to identify physiological donor for abiotic stresses and also genotypes having multiple abiotic stress tolerance. Under this experiment, only laboratory situations were used to screen the above genotypes with the following conditions, 1. Anaerobic germination: In this situation the genotypes were imposed to the stress by allowing germination in water at a depth of 15 cm (Submergence stress). 2. Water stress: Seeds were allowed to germinate by providing 1% and 2% mannitol solutions. 3. Salinity stress: Sodium chloride of concentration 200mM (Water potential -1.26, PF: 4.11) was used for germinating the seeds. 4. Cold stress: Seeds were germinated at 8-10^{O}C in refrigerator. In case of control conditions, seedlings were grown in hoglands solution and following observations were recorded in each of the stresses and control grown situations. Seed germination percentage, Shoot, root length in Cm and seedling vigour were recorded and reported as below.

Seed germination:

The results of seed germination under anaerobic conditions revealed that the cultures had highest submergence tolerance in terms of germination percentage at Ranchi (90.7%) followed by PTB (88.6%). Similarly under saline conditions, PTB recorded highest germination percentage (93.8%) followed by CBT (88.2%). In terms of entries, tolerance was observed in IET 26498 (88.8%) and IET 26487 (88.8%) across the locations.

Under water stress (1% mannitol) condition grand mean of germination percentage is 88.7% across the locations and it was observed that at 2% mannitol water stress there was reduction in germination percentage in comparison with 1% mannitol stress. However, water stress at 1% mannitol revealed that CBT centre has highest germination percentage and among the entries IET 26487 (92.3%) and BPT 2776 (89%) were noticed to be good (Table 6.4.1).

Shoot length

Shoot length was measured as a factor of seedling at an age of 21 days. It was observed that among the entries shoot length was less under submergence condition in comparison to other stress conditions. Under submergence, shoot length was higher in CBT followed by TTB. The entries noticed to be good are IET 26493, BPT 2776 and IET 26493 across the locations.

Under saline conditions, shoot length was increased drastically at REWA centre followed by PTB. Among the entries, Lalat, Karjat-7 and IET 26866 were found to be tolerant to salinity over the control. However at 2% mannitol stress, gradual reduction in shoot length was observed. At REWA centre, shoot length was noticed highest (13.56) followed by CBT (9.48). Among the entries studied, shoot length was highest in Lalat followed by IET 26487 and IET 26866 (Table 6.4.2).

Root length

Significant reduction was observed in root length under submergence condition. At TTB (10.83) highest value was noticed. There is a drastic reduction in root length was observed at PTB over the control. Under salinity stress, root length recorded highest at Rewa (18.47) and lowest at Karjat (0.73). Since the results are significant, Karjat7 showed good amount of tolerance to salinity followed by IET 26487. Under water stress condition (1% and 2% mannitol), the root length was least affected at Rewa. Among the entries, BPT 2782 was found to be good at root length under 1% mannitol condition followed by IET 26917. Under 2% mannitol stress, IET 26913, Lalat and Karjat7 are recorded as superior (Table 6.4.3).

Seedling vigour

Seedling vigour was calculated using the following formulae

Seedling vigour = (Germination % X Seedling length)

The results of seedling vigour revealed that seedling vigour was highest in TTB (1702.6) followed by CBT (770.7). Among the entries studied IET 26487, IET 26493 and IET 26498 were found to be good under submergence condition over the control. Under salinity stress, highest seedling vigour was recorded at PTB followed by Rewa. Among the entries studied, significant increase was observed in Lalat followed by Karjat7 and IET 26493. Under water stress, most of the entries performed better at CBT centre. Water stress severely inhibited seedling vigour at IIRR. Among the entries studied, it was observed that BPT 2782 was superior at 1% and 2% mannitol stress. Entries such as BPT 2411, IET 26487, IET 26493 and Lalat were found to be promising under drought conditions (Table 6.4.4)

The cold injury test was conducted on 21 entries at KRK centre, PY. The germination percentage was least effected in IET 26493 followed by IET 26498. The shoot length under low temperature was observed to be highest in IET 26866 followed by IET 26913. Root

length was reduced under low temperature stress. Seedling vigour was noticed high in entries IET 26487, IET 26493 and IET 26498 (Table 6.4.5 and 6.4.6).

Summary and conclusion

Some degree of cultivars tolerant to multiple abiotic stress (MAS) is available in rice germplasm. Traditional cultivars are most tolerant to abiotic stresses, but these cultivars possess poor agronomical traits such as photosensitivity, poor grain quality and are low yielding. Hence, an effort was made to identify rice cultivars which may be resistant to more than one stresses at a given point of time. In the present study attempts were made to screen 21 entries for multiple abiotic stress (MAS). Entries, IET 26487, IET 26493, BPT 2782, Karjat7 and Lalat are identified as promising for multiple abiotic stress (MAS). However, the study reveals that entries with MAS tolerance are very few and it was observed that the different entries performed differently under stress induced conditions.

Table 6.4.1 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat	S.No.	Entries	Germination									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Anaerobic germination	1	BPT-2411	72.0	13.3	0.0	0.0	0.0	100.0	91.9	0.0	44.0	64.2
	2	BPT-2593	66.0	10.0	0.0	0.0	0.0	100.0	92.0	0.0	40.0	61.6
	3	BPT-2595	68.0	50.0	0.0	0.0	0.0	80.0	88.6	0.0	31.0	63.5
	4	BPT-2766	68.0	75.0	0.0	0.0	0.0	80.0	79.3	0.0	25.0	65.5
	5	BPT-2776	64.0	41.7	0.0	0.0	0.0	90.0	0.0	0.0	0.0	65.2
	6	BPT-2782	74.0	18.3	0.0	0.0	0.0	100.0	81.0	0.0	35.0	61.7
	7	Gontrabidhan-3	88.0	15.0	0.0	0.0	0.0	60.0	87.6	0.0	25.0	55.1
	8	IET 26487	86.0	70.0	0.0	0.0	0.0	100.0	93.7	0.0	60.0	81.9
	9	IET 26493	82.0	53.3	0.0	0.0	0.0	100.0	91.3	0.0	71.5	79.6
	10	IET 26498	88.0	16.7	0.0	0.0	0.0	80.0	93.4	0.0	57.0	67.0
	11	IET 26866	88.0	25.0	0.0	0.0	0.0	100.0	95.0	0.0	0.0	69.3
	12	IET 26871	86.0	36.7	0.0	0.0	0.0	60.0	90.3	0.0	23.0	59.2
	13	IET 26908	68.0	16.7	0.0	0.0	0.0	90.0	88.2	0.0	59.0	64.4
	14	IET 26910	82.0	36.7	0.0	0.0	0.0	90.0	92.1	0.0	43.0	68.7
	15	IET 26913	70.0	11.7	0.0	0.0	0.0	100.0	91.4	0.0	39.0	62.4
	16	IET 26917	66.0	21.7	0.0	0.0	0.0	100.0	90.7	0.0	51.0	65.9
	17	KARJAT-7	90.0	31.7	0.0	0.0	0.0	100.0	97.5	0.0	50.0	73.8
	18	LALAT	74.0	58.3	0.0	0.0	0.0	100.0	96.4	0.0	49.0	75.5
	19	MTU-1010	74.0	23.3	0.0	0.0	0.0	100.0	92.0	0.0	64.0	70.7
	20	PR-113	74.0	30.0	0.0	0.0	0.0	90.0	0.0	0.0	51.0	61.3
	21	US-312	80.0	13.3	0.0	0.0	0.0	40.0	0.0	0.0	49.0	45.6
		Mean	**76.6**	**31.8**	**0.0**	**0.0**	**0.0**	**88.6**	**90.7**	**0.0**	**45.6**	**66.7**
Control	1	BPT-2411	100.0	97.0	89.7	100.0	95.3	100.0	96.8	87.3	98.0	96.0
	2	BPT-2593	92.0	97.0	96.7	100.0	96.0	90.0	97.1	89.3	98.0	95.1
	3	BPT-2595	100.0	97.0	94.0	91.4	94.3	90.0	96.9	86.3	84.0	92.7
	4	BPT-2766	100.0	96.0	90.0	95.7	89.3	60.0	97.3	87.3	84.0	88.9
	5	BPT-2776	100.0	98.3	93.0	95.7	99.3	60.0	0.0	0.0	0.0	91.1
	6	BPT-2782	92.0	92.0	90.7	100.0	98.0	60.0	97.5	82.3	85.3	88.7
	7	Gontrabidhan-3	100.0	68.3	68.7	50.0	70.0	80.0	98.4	88.3	84.0	78.6
	8	IET 26487	100.0	99.0	98.0	100.0	97.3	90.0	97.3	87.3	100.0	96.6
	9	IET 26493	100.0	91.3	96.7	100.0	96.7	80.0	96.7	85.3	98.0	93.9
	10	IET 26498	100.0	97.0	95.3	100.0	99.0	90.0	97.4	87.3	98.7	96.1
	11	IET 26866	100.0	90.3	81.0	94.3	93.0	80.0	98.3	84.3	90.7	90.2
	12	IET 26871	100.0	84.0	43.0	60.0	74.3	80.0	98.5	88.3	90.0	79.8
	13	IET 26908	92.0	96.0	87.7	100.0	97.7	90.0	98.1	88.3	82.0	92.4
	14	IET 26910	100.0	95.0	91.3	87.1	96.7	90.0	97.8	89.3	87.3	92.7
	15	IET 26913	92.0	97.0	93.3	98.6	95.7	80.0	97.3	87.3	84.7	91.8
	16	IET 26917	100.0	80.3	89.3	100.0	96.0	90.0	97.9	89.3	95.3	93.1
	17	KARJAT-7	100.0	99.3	95.3	100.0	94.3	80.0	96.9	87.3	85.3	93.2
	18	LALAT	100.0	98.3	86.7	100.0	96.7	80.0	98.0	91.3	86.0	93.0
	19	MTU-1010	100.0	97.0	97.0	100.0	96.7	80.0	97.3	86.3	98.0	94.7
	20	PR-113	96.0	91.3	94.0	95.7	99.0	80.0	97.8	87.3	93.3	92.7
	21	US-312	100.0	97.0	94.7	97.1	99.0	60.0	96.6	85.3	96.0	91.8
		Mean	**98.3**	**93.3**	**88.9**	**93.6**	**94.0**	**80.5**	**97.5**	**87.3**	**90.9**	**91.6**

Contd…Table 6.4.1 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat	S.No.	Entries	Germination									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Saline Test	1	BPT-2411	82.0	88.3	75.7	95.7	80.3	100.0	81.8	71.3	0.0	84.4
	2	BPT-2593	74.0	65.3	94.7	90.0	77.0	100.0	81.9	79.3	0.0	82.8
	3	BPT-2595	80.0	37.7	88.0	91.4	74.7	100.0	84.2	76.0	0.0	79.0
	4	BPT-2766	84.0	43.7	86.0	98.6	63.3	100.0	83.9	74.0	0.0	79.2
	5	BPT-2776	86.0	52.7	78.0	84.3	74.7	100.0	0.0	0.0	0.0	59.5
	6	BPT-2782	86.0	85.0	83.7	97.1	76.0	80.0	79.2	73.3	0.0	82.5
	7	Gontrabidhan-3	86.0	40.0	86.0	12.9	21.7	90.0	77.7	74.7	0.0	61.1
	8	IET 26487	98.0	87.3	94.7	92.9	76.7	100.0	88.3	72.7	0.0	88.8
	9	IET 26493	96.0	80.3	88.7	100.0	75.7	100.0	86.6	70.7	0.0	87.2
	10	IET 26498	98.0	83.7	92.7	95.7	78.7	100.0	84.8	76.7	0.0	88.8
	11	IET 26866	98.0	87.3	89.3	84.3	81.0	90.0	87.3	73.3	0.0	86.3
	12	IET 26871	96.0	37.7	61.3	30.0	20.7	90.0	86.5	78.7	0.0	62.6
	13	IET 26908	78.0	43.7	79.3	98.6	77.3	100.0	84.3	72.3	0.0	79.2
	14	IET 26910	88.0	91.7	89.7	90.0	64.7	100.0	86.1	68.0	0.0	84.8
	15	IET 26913	74.0	35.7	88.0	88.6	82.5	90.0	79.9	67.7	0.0	75.8
	16	IET 26917	94.0	50.3	95.7	98.6	70.3	70.0	82.7	71.0	0.0	79.1
	17	KARJAT-7	98.0	58.3	94.0	92.9	79.7	90.0	84.0	73.0	0.0	83.7
	18	LALAT	98.0	88.3	91.0	85.7	83.0	100.0	79.4	75.7	0.0	87.6
	19	MTU-1010	92.0	43.3	90.0	98.6	73.7	100.0	80.7	75.7	0.0	81.7
	20	PR-113	86.0	75.7	81.0	72.9	76.7	90.0	81.4	75.0	0.0	79.8
	21	US-312	80.0	87.3	81.7	88.6	73.7	80.0	83.0	74.7	0.0	81.1
		Mean	**88.2**	**65.2**	**86.1**	**85.1**	**70.6**	**93.8**	**79.2**	**70.2**	**0.0**	**79.8**
Water Stress (1% Mannitol)	1	BPT-2411	96.0	99.0	92.0	100.0	92.7	90.0	95.8	83.0	78.0	91.8
	2	BPT-2593	86.0	97.3	94.3	100.0	87.0	90.0	95.8	86.0	46.0	86.9
	3	BPT-2595	96.0	95.3	90.7	91.4	80.0	100.0	94.8	84.0	53.3	87.3
	4	BPT-2766	98.0	87.7	91.3	88.6	80.0	70.0	96.0	85.0	46.0	82.5
	5	BPT-2776	100.0	99.0	89.0	86.7	92.3	100.0	0.0	0.0	0.0	94.5
	6	BPT-2782	86.0	96.7	91.3	98.6	90.3	100.0	96.5	80.0	57.3	88.5
	7	gontrabidhan-3	100.0	86.3	62.3	47.1	49.0	100.0	96.2	86.0	79.3	78.5
	8	IET 26487	100.0	97.7	100.0	97.1	91.7	100.0	94.4	85.7	80.0	94.1
	9	IET 26493	100.0	97.3	90.7	100.0	85.0	90.0	94.2	83.7	58.0	88.8
	10	IET 26498	98.0	96.0	95.7	95.7	92.7	100.0	95.0	85.0	63.3	91.3
	11	IET 26866	100.0	98.3	85.0	98.6	86.7	100.0	95.3	82.3	46.0	88.0
	12	IET 26871	100.0	70.0	35.7	44.3	55.3	70.0	95.9	86.7	63.3	69.0
	13	IET 26908	86.0	94.3	93.7	95.7	94.3	100.0	95.1	84.7	75.3	91.0
	14	IET 26910	100.0	95.0	88.3	97.1	85.0	100.0	96.9	87.7	67.3	90.8
	15	IET 26913	94.0	96.0	91.0	98.6	91.7	100.0	95.3	85.7	74.7	91.9
	16	IET 26917	96.0	98.3	91.3	94.3	89.3	100.0	95.5	87.3	76.0	92.0
	17	KARJAT-7	100.0	96.0	99.0	100.0	84.3	90.0	96.4	85.3	61.3	90.3
	18	LALAT	100.0	98.3	98.3	100.0	92.0	100.0	94.6	89.3	80.0	94.7
	19	MTU-1010	100.0	96.0	91.3	97.1	90.7	100.0	95.4	84.7	58.0	90.4
	20	PR-113	92.0	91.7	92.7	95.7	92.7	100.0	96.1	85.0	79.3	91.7
	21	US-312	100.0	97.3	96.7	91.4	92.3	100.0	95.8	83.0	74.0	92.3
		Mean	**96.6**	**94.5**	**88.6**	**91.3**	**85.5**	**95.2**	**95.5**	**85.0**	**65.8**	**88.7**

Contd…Table 6.4.1 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat	S.No.	Entries	Germination									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Water Stress (2% Mannitol)	1	BPT-2411	78.0	97.7	88.7	95.7	89.3	100.0	95.2	82.0	77.3	89.3
	2	BPT-2593	72.0	94.3	88.3	91.4	81.3	80.0	95.6	85.0	33.3	80.1
	3	BPT-2595	74.0	87.7	84.0	88.6	91.3	90.0	95.7	82.7	43.3	81.9
	4	BPT-2766	74.0	95.7	84.3	89.5	73.3	90.0	95.6	82.7	28.0	79.2
	5	BPT-2776	70.0	96.3	92.0	91.7	84.0	100.0	0.0	0.0	0.0	89.0
	6	BPT-2782	82.0	80.7	92.0	99.0	87.7	100.0	96.6	79.3	38.0	83.9
	7	Gontrabidhan-3	98.0	73.3	87.0	41.0	33.3	100.0	95.0	83.0	69.3	75.5
	8	IET 26487	96.0	90.0	93.3	100.0	87.3	100.0	96.0	81.3	86.7	92.3
	9	IET 26493	90.0	89.7	98.3	100.0	81.3	100.0	96.6	78.0	60.7	88.3
	10	IET 26498	98.0	98.7	93.3	94.8	89.3	100.0	95.1	83.0	59.3	90.2
	11	IET 26866	98.0	54.7	71.7	93.3	83.7	90.0	95.0	81.3	44.0	79.1
	12	IET 26871	100.0	68.0	33.0	37.1	43.0	80.0	93.9	84.3	56.0	66.2
	13	IET 26908	74.0	83.3	88.3	95.7	85.7	100.0	93.7	83.0	72.0	86.2
	14	IET 26910	92.0	50.3	89.3	91.0	77.3	80.0	95.7	80.7	57.3	79.3
	15	IET 26913	76.0	96.3	89.7	91.9	89.0	80.0	95.9	80.7	60.0	84.4
	16	IET 26917	72.0	96.3	90.7	97.1	80.3	90.0	96.0	81.0	57.3	84.5
	17	KARJAT-7	100.0	83.3	97.0	100.0	82.0	100.0	96.0	83.0	68.0	89.9
	18	LALAT	84.0	96.3	92.3	100.0	90.3	90.0	96.2	86.0	70.7	89.5
	19	MTU-1010	86.0	92.0	98.0	98.6	83.0	100.0	95.7	84.0	36.0	85.9
	20	PR-113	86.0	90.0	96.7	97.6	86.7	70.0	94.8	84.3	70.7	86.3
	21	US-312	90.0	92.0	96.7	91.9	86.3	100.0	95.2	83.0	54.0	87.7
		Mean	**85.2**	**86.0**	**87.8**	**89.8**	**80.3**	**92.4**	**95.5**	**82.4**	**57.1**	**84.2**
		Grand Mean	**89.0**	**74.1**	**70.3**	**72.0**	**66.1**	**90.1**	**86.3**	**62.5**	**49.0**	**73.3**

Table 6.4.2 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Shoot length (cm)									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Anaerobic germination	1	BPT-2411	2.13	0.00	0.00	0.00	0.00	2.50	2.23	0.00	2.88	2.44
	2	BPT-2593	7.97	0.00	0.00	0.00	0.00	3.00	0.83	0.00	2.80	3.65
	3	BPT-2595	5.63	0.00	0.00	0.00	0.00	2.83	1.47	0.00	2.15	3.02
	4	BPT-2766	6.17	0.00	0.00	0.00	0.00	2.17	1.40	0.00	2.27	3.00
	5	BPT-2776	7.87	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	4.93
	6	BPT-2782	6.57	0.00	0.00	0.00	0.00	2.83	1.87	0.00	2.55	3.45
	7	Gontrabidhan-3	2.90	0.00	0.00	0.00	0.00	3.17	1.13	0.00	3.10	2.58
	8	IET 26487	8.40	0.00	0.00	0.00	0.00	3.33	2.40	0.00	3.32	4.36
	9	IET 26493	6.67	0.00	0.00	0.00	0.00	3.67	2.60	0.00	3.48	4.10
	10	IET 26498	6.47	0.00	0.00	0.00	0.00	2.83	3.07	0.00	3.80	4.04
	11	IET 26866	4.87	0.00	0.00	0.00	0.00	2.00	1.33	0.00	0.00	2.73
	12	IET 26871	6.97	0.00	0.00	0.00	0.00	1.33	1.27	0.00	3.18	3.19
	13	IET 26908	7.07	0.00	0.00	0.00	0.00	3.33	2.23	0.00	3.00	3.91
	14	IET 26910	6.27	0.00	0.00	0.00	0.00	2.83	1.40	0.00	3.07	3.39
	15	IET 26913	2.87	0.00	0.00	0.00	0.00	2.17	1.20	0.00	3.17	2.35
	16	IET 26917	3.87	0.00	0.00	0.00	0.00	1.83	1.83	0.00	3.27	2.70
	17	KARJAT-7	1.90	0.00	0.00	0.00	0.00	2.83	2.30	0.00	3.55	2.65
	18	LALAT	5.90	0.00	0.00	0.00	0.00	3.50	2.67	0.00	3.05	3.78
	19	MTU-1010	6.67	0.00	0.00	0.00	0.00	3.17	2.60	0.00	2.83	3.82
	20	PR-113	4.77	0.00	0.00	0.00	0.00	3.17	0.17	0.00	3.87	2.99
	21	US-312	4.07	0.00	0.00	0.00	0.00	1.33	0.00	0.00	2.85	2.75
		Mean	**5.52**	**0.00**	**0.00**	**0.00**	**0.00**	**2.66**	**1.79**	**0.00**	**3.06**	**3.26**
Control	1	BPT-2411	10.43	4.50	6.43	9.85	6.33	17.57	9.93	17.47	10.83	10.37
	2	BPT-2593	10.77	6.60	7.50	9.33	7.03	18.33	9.70	18.23	10.33	10.87
	3	BPT-2595	9.77	9.37	5.23	9.62	5.60	15.63	10.80	18.67	8.50	10.35
	4	BPT-2766	10.20	6.23	5.37	7.83	5.10	15.13	10.87	19.40	7.67	9.76
	5	BPT-2776	10.07	6.17	6.20	7.27	6.27	15.90	0.00	0.00	0.00	8.64
	6	BPT-2782	10.12	2.45	5.37	7.52	6.00	12.97	10.60	18.10	7.50	9.21
	7	Gontrabidhan-3	11.37	4.30	6.63	10.98	6.57	17.10	10.37	19.23	12.00	10.95
	8	IET 26487	10.27	5.73	9.03	11.77	8.27	14.50	9.93	18.80	11.17	11.05
	9	IET 26493	10.97	3.43	7.43	8.55	7.07	23.80	9.97	18.27	14.00	11.50
	10	IET 26498	11.87	6.33	6.53	9.12	7.87	26.10	10.33	18.40	12.83	12.15
	11	IET 26866	10.60	5.10	8.40	11.48	8.87	21.20	9.80	18.30	10.83	11.62
	12	IET 26871	11.57	13.83	7.73	9.62	6.87	17.43	10.60	18.37	9.00	11.67
	13	IET 26908	10.50	5.90	8.50	10.27	7.97	24.10	11.20	18.10	12.50	12.11
	14	IET 26910	11.37	4.23	7.93	9.68	5.60	14.20	10.13	17.87	11.33	10.26
	15	IET 26913	11.08	9.53	8.23	12.08	5.57	22.83	10.50	18.73	15.67	12.69
	16	IET 26917	9.87	0.30	7.93	9.98	4.37	19.23	10.43	18.90	11.67	10.30
	17	KARJAT-7	10.63	3.90	9.47	10.52	5.60	20.33	9.87	18.87	11.67	11.21
	18	LALAT	11.83	5.63	7.83	8.05	5.73	25.37	10.83	19.97	14.50	12.19
	19	MTU-1010	11.67	3.93	7.90	7.80	6.83	20.37	11.27	18.63	12.50	11.21
	20	PR-113	10.83	8.10	7.83	12.02	8.30	14.97	10.63	18.33	11.50	11.39
	21	US-312	10.57	7.60	7.13	7.57	7.40	11.03	10.37	19.00	9.00	9.96
		Mean	**10.78**	**5.87**	**7.37**	**9.57**	**6.63**	**18.48**	**10.41**	**18.58**	**11.25**	**10.93**

Contd... Table 6.4.2 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Shoot length (cm)									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Saline Test	1	BPT-2411	6.87	5.93	0.83	5.25	4.87	17.33	2.43	11.37	0.00	6.86
	2	BPT-2593	5.07	6.07	0.93	4.90	2.90	18.00	4.60	11.53	0.00	6.75
	3	BPT-2595	4.87	1.77	1.13	4.02	3.17	15.33	3.83	12.63	0.00	5.84
	4	BPT-2766	6.17	1.17	1.17	3.37	3.10	13.33	3.20	14.03	0.00	5.69
	5	BPT-2776	4.97	2.30	1.03	4.13	3.23	15.67	0.00	0.00	0.00	5.22
	6	BPT-2782	5.17	3.73	1.03	4.63	2.40	12.00	3.70	12.57	0.00	5.65
	7	Gontrabidhan-3	2.87	3.30	1.03	3.62	2.17	17.67	2.43	14.80	0.00	5.99
	8	IET 26487	6.30	1.83	1.23	1.35	3.13	14.00	5.80	13.53	0.00	5.90
	9	IET 26493	5.90	2.07	1.63	1.75	3.37	24.00	5.20	12.33	0.00	7.03
	10	IET 26498	5.47	0.00	1.20	1.93	3.87	26.00	5.73	12.43	0.00	7.08
	11	IET 26866	8.77	3.93	1.33	2.02	3.03	23.33	2.97	12.90	0.00	7.29
	12	IET 26871	9.17	0.00	1.00	2.02	2.27	15.67	4.43	12.67	0.00	5.90
	13	IET 26908	7.87	1.50	1.13	5.32	3.43	24.00	3.53	12.47	0.00	7.41
	14	IET 26910	3.67	1.23	1.17	6.27	3.63	13.67	4.47	12.63	0.00	5.84
	15	IET 26913	4.77	1.67	1.20	4.73	3.23	23.33	2.23	13.53	0.00	6.84
	16	IET 26917	3.67	5.60	1.10	6.30	1.80	18.67	3.87	13.87	0.00	6.86
	17	KARJAT-7	5.27	7.87	1.13	5.55	3.70	19.33	5.10	13.60	0.00	7.69
	18	LALAT	5.17	8.50	1.27	4.78	2.83	24.67	3.77	15.23	0.00	8.28
	19	MTU-1010	5.37	4.67	1.10	5.70	2.87	21.00	3.30	12.90	0.00	7.11
	20	PR-113	4.77	2.47	`	5.07	2.93	13.67	3.87	13.13	0.00	5.85
	21	US-312	2.50	4.90	0.73	4.70	3.07	10.67	3.53	14.23	0.00	5.54
		Mean	**5.46**	**3.36**	**1.11**	**4.16**	**3.10**	**18.16**	**3.90**	**13.12**	**0.00**	**6.55**
Water Stress (1% Mannitol)	1	BPT-2411	9.27	7.50	7.03	9.87	5.93	10.43	6.60	15.20	8.50	8.93
	2	BPT-2593	11.17	8.97	6.43	8.18	5.87	4.93	6.43	15.80	5.33	8.12
	3	BPT-2595	11.87	7.33	5.90	6.03	5.00	9.45	6.70	16.03	4.83	8.13
	4	BPT-2766	11.77	7.87	5.83	6.72	4.07	4.58	6.57	17.33	8.00	8.08
	5	BPT-2776	9.87	6.97	6.55	6.60	4.50	5.78	0.00	0.00	0.00	6.71
	6	BPT-2782	12.97	1.30	6.53	7.23	4.53	4.97	7.47	16.97	4.17	7.35
	7	Gontrabidhan-3	12.57	3.40	8.40	8.30	5.07	14.67	6.23	17.60	11.00	9.69
	8	IET 26487	9.87	8.87	10.00	9.67	6.17	7.73	6.77	17.40	8.50	9.44
	9	IET 26493	9.67	9.43	9.70	7.72	6.50	8.23	7.13	16.40	6.50	9.03
	10	IET 26498	12.77	9.43	9.40	8.13	5.57	8.67	6.53	16.50	5.33	9.15
	11	IET 26866	13.47	6.60	8.67	8.87	7.40	5.97	5.70	17.00	5.83	8.83
	12	IET 26871	10.27	2.17	7.93	9.27	4.97	8.23	6.47	17.30	7.17	8.20
	13	IET 26908	11.87	8.33	9.67	8.53	5.10	11.80	5.70	16.30	6.83	9.35
	14	IET 26910	11.17	2.80	7.97	6.78	4.53	14.03	5.70	16.30	7.33	8.51
	15	IET 26913	9.97	7.77	7.67	9.63	4.47	4.93	6.87	18.00	9.50	8.76
	16	IET 26917	11.27	5.83	8.70	9.25	4.13	12.20	8.30	17.80	9.00	9.61
	17	KARJAT-7	12.47	3.70	8.70	10.15	5.43	6.67	7.17	16.90	8.33	8.84
	18	LALAT	13.77	3.03	9.70	11.03	5.27	6.77	6.97	18.60	8.50	9.29
	19	MTU-1010	11.77	3.13	8.67	9.15	5.67	4.07	6.77	16.77	6.33	8.04
	20	PR-113	11.57	6.03	9.20	7.70	5.37	17.67	6.43	16.50	9.50	10.00
	21	US-312	10.87	7.93	7.43	7.97	5.80	5.87	7.00	16.83	5.00	8.30
		Mean	**11.44**	**6.11**	**8.09**	**8.42**	**5.30**	**8.46**	**6.68**	**16.88**	**7.28**	**8.74**

Contd...Table 6.4.2 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Shoot length (cm)									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Water Stress (2% Mannitol)	1	BPT-2411	7.28	5.33	7.03	6.13	5.37	5.53	8.87	10.70	8.33	7.18
	2	BPT-2593	9.18	5.93	6.43	10.30	5.50	2.68	8.80	12.83	3.33	7.22
	3	BPT-2595	9.92	5.83	5.90	6.92	4.50	2.73	9.37	12.80	4.33	6.92
	4	BPT-2766	9.82	6.70	5.83	7.10	3.50	3.92	9.53	13.67	4.17	7.14
	5	BPT-2776	7.92	2.80	6.37	5.67	4.10	3.30	0.00	0.00	0.00	5.03
	6	BPT-2782	10.98	5.10	6.53	5.13	4.20	4.33	9.70	11.93	4.50	6.94
	7	Gontrabidhan-3	10.62	2.37	8.40	4.45	4.73	8.47	6.53	14.00	6.17	7.30
	8	IET 26487	7.88	7.70	10.00	5.77	5.97	5.95	7.17	14.23	8.83	8.17
	9	IET 26493	7.68	5.57	9.70	7.40	6.17	3.75	7.83	12.07	8.00	7.57
	10	IET 26498	10.88	1.33	9.40	7.78	5.40	6.10	7.43	13.40	6.50	7.58
	11	IET 26866	11.48	5.57	8.67	7.37	5.80	4.35	6.57	13.60	9.83	8.14
	12	IET 26871	8.32	2.20	7.93	9.22	4.83	3.17	6.73	14.03	8.50	7.21
	13	IET 26908	9.88	3.67	9.67	10.28	5.27	3.87	6.53	12.83	5.67	7.52
	14	IET 26910	9.22	1.43	7.97	8.50	4.77	2.73	7.80	13.53	8.00	7.11
	15	IET 26913	8.02	6.23	7.67	7.07	4.67	3.30	7.67	15.07	10.17	7.76
	16	IET 26917	9.32	3.13	8.70	3.22	3.70	2.73	8.40	14.57	8.63	6.93
	17	KARJAT-7	10.52	0.30	8.70	8.70	5.13	3.40	7.73	13.97	10.00	7.61
	18	LALAT	11.82	5.10	9.70	9.33	4.73	7.37	6.47	16.40	8.50	8.82
	19	MTU-1010	9.85	2.63	8.67	5.78	5.20	9.30	8.47	14.07	6.50	7.83
	20	PR-113	9.58	2.47	9.20	8.70	5.33	4.55	7.57	13.30	7.67	7.60
	21	US-312	8.92	2.00	7.43	8.90	5.40	3.02	9.60	14.13	6.50	7.32
		Mean	**9.48**	**3.97**	**8.09**	**7.32**	**4.97**	**4.50**	**7.94**	**13.56**	**7.21**	**7.45**
		Grand Mean	**8.54**	**3.87**	**4.93**	**5.89**	**4.00**	**10.45**	**5.83**	**11.84**	**10.44**	**7.31**

Table 6.4.3 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Root length (cm)									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Anaerobic germination	1	BPT-2411	2.40	0.00	0.00	0.00	0.00	2.67	0.00	0.00	9.17	4.74
	2	BPT-2593	3.50	0.00	0.00	0.00	0.00	6.00	0.00	0.00	9.17	6.22
	3	BPT-2595	5.67	0.00	0.00	0.00	0.00	4.83	0.00	0.00	7.17	5.89
	4	BPT-2766	5.60	0.00	0.00	0.00	0.00	2.83	0.00	0.00	6.17	4.87
	5	BPT-2776	5.00	0.00	0.00	0.00	0.00	2.50	0.00	0.00	0.00	2.50
	6	BPT-2782	4.50	0.00	0.00	0.00	0.00	2.33	0.00	0.00	7.17	4.67
	7	Gontrabidhan-3	2.70	0.00	0.00	0.00	0.00	4.50	0.00	0.00	6.67	4.62
	8	IET 26487	5.70	0.00	0.00	0.00	0.00	2.00	0.00	0.00	13.33	7.01
	9	IET 26493	3.20	0.00	0.00	0.00	0.00	1.17	0.00	0.00	12.83	5.73
	10	IET 26498	2.70	0.00	0.00	0.00	0.00	2.67	0.00	0.00	10.33	5.23
	11	IET 26866	6.57	0.00	0.00	0.00	0.00	2.33	0.00	0.00	0.00	2.97
	12	IET 26871	2.53	0.00	0.00	0.00	0.00	2.17	0.00	0.00	7.67	4.12
	13	IET 26908	12.27	0.00	0.00	0.00	0.00	1.17	0.00	0.00	10.00	7.81
	14	IET 26910	5.27	0.00	0.00	0.00	0.00	3.17	0.00	0.00	11.17	6.53
	15	IET 26913	5.90	0.00	0.00	0.00	0.00	3.00	0.00	0.00	6.33	5.08
	16	IET 26917	3.50	0.00	0.00	0.00	0.00	2.33	0.00	0.00	10.67	5.50
	17	KARJAT-7	2.40	0.00	0.00	0.00	0.00	3.50	0.00	0.00	10.67	5.52
	18	LALAT	4.33	0.00	0.00	0.00	0.00	2.50	0.00	0.00	9.00	5.28
	19	MTU-1010	5.20	0.00	0.00	0.00	0.00	3.67	0.00	0.00	8.00	5.62
	20	PR-113	5.83	0.00	0.00	0.00	0.00	2.17	0.00	0.00	15.33	7.78
	21	US-312	3.30	0.00	0.00	0.00	0.00	1.00	0.00	0.00	10.83	5.04
		Mean	**4.67**	**0.00**	**0.00**	**0.00**	**0.00**	**2.79**	**0.00**	**0.00**	**8.65**	**5.37**
Control	1	BPT-2411	9.30	2.70	7.03	6.92	5.50	8.42	10.23	21.03	9.83	9.00
	2	BPT-2593	11.20	6.43	6.37	9.33	5.97	11.37	10.40	21.03	13.83	10.66
	3	BPT-2595	11.90	6.17	6.40	8.98	6.13	6.73	10.97	21.70	12.17	10.13
	4	BPT-2766	11.77	2.20	5.60	8.13	4.67	5.27	10.93	22.70	12.17	9.27
	5	BPT-2776	9.90	4.27	6.40	6.30	4.53	9.10	0.00	0.00	0.00	6.75
	6	BPT-2782	12.83	1.75	6.14	7.43	6.03	6.10	10.83	21.13	12.67	9.73
	7	Gontrabidhan-3	12.50	5.13	4.83	12.30	5.07	11.42	11.07	23.23	13.50	11.01
	8	IET 26487	9.90	6.10	7.97	3.18	5.30	7.20	10.53	22.60	10.67	9.27
	9	IET 26493	9.70	2.07	6.47	4.85	4.27	10.83	10.47	21.47	10.83	8.99
	10	IET 26498	12.53	4.17	5.37	7.80	6.30	8.88	11.03	21.87	7.17	9.46
	11	IET 26866	13.00	3.43	7.10	9.62	7.27	9.00	10.43	22.03	12.83	10.52
	12	IET 26871	10.30	7.50	5.57	7.32	6.10	11.97	11.30	21.57	10.00	10.18
	13	IET 26908	11.90	7.93	8.80	7.82	5.13	7.20	11.83	20.63	6.83	9.79
	14	IET 26910	11.20	3.07	5.53	7.90	5.77	6.97	10.90	20.87	12.00	9.36
	15	IET 26913	10.00	8.33	7.07	6.53	5.63	8.00	11.10	22.60	12.83	10.23
	16	IET 26917	11.30	2.00	5.10	8.18	4.60	10.73	10.73	23.83	10.67	9.68
	17	KARJAT-7	12.40	2.13	9.60	8.82	5.90	11.60	10.77	22.53	11.17	10.55
	18	LALAT	13.47	2.70	3.37	7.97	5.20	8.38	11.17	23.83	9.67	9.53
	19	MTU-1010	11.80	3.60	7.97	28.38	8.73	12.65	11.67	21.63	13.33	13.31
	20	PR-113	11.60	6.70	8.05	7.65	6.43	8.50	11.33	20.77	9.67	10.08
	21	US-312	10.90	5.63	5.97	6.43	5.43	4.72	10.70	22.67	9.17	9.07
		Mean	**11.40**	**4.52**	**6.52**	**8.66**	**5.71**	**8.81**	**10.92**	**21.99**	**11.05**	**9.84**

Contd...Table 6.4.3 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Root length (cm)									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Saline Test	1	BPT-2411	4.40	3.10	0.83	0.35	1.90	8.00	4.90	16.67	0.00	5.02
	2	BPT-2593	5.20	2.90	0.93	1.45	1.63	11.67	6.73	15.57	0.00	5.76
	3	BPT-2595	5.33	0.93	1.13	0.60	1.90	6.33	5.97	16.67	0.00	4.86
	4	BPT-2766	5.10	0.40	1.17	0.88	2.47	6.33	5.57	17.77	0.00	4.96
	5	BPT-2776	3.23	1.77	1.03	1.40	1.97	9.33	0.00	0.00	0.00	3.12
	6	BPT-2782	3.10	3.88	1.03	2.23	1.63	6.67	6.03	16.07	0.00	5.08
	7	Gontrabidhan-3	2.83	1.20	1.03	1.58	2.23	11.67	4.70	18.47	0.00	5.46
	8	IET 26487	3.63	0.77	1.27	0.47	2.33	6.67	7.90	17.77	0.00	5.10
	9	IET 26493	5.20	1.10	1.27	1.78	1.97	10.67	7.23	16.77	0.00	5.75
	10	IET 26498	3.37	0.00	1.47	2.25	1.27	8.00	7.17	16.17	0.00	4.96
	11	IET 26866	4.53	1.43	1.20	1.37	2.37	9.00	5.27	18.07	0.00	5.40
	12	IET 26871	4.37	0.00	1.00	0.98	2.00	11.67	6.30	16.97	0.00	5.41
	13	IET 26908	4.47	0.63	1.13	1.37	1.70	7.33	5.70	15.27	0.00	4.70
	14	IET 26910	3.50	1.40	1.17	2.13	1.67	6.33	6.43	14.97	0.00	4.70
	15	IET 26913	3.40	0.97	1.20	1.12	2.53	8.00	4.27	17.47	0.00	4.87
	16	IET 26917	3.00	3.57	1.10	1.28	0.97	11.33	5.87	19.07	0.00	5.77
	17	KARJAT-7	4.10	4.03	1.13	2.83	1.87	11.33	7.20	17.87	0.00	6.30
	18	LALAT	4.00	2.23	1.27	1.28	2.37	7.33	5.83	18.87	0.00	5.40
	19	MTU-1010	3.20	3.90	1.10	0.92	2.33	12.33	5.23	16.57	0.00	5.70
	20	PR-113	3.00	1.50	0.87	1.10	2.37	8.67	6.03	14.77	0.00	4.79
	21	US-312	4.30	4.80	0.73	2.05	2.07	4.67	5.60	17.47	0.00	5.21
		Mean	**3.97**	**1.96**	**1.10**	**1.40**	**1.98**	**8.73**	**6.00**	**16.96**	**0.00**	**5.16**
Water Stress (1% Mannitol)	1	BPT-2411	6.99	5.47	5.63	8.07	5.23	7.98	9.23	17.63	4.17	7.82
	2	BPT-2593	7.25	5.07	5.90	9.32	5.10	3.42	9.07	18.63	2.67	7.38
	3	BPT-2595	6.22	3.53	5.33	8.33	5.20	6.93	8.80	20.13	3.50	7.55
	4	BPT-2766	6.62	4.40	5.90	7.90	3.60	3.93	8.50	19.43	6.67	7.44
	5	BPT-2776	6.75	7.70	4.45	7.90	3.73	4.83	0.00	0.00	0.00	5.90
	6	BPT-2782	6.67	1.20	5.90	8.53	5.27	87.28	10.20	18.13	2.67	16.21
	7	Gontrabidhan-3	7.85	3.87	8.53	5.83	4.07	4.70	9.97	19.63	11.17	8.40
	8	IET 26487	6.75	5.40	7.37	9.75	4.17	3.63	8.63	18.83	11.33	8.43
	9	IET 26493	7.45	3.50	7.57	6.68	4.00	4.83	8.63	19.33	4.17	7.35
	10	IET 26498	8.35	4.60	5.47	6.78	5.40	6.32	8.83	19.53	2.17	7.49
	11	IET 26866	7.15	5.40	7.20	9.80	7.20	1.92	8.27	19.03	2.83	7.64
	12	IET 26871	8.19	1.07	4.10	8.80	4.77	3.43	8.53	17.53	3.17	6.62
	13	IET 26908	6.95	1.17	6.57	8.48	5.33	5.33	7.87	17.83	1.17	6.74
	14	IET 26910	7.85	6.30	6.33	7.43	5.07	8.87	7.40	20.13	7.83	8.58
	15	IET 26913	7.60	4.00	6.93	8.25	4.73	3.35	9.17	21.43	9.17	8.29
	16	IET 26917	6.35	3.60	7.33	8.85	4.33	10.77	10.70	20.43	5.83	8.69
	17	KARJAT-7	7.19	2.33	7.13	8.42	4.70	2.22	11.23	21.33	4.00	7.62
	18	LALAT	8.45	1.53	8.73	8.40	4.93	4.88	9.77	18.63	9.83	8.35
	19	MTU-1010	8.19	1.33	5.70	7.00	4.97	1.60	9.10	18.03	2.17	6.45
	20	PR-113	7.39	2.53	6.17	7.58	4.97	7.83	8.67	19.93	7.50	8.06
	21	US-312	7.02	6.37	6.73	8.30	5.27	3.05	9.50	18.53	2.17	7.44
		Mean	**7.30**	**3.83**	**6.42**	**8.12**	**4.86**	**8.91**	**9.10**	**19.21**	**5.21**	**8.02**

Contd...Table 6.4.3 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Root length (cm)									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Water Stress (2% Mannitol)	1	BPT-2411	8.55	4.97	7.33	7.83	4.67	2.68	10.03	16.77	4.00	7.43
	2	BPT-2593	8.85	4.87	5.57	9.13	5.17	1.57	9.83	16.07	2.33	7.04
	3	BPT-2595	7.82	4.50	5.77	7.05	4.83	2.62	10.57	17.10	2.17	6.94
	4	BPT-2766	8.25	6.13	3.90	6.57	3.50	2.68	10.70	18.50	1.17	6.82
	5	BPT-2776	8.25	1.53	5.77	7.00	3.47	3.32	0.00	0.00	0.00	4.89
	6	BPT-2782	8.27	3.30	5.00	6.45	4.87	3.31	10.73	16.57	2.17	6.74
	7	Gontrabidhan-3	9.45	1.63	7.53	6.00	3.90	2.27	7.80	18.57	3.00	6.68
	8	IET 26487	8.35	3.90	7.13	6.20	3.63	1.13	8.77	17.77	8.83	7.30
	9	IET 26493	9.02	3.27	6.07	7.82	4.07	2.65	9.30	16.87	5.33	7.15
	10	IET 26498	9.95	2.37	6.10	8.88	5.20	2.90	8.73	17.53	2.33	7.11
	11	IET 26866	8.75	4.63	4.70	10.32	5.30	0.87	7.80	17.60	9.33	7.70
	12	IET 26871	9.78	1.40	4.10	8.57	4.67	1.53	7.97	17.17	7.00	6.91
	13	IET 26908	8.55	2.80	2.87	8.98	4.43	2.13	7.90	15.73	2.50	6.21
	14	IET 26910	9.45	1.60	7.17	10.42	5.03	1.33	8.80	16.00	11.00	7.87
	15	IET 26913	9.19	4.80	6.47	9.72	4.60	4.13	9.00	18.17	7.00	8.12
	16	IET 26917	7.95	1.37	4.53	5.07	4.17	2.40	9.53	19.27	4.83	6.57
	17	KARJAT-7	8.75	1.63	6.80	11.22	4.20	1.63	8.83	17.73	10.50	7.92
	18	LALAT	9.82	4.20	6.53	11.78	4.80	1.82	7.77	19.50	4.67	7.88
	19	MTU-1010	9.72	4.00	7.57	6.87	4.73	3.37	9.83	16.67	1.67	7.16
	20	PR-113	8.95	2.37	6.43	11.67	3.17	0.87	8.80	16.70	5.33	7.14
	21	US-312	8.58	0.93	5.87	9.55	4.07	2.97	10.63	18.53	5.83	7.44
		Mean	**8.87**	**3.15**	**5.87**	**8.43**	**4.40**	**2.29**	**9.17**	**17.44**	**5.05**	**7.10**
		Grand Mean	**7.24**	**2.68**	**3.98**	**5.32**	**3.39**	**6.31**	**6.70**	**14.40**	**5.79**	**6.20**

Table 6.4.4 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Seedling Vigour									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Anaerobic germination	1	BPT-2411	328.8	0.0	0.0	0.0	0.0	516.7	204.8	0.0	1699.0	687.3
	2	BPT-2593	758.0	0.0	0.0	0.0	0.0	900.0	76.6	0.0	1482.0	804.1
	3	BPT-2595	768.4	0.0	0.0	0.0	0.0	613.3	130.5	0.0	888.7	600.2
	4	BPT-2766	802.5	0.0	0.0	0.0	0.0	400.0	110.9	0.0	713.8	506.8
	5	BPT-2776	825.9	0.0	0.0	0.0	0.0	405.0	0.0	0.0	0.0	307.7
	6	BPT-2782	817.7	0.0	0.0	0.0	0.0	516.7	151.2	0.0	1142.0	656.9
	7	Gontrabidhan-3	490.4	0.0	0.0	0.0	0.0	460.0	99.4	0.0	941.7	497.9
	8	IET 26487	1211.4	0.0	0.0	0.0	0.0	533.3	225.1	0.0	2770.0	1185.0
	9	IET 26493	807.9	0.0	0.0	0.0	0.0	483.3	237.0	0.0	3419.3	1236.9
	10	IET 26498	804.3	0.0	0.0	0.0	0.0	440.0	286.3	0.0	2757.0	1071.9
	11	IET 26866	1003.7	0.0	0.0	0.0	0.0	433.3	126.5	0.0	0.0	390.9
	12	IET 26871	813.2	0.0	0.0	0.0	0.0	210.0	113.5	0.0	915.2	513.0
	13	IET 26908	1317.1	0.0	0.0	0.0	0.0	405.0	196.9	0.0	2351.7	1067.6
	14	IET 26910	944.5	0.0	0.0	0.0	0.0	540.0	129.3	0.0	1793.0	851.7
	15	IET 26913	614.9	0.0	0.0	0.0	0.0	516.7	110.0	0.0	1484.5	681.5
	16	IET 26917	487.4	0.0	0.0	0.0	0.0	416.7	166.1	0.0	2212.5	820.7
	17	KARJAT-7	385.8	0.0	0.0	0.0	0.0	633.3	224.2	0.0	2255.0	874.6
	18	LALAT	756.1	0.0	0.0	0.0	0.0	600.0	257.1	0.0	1897.5	877.7
	19	MTU-1010	876.9	0.0	0.0	0.0	0.0	683.3	239.1	0.0	2338.7	1034.5
	20	PR-113	783.2	0.0	0.0	0.0	0.0	480.0	0.0	0.0	2744.5	1001.9
	21	US-312	586.9	0.0	0.0	0.0	0.0	93.3	0.0	0.0	1948.2	657.1
		Mean	**770.7**	**0.0**	**0.0**	**0.0**	**0.0**	**489.5**	**146.9**	**0.0**	**1702.6**	**777.4**
Control	1	BPT-2411	1973.3	696.1	1208.3	1676.7	1128.5	2600.0	1406.8	1525.3	2027.3	1582.5
	2	BPT-2593	2020.9	1262.6	1341.0	1866.7	1248.3	2673.0	1951.1	1629.1	2367.0	1817.8
	3	BPT-2595	2166.7	1502.7	1098.3	1702.0	1106.9	2014.3	2108.8	1612.0	1736.0	1672.0
	4	BPT-2766	2196.7	808.7	989.7	1530.9	873.0	1238.7	2121.8	1693.7	1660.7	1457.1
	5	BPT-2776	1996.7	1025.5	1172.0	1356.7	1072.8	1500.0	0.0	0.0	0.0	1353.9
	6	BPT-2782	2111.7	386.9	1042.7	1495.0	1179.6	1134.0	2092.3	1490.8	1724.3	1445.6
	7	Gontrabidhan-3	2386.7	643.1	787.7	1171.1	814.1	2282.7	2108.6	1699.4	2142.0	1559.5
	8	IET 26487	2016.7	1172.1	1666.3	1495.0	1319.3	1953.0	1991.6	1641.8	2183.3	1715.5
	9	IET 26493	2066.7	503.6	1344.3	1340.0	1096.1	2770.7	4588.4	1558.3	2437.3	1967.3
	10	IET 26498	2440.0	1018.7	1135.0	1691.7	1401.8	2467.7	2044.1	1606.7	1972.3	1753.1
	11	IET 26866	2360.0	774.3	1255.3	1989.4	1500.1	2416.0	1988.2	1543.1	2144.7	1774.6
	12	IET 26871	2186.7	1791.6	572.7	1009.9	963.4	2352.0	2158.1	1621.9	1710.0	1596.3
	13	IET 26908	2060.8	1328.0	1516.0	1808.3	1278.5	2818.3	2259.5	1598.6	1586.7	1806.1
	14	IET 26910	2256.7	695.4	1230.3	1524.6	1098.9	1905.0	2057.2	1596.6	2036.0	1600.1
	15	IET 26913	1939.1	1727.7	1430.7	1834.6	1071.6	2466.7	2103.5	1636.0	2412.3	1846.9
	16	IET 26917	2116.7	185.5	1163.7	1816.7	861.3	2697.0	2072.2	1688.7	2129.0	1636.7
	17	KARJAT-7	2303.3	599.5	1819.0	1933.3	1085.2	2554.7	1999.9	1648.2	1950.0	1765.9
	18	LALAT	2530.0	818.4	972.0	1601.7	1057.1	2701.3	2156.5	1823.3	2077.0	1748.6
	19	MTU-1010	2346.7	736.8	1542.0	3618.3	1505.2	2641.0	2232.5	1608.8	2533.0	2084.9
	20	PR-113	2153.6	1351.8	1493.7	1882.7	1457.9	1877.3	2122.8	1600.8	1975.0	1768.4
	21	US-312	2146.7	1287.1	1241.0	1360.0	1270.7	946.0	2034.6	1620.9	1746.0	1517.0
		Mean	**2179.8**	**976.8**	**1241.1**	**1700.2**	**1161.4**	**2190.9**	**2179.9**	**1622.2**	**2027.5**	**1689.0**

Contd...Table 6.4.4 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat	S.No.	Entries	Seedling Vigour									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Saline Test	1	BPT-2411	925.1	798.4	127.0	536.2	545.0	2533.3	600.4	810.7	0.0	859.5
	2	BPT-2593	760.9	585.1	177.0	571.8	349.3	2966.7	916.2	916.2	0.0	905.4
	3	BPT-2595	816.0	102.4	199.7	422.7	379.0	2166.7	825.2	958.6	0.0	733.8
	4	BPT-2766	946.4	68.5	201.0	419.1	351.5	1966.7	736.0	1034.9	0.0	715.5
	5	BPT-2776	706.4	213.8	161.3	553.3	388.0	2500.0	0.0	0.0	0.0	753.8
	6	BPT-2782	712.1	610.7	173.0	664.8	305.7	1493.3	770.3	919.9	0.0	706.2
	7	Gontrabidhan-3	488.9	181.4	177.7	71.1	94.9	2640.0	554.7	1104.9	0.0	664.2
	8	IET 26487	972.3	228.2	237.0	169.8	419.1	2066.7	1219.3	982.7	0.0	786.9
	9	IET 26493	1065.6	255.2	257.7	353.3	403.5	3466.7	1105.7	870.8	0.0	972.3
	10	IET 26498	866.9	0.0	247.7	399.1	403.3	3400.0	1094.7	953.7	0.0	920.7
	11	IET 26866	1302.1	468.0	226.3	284.7	438.1	2910.0	718.5	947.8	0.0	912.0
	12	IET 26871	1299.2	0.0	122.7	92.4	88.0	2460.0	929.8	996.4	0.0	748.6
	13	IET 26908	963.2	93.7	179.7	658.4	396.9	3133.3	778.7	901.6	0.0	888.2
	14	IET 26910	628.3	239.9	209.3	756.2	343.3	2000.0	938.2	859.8	0.0	746.9
	15	IET 26913	605.5	93.3	211.0	519.8	476.0	2820.0	519.5	916.2	0.0	770.2
	16	IET 26917	625.5	461.5	210.7	748.0	194.8	2100.0	805.5	986.1	0.0	766.5
	17	KARJAT-7	919.1	694.1	213.0	776.3	444.7	2760.0	1033.6	994.4	0.0	979.4
	18	LALAT	897.1	942.6	230.7	521.1	431.8	3200.0	763.4	1153.1	0.0	1017.5
	19	MTU-1010	788.1	370.6	198.0	651.2	383.0	3333.3	689.1	977.5	0.0	923.8
	20	PR-113	666.7	293.4	140.3	448.1	406.0	2010.0	804.6	988.1	0.0	719.7
	21	US-312	544.0	847.4	119.0	591.9	377.7	1226.7	757.9	1062.5	0.0	690.9
		Mean	**833.3**	**363.4**	**191.4**	**486.2**	**362.8**	**2531.1**	**788.6**	**920.8**	**0.0**	**818.2**
Water Stress (1% Mannitol)	1	BPT-2411	1560.8	1282.9	1155.0	1793.3	1036.9	1657.5	1516.3	1263.1	986.7	1361.4
	2	BPT-2593	1585.8	1365.8	1166.7	1750.0	953.7	751.5	1485.6	1359.5	372.0	1199.0
	3	BPT-2595	1736.8	1034.6	1025.3	1313.5	816.4	1638.3	1469.1	1347.4	448.7	1203.3
	4	BPT-2766	1801.2	1077.7	1067.7	1298.5	611.6	596.2	1446.1	1474.0	674.7	1116.4
	5	BPT-2776	1662.5	1450.7	976.5	1450.0	759.3	1061.7	0.0	0.0	0.0	1226.8
	6	BPT-2782	1690.7	241.8	1126.3	1556.6	885.0	9225.0	1703.7	1358.0	387.7	2019.4
	7	Gontrabidhan-3	2042.5	634.0	1065.0	664.2	442.8	1936.7	1559.7	1514.7	1756.7	1290.7
	8	IET 26487	1662.5	1395.2	1736.7	1881.9	947.3	1136.7	1453.7	1491.2	1570.0	1475.0
	9	IET 26493	1712.5	1258.9	1573.7	1440.0	893.1	1170.0	1485.9	1372.7	625.3	1281.3
	10	IET 26498	2069.2	1346.5	1418.3	1426.0	1016.1	1498.3	1459.4	1403.6	473.3	1345.7
	11	IET 26866	2062.5	1179.3	1342.0	1836.8	1258.2	788.3	1387.9	1400.5	392.7	1294.2
	12	IET 26871	1845.8	225.3	414.7	800.2	540.8	805.0	1438.3	1499.9	658.3	914.3
	13	IET 26908	1620.2	895.5	1526.0	1625.0	984.1	1713.3	1289.1	1381.1	601.7	1292.9
	14	IET 26910	1902.5	862.2	1264.3	1377.8	816.0	2290.0	1269.9	1429.6	1013.0	1358.4
	15	IET 26913	1652.6	1128.8	1315.3	1766.5	843.4	828.3	1528.0	1542.6	1402.0	1334.2
	16	IET 26917	1692.0	934.5	1472.0	1700.6	755.4	2296.7	1816.8	1555.4	1120.0	1482.6
	17	KARJAT-7	1965.8	578.9	1565.7	1856.7	854.7	784.5	1772.5	1443.0	751.3	1285.9
	18	LALAT	2222.5	450.5	1807.7	1943.3	937.5	1165.0	1583.3	1662.4	1469.3	1471.3
	19	MTU-1010	1995.8	429.2	1310.0	1568.9	962.8	566.7	1514.7	1420.1	483.0	1139.0
	20	PR-113	1744.2	784.0	1430.0	1460.9	956.3	2550.0	1451.3	1403.0	1356.7	1459.6
	21	US-312	1789.2	1391.9	1370.7	1489.0	1021.3	891.7	1579.0	1397.8	531.3	1273.6
		Mean	**1810.4**	**949.9**	**1290.4**	**1523.8**	**871.1**	**1683.4**	**1510.5**	**1436.0**	**853.7**	**1325.0**

Table 6.4.4 Physiological characterization of selected rice multiple abiotic stress tolerance at different AICRIP centers Kharif 2018

Treat.	S.No.	Entries	Seedling Vigour									Grand Mean
			CBT	IIRR	KJT	KRK	MTU	PTB	RANCHI	REWA	TTB	
Water Stress (2% Mannitol)	1	BPT-2411	1236.2	1002.9	1269.3	1343.7	895.3	821.7	1798.3	877.2	953.3	1133.1
	2	BPT-2593	1298.4	1017.9	1058.0	1764.5	868.7	340.0	1780.8	1090.2	187.7	1045.1
	3	BPT-2595	1311.1	907.3	978.7	1243.0	852.2	481.5	1907.7	1057.0	278.3	1001.9
	4	BPT-2766	1338.1	1224.7	845.0	1218.7	515.6	582.3	1933.7	1132.8	147.7	993.2
	5	BPT-2776	1132.8	415.7	1118.7	1266.7	636.1	661.7	0.0	0.0	0.0	871.9
	6	BPT-2782	1577.5	623.7	1058.7	1146.2	795.6	764.0	1973.2	946.5	254.7	1015.6
	7	Gontrabidhan-3	1965.3	293.0	1091.7	431.1	287.3	1073.3	1360.7	1161.1	635.0	922.1
	8	IET 26487	1558.4	1043.8	1617.7	1196.7	839.3	708.3	1529.3	1157.0	1530.0	1242.3
	9	IET 26493	1501.9	792.0	1551.7	1521.7	831.7	640.0	1655.6	941.4	830.7	1140.7
	10	IET 26498	2040.5	363.5	1440.3	1579.3	946.7	900.0	1536.7	1112.3	521.7	1160.1
	11	IET 26866	1981.7	557.5	962.0	1650.3	929.7	454.5	1365.3	1106.4	831.3	1093.2
	12	IET 26871	1810.0	243.9	398.7	663.1	407.3	376.0	1381.0	1184.1	870.0	814.9
	13	IET 26908	1365.3	538.0	1116.7	1850.0	829.9	600.0	1352.6	1065.6	589.0	1034.1
	14	IET 26910	1717.3	153.1	1353.3	1726.0	758.4	325.3	1589.1	1091.0	1110.7	1091.6
	15	IET 26913	1308.0	1055.8	1266.0	1552.9	824.1	588.0	1598.1	1216.4	1021.7	1159.0
	16	IET 26917	1243.2	435.3	1204.7	804.0	631.9	462.0	1702.4	1180.4	750.7	935.0
	17	KARJAT-7	1926.7	161.4	1504.3	1991.7	766.4	503.3	1591.3	1159.0	1394.0	1222.0
	18	LALAT	1817.2	899.4	1511.7	2111.7	861.6	826.5	1443.7	1411.9	928.3	1312.4
	19	MTU-1010	1684.0	610.8	1593.7	1248.8	824.1	1266.7	1751.6	1181.5	294.0	1161.7
	20	PR-113	1595.1	433.6	1514.0	1989.1	737.1	379.2	1551.8	1123.1	919.7	1138.1
	21	US-312	1573.7	269.8	1288.0	1694.1	817.8	598.3	1926.7	1173.4	674.0	1112.9
		Mean	1570.6	621.1	1225.8	1428.2	755.1	635.8	1636.5	1118.4	736.1	1076.2
		Grand Mean	1433.0	580.3	789.7	1027.7	630.1	1506.2	1201.8	979.7	1029.5	1019.8

Table 6.4.5 Influence of low temperature stress on germination and related traits in different rice genotypes at KRK center

S.No.	Entries	Shoot Length (cm)		Grand Mean	Germination (%)		Grand Mean
		Control	Low Temperature		Control	Low Temperature	
1	BPT-2411	9.85	1.23	5.54	100.0	88.6	94.3
2	BPT-2593	9.33	0.10	4.72	100.0	81.4	90.7
3	BPT-2595	9.62	0.10	4.86	91.4	87.1	89.3
4	BPT-2766	7.83	0.10	3.97	95.7	95.7	95.7
5	BPT-2776	7.27	0.10	3.68	95.7	85.7	90.7
6	BPT-2782	7.52	0.10	3.81	100.0	87.1	93.6
7	GONTRABIDHAN-3	10.98	0.38	5.68	50.0	22.9	36.4
8	IET 26487	11.77	0.35	6.06	100.0	92.9	96.4
9	IET 26493	8.55	0.38	4.47	100.0	100.0	100.0
10	IET 26498	9.12	0.37	4.74	100.0	97.1	98.6
11	IET 26866	11.48	0.67	6.08	94.3	85.7	90.0
12	IET 26871	9.62	0.10	4.86	60.0	34.3	47.1
13	IET 26908	10.27	0.10	5.18	100.0	94.3	97.1
14	IET 26910	9.68	0.47	5.08	87.1	88.6	87.9
15	IET 26913	12.08	0.60	6.34	98.6	82.9	90.7
16	IET 26917	9.98	0.10	5.04	100.0	94.3	97.1
17	KARJAT-7	10.52	1.17	5.84	100.0	82.9	91.4
18	LALAT	8.05	0.47	4.26	100.0	94.3	97.1
19	MTU-1010	7.80	0.12	3.96	100.0	87.1	93.6
20	PR-113	12.02	0.10	6.06	95.7	85.7	90.7
21	US-312	7.57	0.10	3.83	97.1	78.6	87.9
22	Grand Total	9.57	0.34	4.95	93.6	83.2	88.4
23	LSD (Treat)		0.65**			2.0**	
24	LSD(Variety)		2.11**			6.5**	
25	LSD (Treat x Variety)		NS			9.2**	

Table 6.4.6 Influence of low temperature stress on germination and related traits in different rice genotypes at KRK centre

S.No	Entries	Seedling Vigour		Grand Mean	Root Length (cm)		Grand Mean
		Control	Low Temperature		Control	Low Temperature	
1	BPT-2411	1677	179	928	6.92	0.83	3.88
2	BPT-2593	1867	18	942	9.33	0.22	4.78
3	BPT-2595	1702	63	882	8.98	0.72	4.85
4	BPT-2766	1531	29	780	8.13	0.30	4.22
5	BPT-2776	1357	79	718	6.30	0.73	3.52
6	BPT-2782	1495	28	761	7.43	0.32	3.88
7	GONTRABIDHAN-3	1171	34	603	12.30	1.15	6.73
8	IET 26487	1495	193	844	3.18	1.73	2.46
9	IET 26493	1340	188	764	4.85	1.50	3.18
10	IET 26498	1692	204	948	7.80	1.73	4.77
11	IET 26866	1989	200	1095	9.62	1.67	5.64
12	IET 26871	1010	48	529	7.32	1.40	4.36
13	IET 26908	1808	153	981	7.82	1.63	4.73
14	IET 26910	1525	182	853	7.90	1.60	4.75
15	IET 26913	1835	183	1009	6.53	1.62	4.08
16	IET 26917	1817	130	973	8.18	1.38	4.78
17	KARJAT-7	1933	191	1062	8.82	1.17	4.99
18	LALAT	1602	145	873	7.97	1.08	4.53
19	MTU-1010	3618	63	1840	28.38	0.60	14.49
20	PR-113	1883	46	964	7.65	0.53	4.09
21	US-312	1360	71	715	6.43	0.90	3.67
22	Grand Total	1700	115	908	8.66	1.09	4.87
23	LSD (Treatment)		259**			2.5**	
24	LSD (Variety)		NS			NS	
25	LSD (Treatment x Variety)		Ns			NS	

6.5. Evaluation of Radiation and Nitrogen use efficient promising rice genotypes

Location: CBT, IIRR, KJT, MTU, PNR, PTB, RPR and TTB

Nitrogen (N) nutrition affects all levels of plant function from metabolism to resource allocation, growth. Nitrogen use efficiency (NUE) in plants is a complex phenomenon that depends on a number of internal and external factors, which include soil N availability, its uptake and assimilation of carbon and nitrogen. An increased awareness of the regulatory mechanisms controlling Nitrogen economy is imperative to enhance nitrogen uptake and use efficiency so as to reduce excessive input of fertilizers. Under National Innovative climate resilient project (NICRA) one of the major activities undertaken was developing nitrogen use efficient rice varieties. Facilities to screen large number of rice genotypes were created at IIRR field and promising donors have been identified and crosses were made (12 entries with various cross combinations and High yielding varieties) and promising lines were identified and evaluated to the nitrogen use efficiency. A trial was conducted with 3 N treatments (100, 50 and 0 kg N ha^{-1}) and recommended P and K fertilizer (45 P_2O_5, 60K_20 kg/ha applied as basal dose and the N was applied in 3 splits were used and the trial is conducted for 3nd successive year at 8 AICRIP centres.

Nitrogen levels did not significantly influenced the mean days to 50% flowering (DAF) (Table6.5.1). The mean days to flowering for all the varieties and treatments at different centres varied between 58.5 (FZB) to 94.5 days (CBT). Significant ($p<0.01$) differences were noticed between genotypes. The mean DAF varied between 75.3 (Varadhan) to a maximum of 95.3 Days (Sampada x Jaya/2) followed by 94.7 days(Jaya) under T1 (0 kg N ha^{-1}). Under 50% RDN (T2) the mean DAF varied between 72.1 days (Rasi x Jaya/2) to a maximum of 96.5 days (Jaya) followed by 95.2 days (Sampada x Jaya/2). The mean DAF varied between 74.4 days (Rasi x Jays/2) to 95.4 (sampada x jaya/2) followed by Rasi (95.1 days). The interaction between Location x Treatment was found to be significant (*$p<0.01$)*. Similarly, the interaction between Location x Treatment x genotype was also found to be significant (*$p<0.01$)*.

Similarly, the days to maturity (DM) was also not significantly affected by N dose. The mean days to maturity for all locations and varieties is 118.6, 119.6 and 118.9 respectively, under 0, 50 and 100% RDN. The mean days to maturity for all the varieties and treatments varied between 101.1 days (RPR) and 126.9 days (TTB). The mean days to maturity for all the centres ranged between 112 days (Varadhan x BPT 5204/6) to 128 days (Sampada x Jaya/3) at T1 and under T2 the days to maturity varied between days (Varadhan) to 138 days (Sampada X Jaya/2). Under 100% RDN (T3) the DM varied between 106.6 days (Rasi x Jaya/2) to 127.4 days (Sampada x Jaya/2) (Table 6.5.2).

The mean plant height for all varieties was 94.2 cm under T1, under T2 the mean plant height increased up to 100.6 cm and under T3 it increased to 103.1 cm and the differences were found to be significant (*$p<0.01$)*. Significant differences were observed between the varieties for plant height. The mean Plant height varied between 91.1 (Sampada)

followed by Varadhan x BPT5204 (91.2 cm) under T1 and under T2 the mean plant height ranged from 88 (Varadhan) to 108 cm (BPT 5204) and under T3 the plant height varied between 86.9 cm (Rasi x Jaya/2) and 122.4 (MTU 1010). The interaction between treatment x variety is significant ($p<0.01$) and interaction between location x treatment x genotype is also found to be significant (Table 6.5.3).

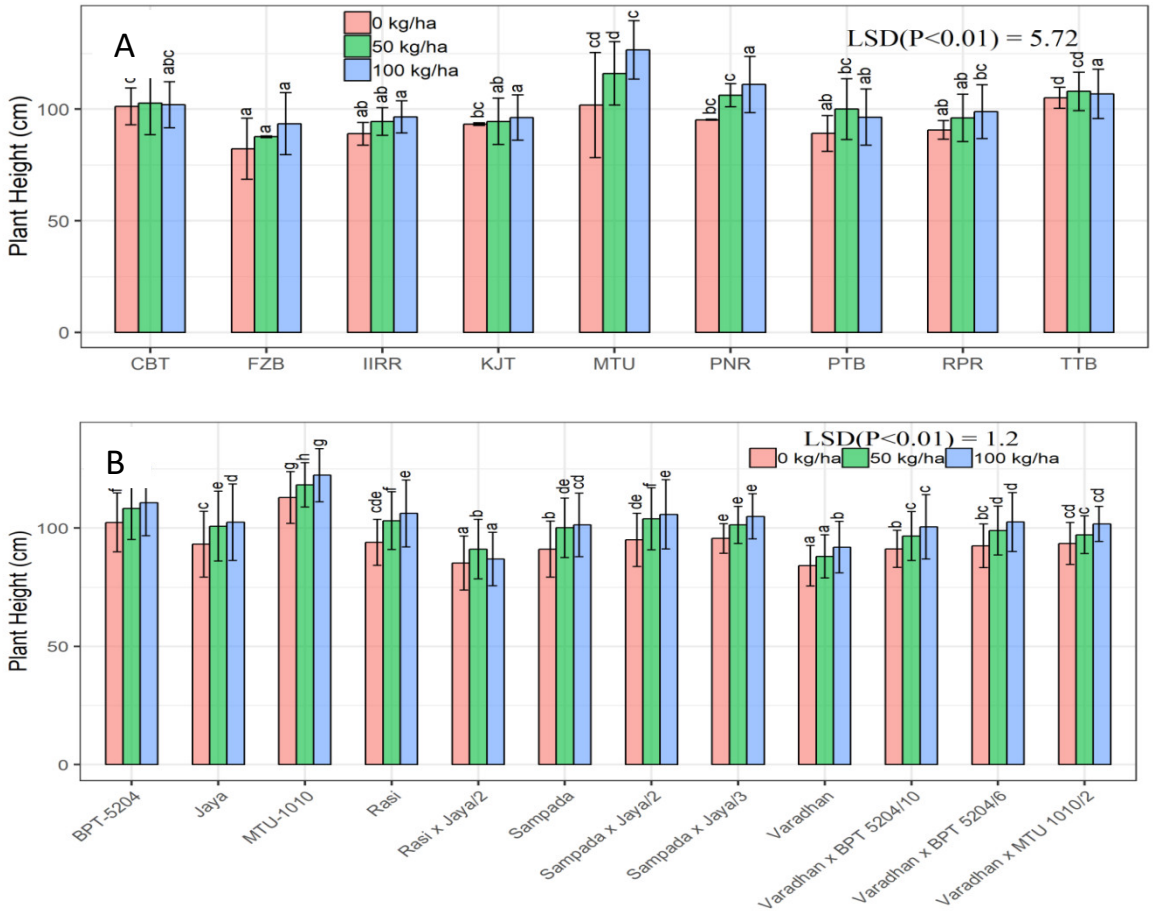


Fig.1 Influence f Nitrogen levels on plant height (A) Mean of all varieties (B) Mean of all centres. Each bar represents the mean ± Stdev. Bars with same letters are statistically non-significant.

Data pertaining to the flag leaf area under different Nitrogen regimes was presented in Table 6.5.7**.** Nitrogen levels significantly ($p<0.01$) influenced the mean flag leaf area. The interaction between location x treatment and location x genotype was found to be significant ($p<0.01$). Significant differences were observed between tested genotypes. The three way interaction between Location x genotype x treatment was highly significant ($p<0.01$) indicating that the treatment effect is dependent on location and genotype (Table 6.5.7).

Leaf Area Index (LAI) was measured at flowering stage. The data indicated that N levels had significantly ($p<-0.01$) affected the mean LAI. The mean leaf area for all centres was 3.54 under T1 (0% RDN), 4.20 and 4.69 under T2 (50% RDN) and T3 (100% RDN) respectively (Table 6.5.8). The interaction between Location x Treatment was found to be significant ($p<0.01$). However, the differences amongst the genotypes was non-significant for mean LAI (mean of all locations). The interaction between location x genotype was

found to be highly significant (p<0.01) implying that the genotypes behaved differently at different locations. The man LAI (mean of all treatments) between 3.25 (PTB) to maximum of 5.15 (CBT) (Table 6.5.8).

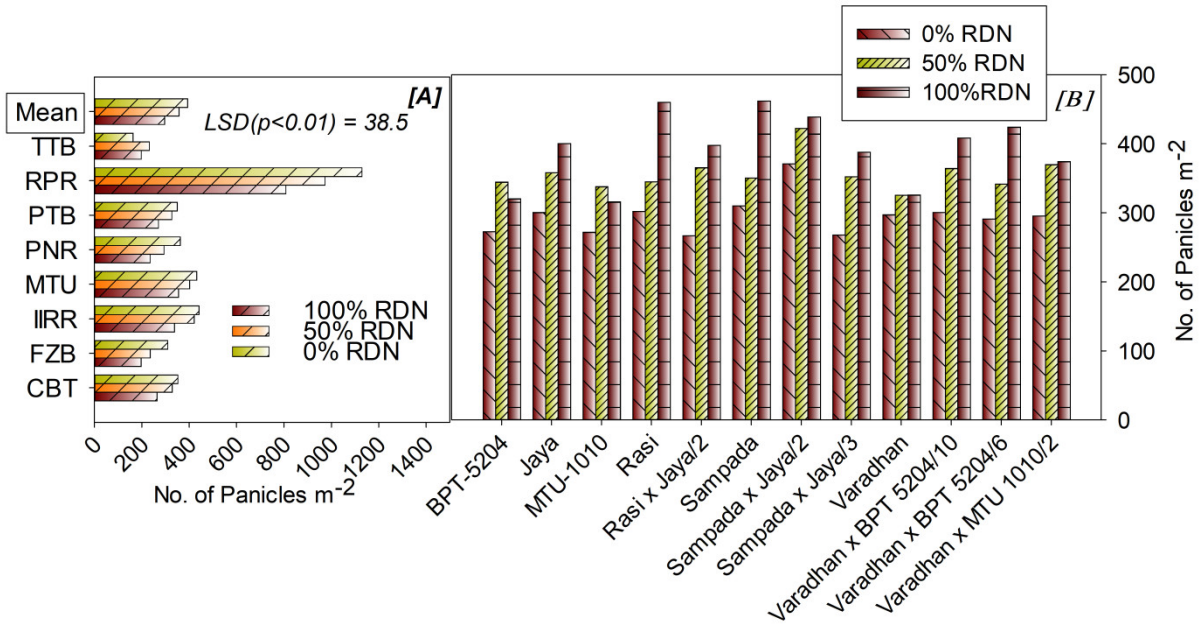


Fig. 2: Influence of nitrogen levels on number of panicles per sq.m. during kharif-2018 (A) Mean of all varieties (B) Mean of all locations.

Number of panicles/m^2 (Pan No) is an important yield determining trait which was significantly affected by nitrogen doses. The mean Pan No (mean of all varieties) was significantly (p<0.01) affected by nitrogen. The mean Pan No under 0% RDN was 296 which was increased to 356 and 393 under 50%RDN and 100%RDN, respectively. The mean Pan No. (mean of all locations) was not significantly affected amongst the tested entries (Table 6.5.10 & Fig 2). Interaction between Location x Genotype and Location x Treatment was statistically significant (p<001), similarly the three way interaction between Location x treatment x genotypes was also found to be significant (p<0.01) (Table 6.5.10).

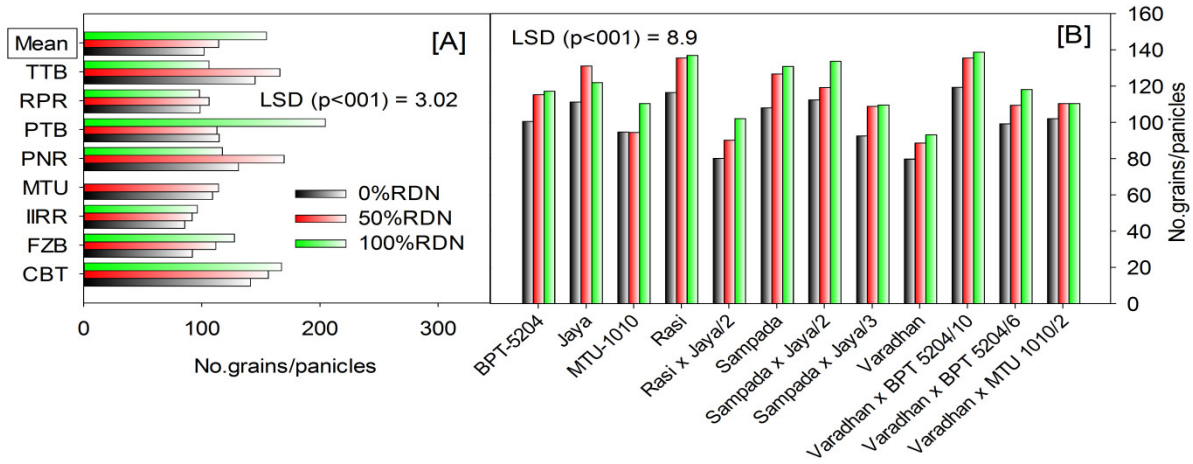


Fig.3: Influence of nitrogen levels on number of grains/panicle (A) Mean of all varieties (B) Mean of all locations

Nitrogen significantly (p<0.01) influenced the number of grains/panicles (GNP). The mean GNP under 0% RDN is 101.7 and 114 and 118, respectively under 50% RDN and 100%RDN. The interaction between Location x Treatment was found to be highly significant (p<001) implying that the treatment effect is different between the locations (Fig 3). Significant (p<001) differences were observed amongst the genotypes (Table 6.5.11). However, the interaction between Treatment x Genotype was found to be non-significant implying that the genotypes did not behaved differently under different N treatments (Table 6.5.11).

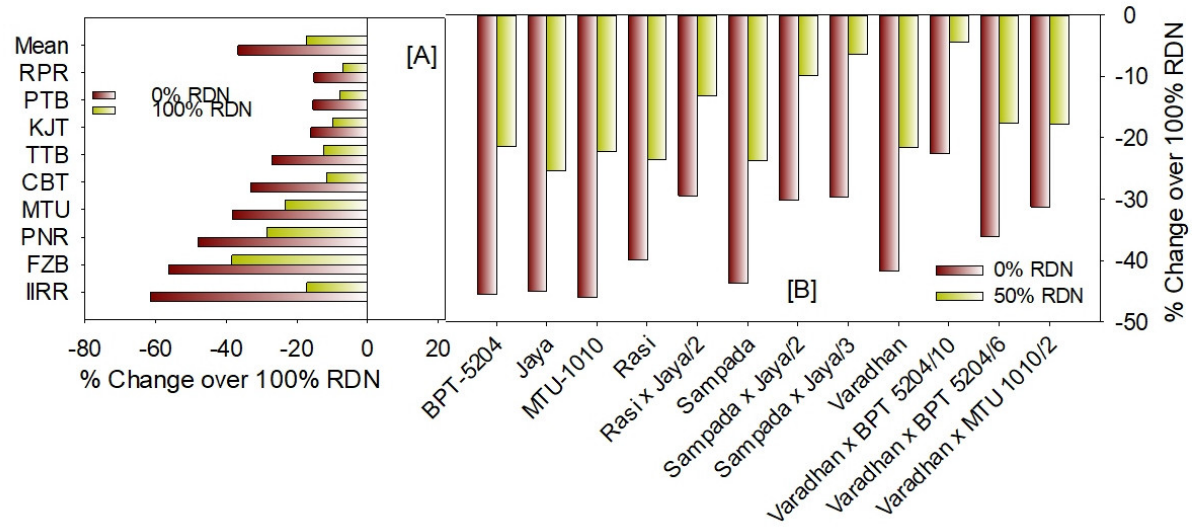


Fig.4: Influence of nitrogen levels on grain yield of selected rice genotypes. Each bar represent the mean of three replications. The data was presented as % change in grain yield over 100% RDN (recommended dose of Nitrogen).

The grain yield was reduced by 36% over RDN under 0% RDN level and the reduction was 17.3% when 50% of RDN was supplied (Fig.4). Interaction between Location

x treatment and Location x Genotypes was found to be statistically significant ($p<0.01$). The % reduction in grain yield was maximum at IIRR followed by FZB, PNR and MTU). Minimum reduction in mean grain yield (mean of all genotypes) at both 0% RDN and 50% RDN was observed at KJT, PTB and RPR centres. Significant variation was observed amongst the genotypes. The mean (mean of all locations) grain yield varied between 283 g m^{-2} (MTU 1010) to 413 g m^{-2} (Varadhan x BPT 52041/10) followed by Sampada x Jaya/3 (408 g m^{-2}), 407 (varadhan x MTU 1010/2) and Sampada x Jaya/2 (406.1 g m^{-2}) under 0%RDN. Under 50% RDN the grain yield varied between 369 g m^{-2} (Varadhan) to 543.4 (Sampada x Jaya/3), Sampada x Jaya/2 and Varadhan x BPT 5204 (504.3 g m^{-2}) (Table 6.5.15).

The total above ground dry matter was measured at PI, 50% flowering and at maturity. The data was presented in Tables 6.5.4 to 6.5.6. At maturity, the TDM was significantly ($p<-0.01$) influenced by nitrogen treatments. The TDM was reduced by >20% over 100% RDN and >11% over 100% RDN under 0 and 50% RDN, respectively (Fig.5). Significant differences were observed amongst the tested entries for TDM, maximum reduction (>26%) in TDM was observed in Varadhan x BPT 5204/10 and Jaya followed by Varadhan. The reduction is <15% over 100% RDN treatment in Sampada x Jaya/2 and Sampada x Jaya/3. In all other entries the reduction is >20% over 100% RDN (Fig.5(B)) under 0% RDN. Under 50% RDN the reduction in TDM was >15% in Sampada x Jaya/2 and Sampada x Jaya/3. The reduction was minimum in MTU 1010 and Varadhan x MTU 1010/2. The reduction in mean TDM (for all genotypes) was highest at IIRR under 0% RDN followed by FZB. Under 50% of RDN, the reduction was more in FZB followed by PNR. However, at TTB and RPR no significant reduction in TDM was observed (Fig.5). The interaction between Location x Genotype was found to be statistically significant ($p<0.01$) implying that significant Genotype x Environment interaction existed. However, the interaction between Treatment x Genotype was non-significant. However, interaction between Location x Genotypes x treatment was highly significant (Table 6.5.4, 6.5.5 and 6.5.6).

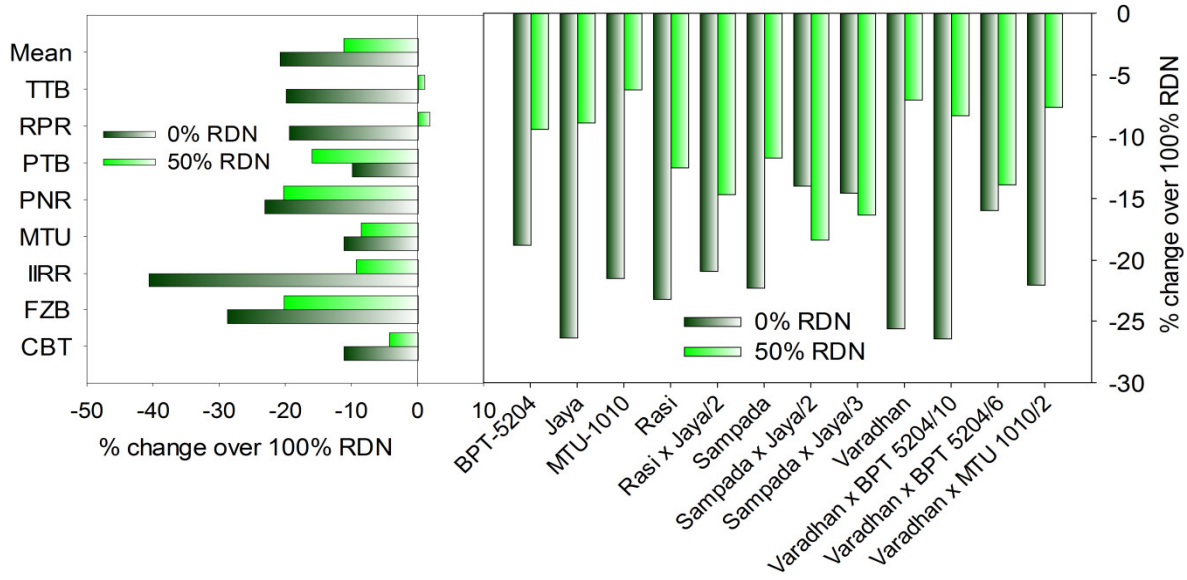


Fig. 5: Influence of nitrogen levels on total above ground biomass (TDM) in selected rice genotypes. Each bar represents the mean of three replications and the values were presented as % change over 100% RDN.

Test weight (1000 grain weight) is one of the important yield attribute. The test weight was significantly ($p<0.01$) affected by nitrogen dose. The mean test weight was reduced by7.8% and 3.2% when 0% RDN and 50% RDN was applied (Fig.6). The extent of reduction in test was significantly different amongst the locations. Maximum reduction in mean test weight was observed at CBT followed by MTU under 0% RDN and under 50% RDN the reduction was higher at MTU (>10%) followed by CBT (8.9%) over 100% RDN. However, at RPR, IIRR, KJT and TTB the reduction in test weight is only marginal and non-significant (Fig 6) and Table 6.5.16.The interaction between location x treatment was found to be significant ($p<001$) implying that the treatment effect on test weight varied between the locations. Similarly, the interaction between Location x Genotype was found to be highly significant ($p<0.01$). However, the interaction between treatment x genotype and Location x Treatment x genotype was found to be non-significant. Significant variation was observed amongst the genotypes for their response to nitrogen dose. The reduction in test weight was >13% in Jaya and Sampada x Jaya/2 followed by Varadhan x BPT 5204/6. However, Rasi x Jaya/2 and Varadhan showed minimum reduction in test weight under 0%RDN treatment. Furthermore, under 50% RDN treatment, the reduction in test weight is <5% in all genotypes except Jaya and Varadhan x MTU1010/2, where the reduction is 6.7 and 5.7 over 100% RDN, respectively (Fig.6 and Table 6.5.16).

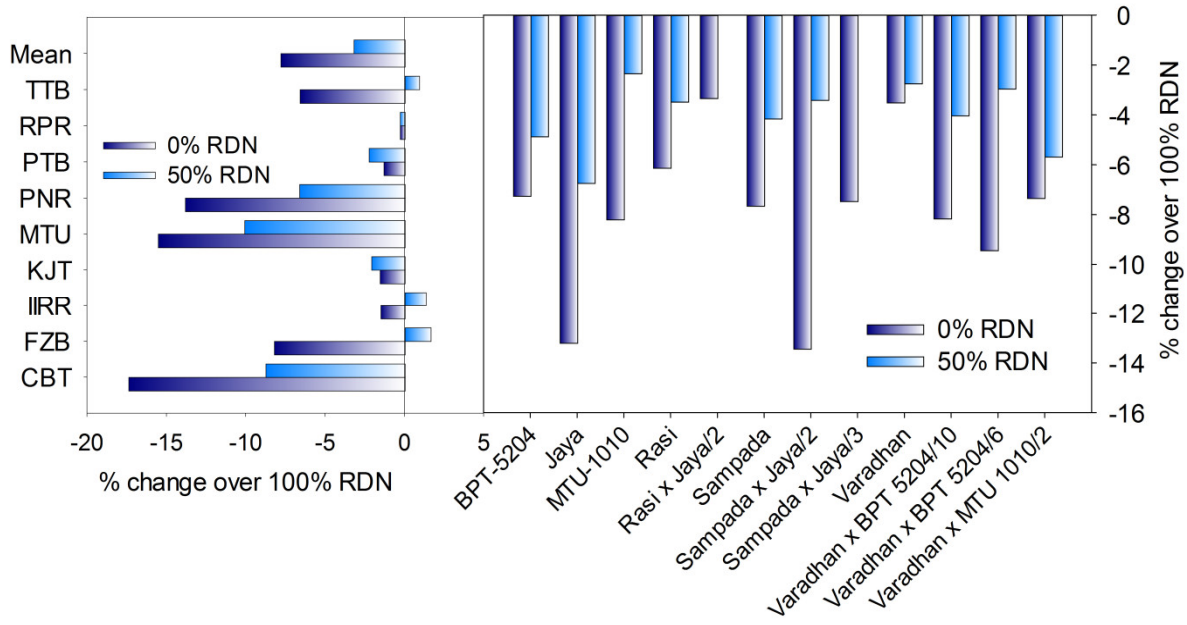


Fig. 6: Influence of nitrogen levels on Test weight (1000 grain weight) in selected rice genotypes. Each bar represents the mean of three replications and the values were presented as % change over 100% RDN.

The mean Harvest index (HI) was not influenced by Nitrogen levels (Table 6.5.17). The HI (mean of all locations and genotypes) was reduced by 1.9 and 1.89%, respectively under 0 and 50% RDN. Differences amongst genotypes for mean HI was also found to be non-signficant (Table 6.5.17). Amongst the genotypes only MTU 1010 recorded moderate reduction (>5% over RDN) in HI. The change in HI in other genotypes was non-significant (Table 6.5.17).

AMMI Biplot analysis for stability of grain yield under low Nitrogen application:

In our trial the grain yield recorded under low nitrogen i.e. 0 kg N ha^{-1} and 50 kg N ha^{-1} was subjected to AMMI analysis. Variance analysis showed that both the main effects genotype (G) and environment (E) were highly significant ($p<0.01$) under both 0 kg N ha^{-1} and 50 kg N ha^{-1} treatments. The large sum of square for environment under both the N treatments indicate strong environmental influence on grain yield.. Similarly significant genotypic effect also suggested that the variation in grain yield under low N treatments amongst the genotypes is in part are due to genetic differences among the tested entries. Highly significant ($p<0.01$) interaction effect between G X E was also noticed under both N treatments *(Table 6.5.18).* The first two components could explain 58.3% variation under 0 kg N ha^{-1} and 66.2% under 50 kg N ha^{-1}. With the triplot 77.5% variation could be explained under 0 kg N ha^{-1} and under 50 kg N ha^{-1} triplot can explain 82.5% variation (Table 6.5.19). The AMMI Stability Value(ASV) and AMMI stability index (ASI) are calculated as suggested by *Zobel et al. 1998* and *Purchase et al.(2000)*. The highest grain yield averaged

across the locations was produced by *Varadhan x BPT 5204/10* (413 g m^{-2}) followed by *Sampada x Jaya/3* (408 g m^{-2}) under 0 kg N ha^{-1} where as under 50 kg N ha^{-1} highest mean grain yield was produced by Sampada x Jaya 3 (543 413 g m^{-2}) followed by Sampada x Jaya/2 (523 g m^{-2}) and Varadhan x BPT 5204/10 (509 g m^{-2}).

The genotypes with low ASV are said to be stable. The rASV was lowest in Sampada, Sampada x Jaya/3 followed by MTU 1010 0 kg N ha^{-1} and under 50 kg N ha^{-1} treatment, the ASV is lowest in Varadhan x BPT 5204/10 followed by MTU and Sampada. The genotypes having low ASV value and can be identified as stable genotypes under low nitrogen levels. Based on yield stability index (rYSI) values Varadhan x BPT 5204/10 and Sampada x Jaya/3 can be identified as stable genotypes under 0 kg N ha^{-1} where as under 50 kg N ha^{-1} Sampada x Jaya/3, Sampada x Jaya/2 followed by Varadhan x BPT 5294/10 can be identified as stable genotypes across the environments (Table 6.5.22 & 6.5.23).

The AMMI biplot, the usual interpretation is that the displacements along the abscissa indicate differences in main (additive) effects, where as displacements along the ordinate indicate differences in interaction effects. Genotypes that group together have similar adaptation while environments which group together includes the genotypes in the same way. Fig.7 showed that genotypes which are on the right side of the perpendicular are less affected by G X E interaction. The genotypes which are close to the center point indicated that they are stable across environments. All the environments are connected to the origin (Fig.8). In case of 0 kg N ha^{-1} treatment environments MTU, KJT, PNR, CBT had short spokes and they do not exert strong interactive forces and it indicates that for many cycles in the same places with same genotypes, we can discard any of the above environments without losing precision of the results. The genotypes occur together in the plot tend to have similar yields in all environments, while the genotypes far part may differ in mean yield or show different pattern of response across environments. The Fig.7 show that the genotypes on the right side of the perpendicular i.e. Sampada x Jaya/3, Varadhan x MTU1010/2 and Rasi x Jaya/2 are less affected by environments. Figure 8 depicts the AMMI 2 triplot in which the environmental scares are connected by side lines to the origin. Sites with short arrows does not exert strong interaction. All the environments are connected to the origin. The environments PNR, CBT, MTU and FZB had short spokes and does not exert strong interactive forces. The genotypes which are close together i.e. Rasi and Sampada x Jaya/2 and Rasi x Jaya/2 and MTU 1010 on the triplot tend to have similar yield under similar environment. While genotypes which are far apart tend to have different mean yield or show different pattern of response to environment (Fig. 8).

Similarly under 50 kg N ha^{-1} treatment also the biplot (Fig.9) showed that PNR, CBT, MTU, FZB and TTB are connected to the origin through shorter spokes and they do not exert strong interactive forces. The genotypes which falls on the right side of the perpendicular are sampada x jaya/2, MTU 1010, Rasi x Jaya/2, Varadhan and Varadhan x MTU 1010/2 and are less affected by the environment. The AMMI 2 triplot (Fig.10) show that the locations CBT, KJT, PNR, TTB and MTU are connected by short spokes and do not exert strong environmental effect. Hower, IIRR, PTB, RPR and exert strong environmental effect.

Amongst the tested genotypes, Sampada x Jaya/2, Varadhan x BPT 5204/10 and Sampada x Jaya/3 are close to each other on the triplot tend to have similar yield under similar environment. While genotypes which are far apart tend to have different mean yield or show different pattern of response to environment.

Radiation use efficiency and nitrogen utilization are inter twined characters, as the absorption and utilization of photosynthetic photon flux depends on the availability of nitrogen to the crop which collectively influence crop productivity. In the present study radiation use efficiency was estimated using Oryza 2000 model based on the meteorological data and total dry matter accumulation by the individual genotypes at maturity stage. Nitrogen levels had significant effect on radiation use efficiency (RUE). The mean RUE was reduced by >23% under 0% RDN and by >16% under 50% RDN application. Significant differences were observed in the mean (mean of all varieties) amongst the locations. Maximum reduction in mean RUE was observed at FZB (>41% reduction over RDN) and minimum reduction was noticed at TTB (15% reduction over RDN) centre under 0% RDN treatment. Similarly, at 50% RDN, the reduction in mean NUE is maximum at KJT (>19% over RDN) and minimum reduction was noticed at MTU (>8% reduction over RDN). Significant genotypic differences were observed. The mean (mean of all centres) RUE was reduced in all genotypes under 0 and 50% RDN treatments . Under 0% RDN maximum reduction in NUE was observed in Jaya and minimum reduction was noticed in rasi followed by Rasi x Jaya/2 and Varadhan x BPT 5204/6 (Fig.). Similarly, under 50% RDN, Varadhan, Rasi, BPT-5204 and Sampada x Jaya/2 performed better with <15% reduction in RUE over RDN.

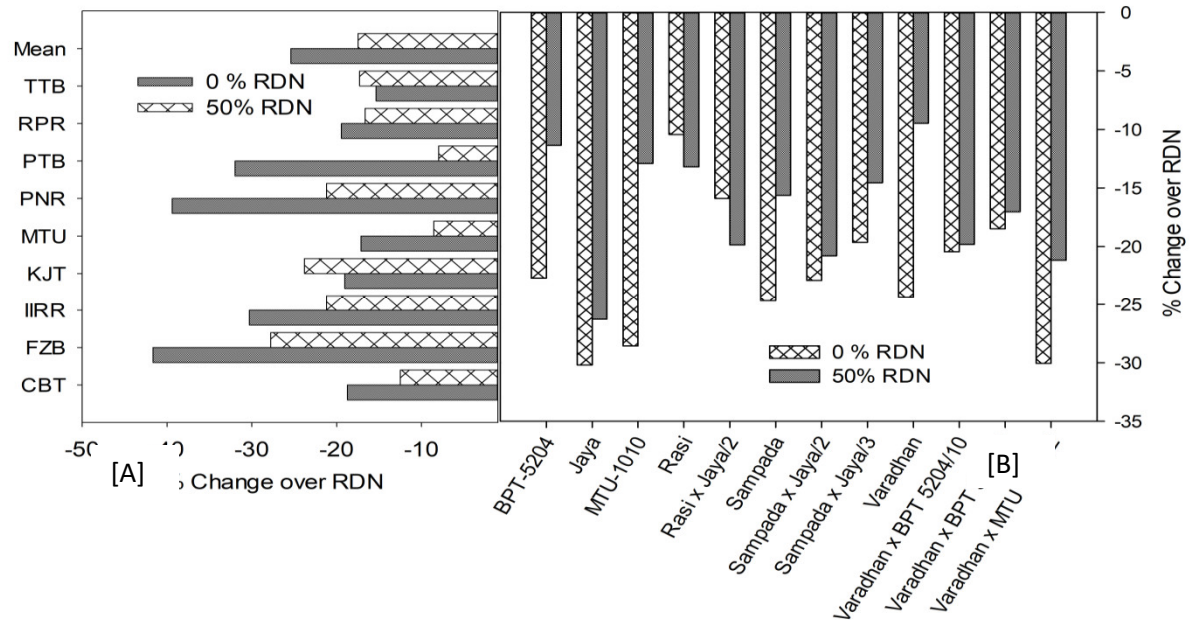


Fig. Influence of nitrogen levels on radiation use efficiency of different rice genotypes. Data was expressed as % change over recommended dose of nitrogen (RDN). [A] Mean of all genotypes [B] Mean of all centres.

Summary & Conclusions

The highest grain yield averaged across the locations was produced by *Varadhan x BPT 5204/10* (413 g m^{-2}) followed by *Sampada x Jaya/3* (408 g m^{-2}) under 0 kg N ha^{-1} where as under 50 kg N ha^{-1} highest mean grain yield was produced by Sampada x Jaya 3 (543 413 g m^{-2}) followed by Sampada x Jaya/2 (523 g m^{-2}) and Varadhan x BPT 5204/10 (509 g m^{-2}). Entries producing higher grain yield under low nitrogen levels can be considered as nitrogen use efficient genotypes . The AMMI biplot analysis was conducted for both 0 and 50% RDBN it revealed that MTU, KJT, PNR, CBT locations are similar and do not exert significant environmental effect. Sampada x Jaya/3, Varadhan x MTU1010/2 and Rasi x Jaya/2 are less affected by environments. The genotypes with low ASV are said to be stable. The rASV was lowest in Sampada, Sampada x Jaya/3 followed by MTU 1010 0 kg N ha^{-1} and under 50 kg N ha^{-1} treatment, the ASV is lowest in Varadhan x BPT 5204/10 followed by MTU and Sampada. The genotypes having low ASV value and can be identified as stable genotypes under low nitrogen levels. Based on yield stability index (rYSI) values Varadhan x BPT 5204/10 and Sampada x Jaya/3 can be identified as stable genotypes under 0 kg N ha^{-1} where as under 50 kg N ha^{-1} Sampada x Jaya/3, Sampada x Jaya/2 followed by Varadhan x BPT 5294/10 can be identified as stable genotypes across the environments.

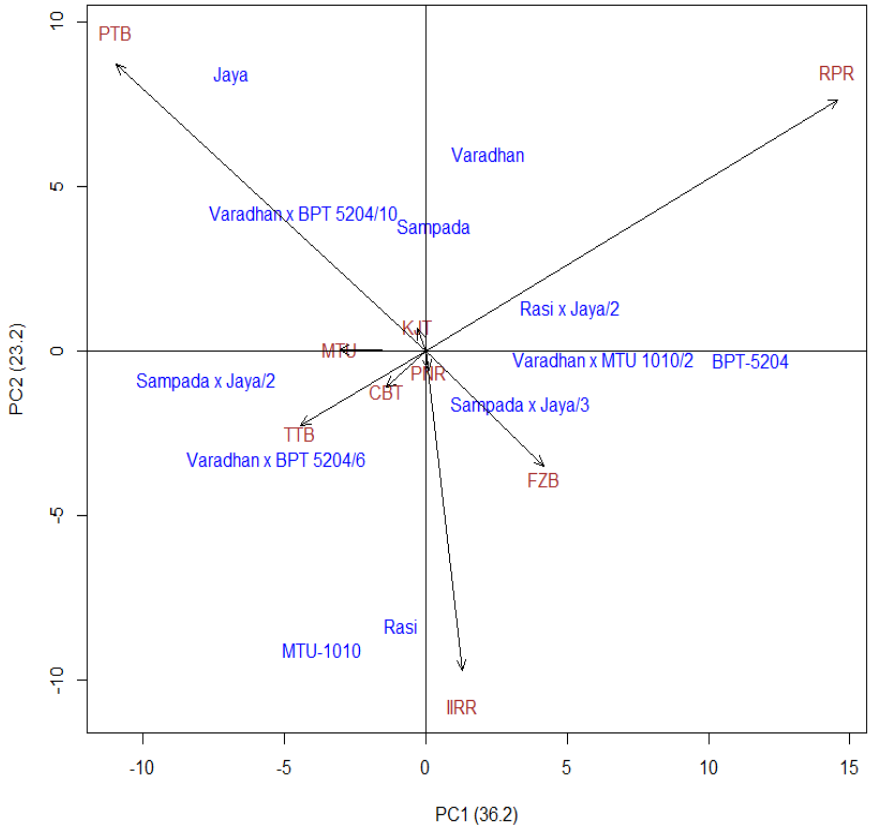


Fig. 7 Ammi Biplot for grain yield (g/m2) recorded under 0 kg N ha^{-1} treatment in 12 rice genotypes and 9 environments using genotype and environment scores

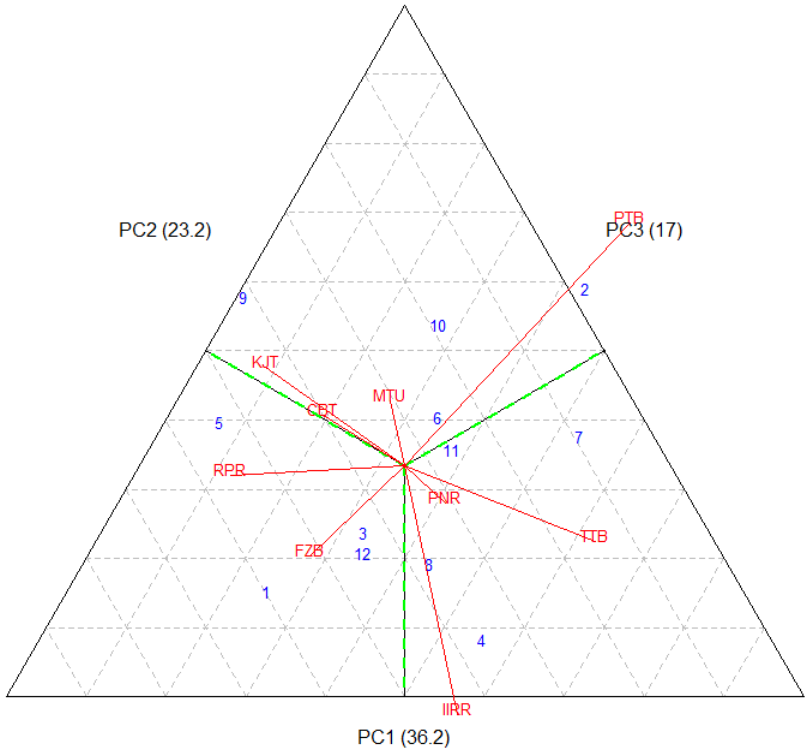


Fig.8 Ammi triplot for grain yield (g/m2) recorded under 0 kg N ha^{-1} treatment in 12 rice genotypes and 9 environments using genotype and environment scores

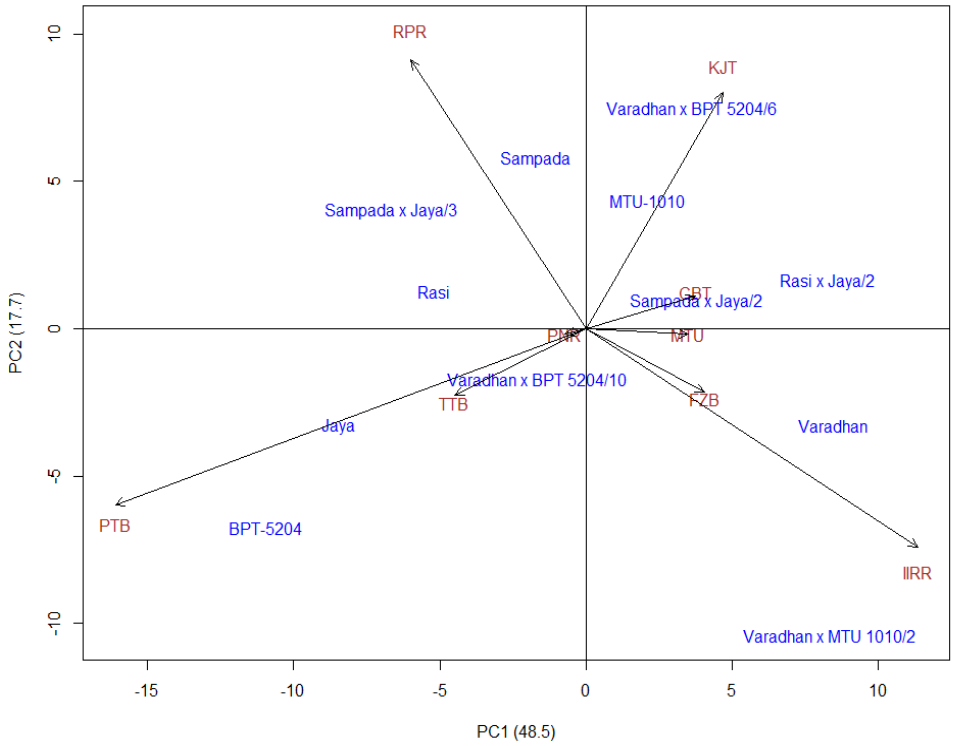


Fig. 9 Ammi Biplot for grain yield (g/m2) recorded under 50 kg N ha^{-1} treatment in 12 rice genotypes and 9 environments using genotype and environment scores

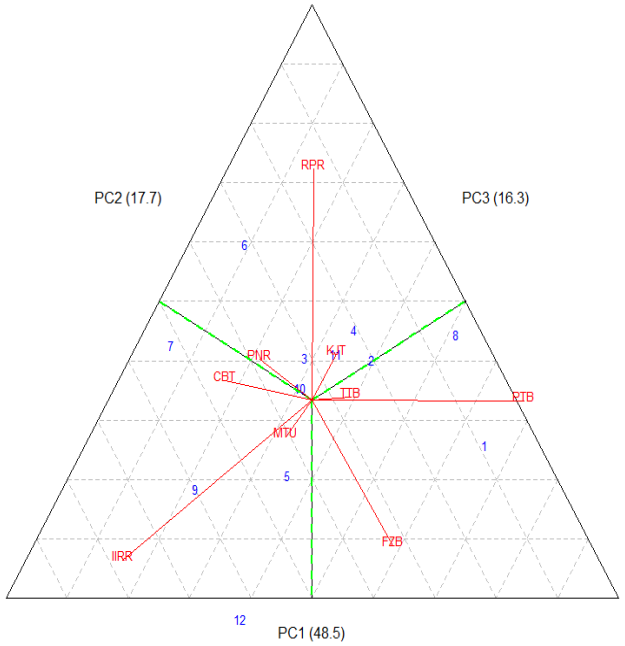


Fig.10 Ammi triplot for grain yield (g/m2) recorded under 50 kg N ha^{-1} treatment in 12 rice genotypes and 9 environments using genotype and environment scores

Table 6.5.1 Radiation and Nitrogen use efficiency Days to flowering at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	89	64	95	105	94	97	82	72	91	88
	2	Jaya	105	70	100	102	98	103	89	81	105	95
	3	MTU-1010	93	40	86	103	81	90	89	82	74	82
	4	Rasi	95	70	99	105	99	110	81	80	105	94
	5	Rasi x Jaya/2	89	36	77	72	77	61	92	78	75	73
	6	Sampada	99	69	95	101	99	104	82	81	106	93
	7	Sampada x Jaya/2	103	68	99	105	99	114	85	80	105	95
	8	Sampada x Jaya/3	100	63	92	72	87	100	85	78	87	85
	9	Varadhan	87	27	76	101	75	73	87	78	73	75
	10	Varadhan x BPT 5204/10	97	68	100	73	94	104	84	72	84	86
	11	Varadhan x BPT 5204/6	93	48	86	74	83	89	82	78	82	79
	12	Varadhan x MTU 1010/2	90	51	85	76	84	97	92	78	83	82
		T1-0 N Mean	**95**	**56**	**91**	**91**	**89**	**95**	**86**	**78**	**89**	**86**
T2 (50 Kg N/ha)	1	BPT-5204	89	67	96	101	94	95	89	72	91	88
	2	Jaya	105	73	102	105	100	104	94	81	105	97
	3	MTU-1010	93	41	88	101	82	87	83	82	74	81
	4	Rasi	95	73	101	106	100	106	85	80	105	95
	5	Rasi x Jaya/2	88	38	79	74	76	59	82	78	75	72
	6	Sampada	98	71	97	105	100	101	94	81	105	95
	7	Sampada x Jaya/2	103	70	101	105	99	114	82	80	105	95
	8	Sampada x Jaya/3	99	65	94	73	94	99	84	78	87	86
	9	Varadhan	87	29	79	100	75	73	89	78	73	76
	10	Varadhan x BPT 5204/10	95	72	102	71	96	102	82	72	83	86
	11	Varadhan x BPT 5204/6	92	52	88	74	87	87	87	78	82	81
	12	Varadhan x MTU 1010/2	90	54	87	72	87	97	85	78	84	82
		T2-50 N Mean	**95**	**59**	**93**	**91**	**91**	**94**	**86**	**78**	**89**	**86**
T3 (100 Kg N/ha)	1	BPT-5204	89	69	97	101	96	94	84	72	91	88
	2	Jaya	102	76	103	103	100	104	82	81	105	95
	3	MTU-1010	93	44	90	102	83	86	89	82	74	82
	4	Rasi	95	76	103	106	101	104	86	80	105	95
	5	Rasi x Jaya/2	87	41	80	73	78	61	96	78	75	74
	6	Sampada	97	73	98	105	98	101	85	81	105	94
	7	Sampada x Jaya/2	101	71	93	106	100	113	89	80	105	95
	8	Sampada x Jaya/3	99	67	94	73	94	98	89	78	87	87
	9	Varadhan	87	32	81	100	77	71	95	78	73	77
	10	Varadhan x BPT 5204/10	95	75	103	71	98	102	82	72	83	87
	11	Varadhan x BPT 5204/6	92	55	90	76	89	87	82	78	82	81
	12	Varadhan x MTU 1010/2	90	57	88	73	87	97	81	78	85	82
		T3-100 N Mean	**94**	**61**	**93**	**91**	**92**	**93**	**87**	**78**	**89**	**86**
		Grand Mean	**94**	**59**	**92**	**91**	**90**	**94**	**86**	**78**	**89**	**86**
		LSD (Treatment)					ns		38**			
		LSD (Location x Treatment)							107.8**			
		LSD (Genotype)							ns			
		LSD (Location x Genotype)							120.8**			
		LSD (Treatment x Genotype)							ns			
		LSD (Location x Treatment x Genotype)							209**			
		CV (Error Treat) (%)							27.35			
		CV (Residual)(%)							28.12			

Table 6.5.2 Radiation and Nitrogen use efficiency Days to maturity at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	127	101	124	132	123	124	130	105	129	122
	2	Jaya	129	105	130	130	127	130	133	111	141	126
	3	MTU-1010	116	98	114	133	109	118	136	100	108	115
	4	Rasi	120	111	128	132	128	145	136	101	143	127
	5	Rasi x Jaya/2	118	92	105	112	106	90	134	92	110	107
	6	Sampada	122	103	124	131	128	131	131	111	142	125
	7	Sampada x Jaya/2	126	105	129	132	129	143	137	111	146	129
	8	Sampada x Jaya/3	131	104	119	101	116	125	130	105	130	118
	9	Varadhan	120	91	104	123	105	101	139	92	107	109
	10	Varadhan x BPT 5204/10	121	107	130	102	121	130	135	106	125	120
	11	Varadhan x BPT 5204/6	125	100	114	104	112	112	137	92	119	113
	12	Varadhan x MTU 1010/2	122	103	113	107	114	122	133	92	116	114
		T1-0 N Mean	**123**	**102**	**120**	**120**	**118**	**123**	**134**	**102**	**126**	**119**
T2 (50 Kg N/ha)	1	BPT-5204	126	103	125	131	124	124	133	105	129	122
	2	Jaya	127	108	131	132	132	130	135	111	142	128
	3	MTU-1010	115	100	116	131	112	118	137	100	109	115
	4	Rasi	118	113	131	133	131	145	139	101	144	128
	5	Rasi x Jaya/2	116	95	107	104	107	90	135	92	111	106
	6	Sampada	120	105	127	132	127	131	135	111	142	126
	7	Sampada x Jaya/2	121	108	130	132	127	143	131	111	147	128
	8	Sampada x Jaya/3	126	107	124	102	122	125	136	105	127	119
	9	Varadhan	118	94	106	131	106	101	137	92	107	110
	10	Varadhan x BPT 5204/10	120	111	131	102	124	130	130	106	125	120
	11	Varadhan x BPT 5204/6	123	102	116	104	115	112	139	92	119	114
	12	Varadhan x MTU 1010/2	120	106	115	102	115	122	137	92	116	114
		T2-50 N Mean	**121**	**104**	**122**	**120**	**120**	**123**	**135**	**102**	**127**	**119**
T3 (100 Kg N/ha)	1	BPT-5204	124	107	127	131	125	124	133	105	130	123
	2	Jaya	125	111	131	133	135	130	139	111	143	129
	3	MTU-1010	115	104	118	130	112	118	139	100	110	116
	4	Rasi	118	117	135	133	130	145	130	101	144	128
	5	Rasi x Jaya/2	115	97	108	102	108	90	135	92	112	107
	6	Sampada	120	108	128	132	127	131	137	111	143	126
	7	Sampada x Jaya/2	121	110	135	133	131	143	114	111	149	127
	8	Sampada x Jaya/3	126	109	126	102	123	125	93	105	127	115
	9	Varadhan	118	96	121	131	107	101	137	92	108	112
	10	Varadhan x BPT 5204/10	120	113	134	102	127	130	100	106	126	118
	11	Varadhan x BPT 5204/6	120	106	118	106	116	112	99	92	120	110
	12	Varadhan x MTU 1010/2	120	108	116	102	118	122	137	92	119	115
		T3-100 N Mean	**120**	**107**	**125**	**120**	**122**	**123**	**124**	**102**	**128**	**119**
		Grand Mean	**121**	**104**	**122**	**120**	**120**	**123**	**131**	**102**	**127**	**119**
		LSD(Treatment)				NS						
		LSD(Location x Treatment)				1.0**						
		LSD (Genotype)				0.77**						
		LSD (Location x Genotype)				2.32**						
		LSD (Treatment x Genotype)				ns						
		LSD (Location x Treatment x Genotype)				4.02**						
		CV (Error Treat) (%)				1.34						
		CV (Residual)(%)				1.6						

Table 6.5.3 Radiation and Nitrogen use efficiency plant height (cm) flowering at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	107.2	78.5	94.8	97.8	122.7	103.0	99.3	103.7	114.3	102.4
	2	Jaya	104.1	79.0	88.0	87.6	124.0	84.0	85.3	87.0	99.7	93.2
	3	MTU-1010	119.2	124.3	91.0	113.7	114.3	105.3	109.3	111.1	128.0	112.9
	4	Rasi	105.0	80.8	89.0	89.1	109.7	92.0	95.3	83.3	101.3	93.9
	5	Rasi x Jaya/2	105.2	71.3	77.0	75.9	80.7	95.3	78.7	85.9	96.7	85.2
	6	Sampada	97.1	76.5	90.7	84.1	114.7	91.7	78.0	87.0	100.0	91.1
	7	Sampada x Jaya/2	104.9	78.9	89.0	108.3	101.3	95.3	80.3	89.7	107.2	95.0
	8	Sampada x Jaya/3	101.1	82.9	98.8	98.9	90.7	94.3	95.0	94.3	104.3	95.6
	9	Varadhan	99.1	74.4	83.0	90.1	78.0	87.0	73.0	81.0	91.2	84.1
	10	Varadhan x BPT 5204/10	91.4	77.5	85.5	84.1	99.7	96.0	91.7	92.7	102.3	91.2
	11	Varadhan x BPT 5204/6	90.1	84.2	93.5	93.4	96.3	95.3	95.7	74.9	108.7	92.5
	12	Varadhan x MTU 1010/2	91.1	78.9	87.7	97.0	89.3	103.3	88.0	97.8	107.7	93.4
		T1-0 N Mean	**101.3**	**82.3**	**89.0**	**93.3**	**101.8**	**95.2**	**89.1**	**90.7**	**105.1**	**94.2**
T2 (50 Kg N/ha)	1	BPT-5204	110.2	84.6	96.7	100.2	130.3	113.3	114.7	108.7	116.2	108.3
	2	Jaya	105.3	85.2	100.8	86.5	133.0	102.7	98.7	87.3	107.7	100.8
	3	MTU-1010	121.2	129.3	97.8	114.9	127.3	113.0	116.7	122.7	121.3	118.2
	4	Rasi	105.0	86.4	98.2	91.2	122.0	104.0	118.7	93.0	109.3	103.1
	5	Rasi x Jaya/2	112.4	76.3	83.8	79.0	91.7	108.3	82.0	95.2	90.8	91.1
	6	Sampada	96.6	81.3	97.7	88.3	124.0	104.0	106.0	93.7	109.7	100.1
	7	Sampada x Jaya/2	105.1	83.9	97.7	109.5	125.7	110.0	102.0	87.0	114.0	103.9
	8	Sampada x Jaya/3	100.8	88.2	98.0	97.6	110.7	112.7	100.7	95.7	108.0	101.4
	9	Varadhan	100.1	79.4	82.0	92.4	90.7	97.7	73.0	82.9	94.2	88.0
	10	Varadhan x BPT 5204/10	96.0	83.1	89.3	82.6	114.3	103.3	100.7	97.5	103.0	96.6
	11	Varadhan x BPT 5204/6	89.3	90.2	92.2	94.9	118.0	105.0	97.3	91.4	111.7	98.9
	12	Varadhan x MTU 1010/2	90.3	84.0	98.8	97.4	104.7	100.7	90.3	98.1	110.0	97.1
		T2-50 N Mean	**102.7**	**87.7**	**94.4**	**94.5**	**116.0**	**106.2**	**100.1**	**96.1**	**108.0**	**100.6**
T3 (100 Kg N/ha)	1	BPT-5204	111.1	88.9	100.3	98.8	135.0	113.7	107.3	123.3	117.7	110.7
	2	Jaya	104.1	89.6	93.2	88.4	140.7	108.0	96.7	94.0	107.7	102.5
	3	MTU-1010	127.1	134.7	105.7	115.1	138.7	116.0	111.3	121.7	131.0	122.4
	4	Rasi	106.0	93.5	104.0	93.4	139.0	105.0	114.3	95.3	105.0	106.2
	5	Rasi x Jaya/2	89.2	79.4	82.5	79.3	99.7	108.0	71.3	82.7	90.0	86.9
	6	Sampada	95.2	86.7	97.7	91.0	131.3	112.7	96.0	98.7	102.7	101.3
	7	Sampada x Jaya/2	104.1	88.6	98.8	109.9	136.7	115.0	97.7	90.7	110.3	105.7
	8	Sampada x Jaya/3	103.4	93.8	102.3	99.8	115.0	124.7	101.3	97.0	107.0	104.9
	9	Varadhan	99.1	84.7	85.5	98.7	111.3	95.3	73.3	88.0	91.3	91.9
	10	Varadhan x BPT 5204/10	96.1	88.5	91.5	83.4	124.3	120.0	101.0	100.0	99.7	100.5
	11	Varadhan x BPT 5204/6	89.1	96.6	100.7	96.0	129.7	107.3	93.7	97.0	113.0	102.6
	12	Varadhan x MTU 1010/2	100.1	96.4	96.5	100.5	117.0	107.0	93.0	98.0	107.0	101.7
		T3-100 N Mean	**102.0**	**93.4**	**96.6**	**96.2**	**126.5**	**111.1**	**96.4**	**98.9**	**106.9**	**103.1**
		Grand Mean	**102.0**	**87.8**	**93.3**	**94.7**	**114.8**	**104.2**	**95.2**	**95.2**	**106.7**	**99.3**
		LSD (Treatment)					1.79**					
		LSD (Location x Treatment)					5.39**					
		LSD (Genotype)					1.91**					
		LSD (Location x Genotype)					5.72**					
		LSD (Treatment x Genotype)					2.51*					
		LSD (Location x Treatment x Genotype)					3.1**					
		CV (Error Treat) (%)					8.5					
		CV (Residual)(%)					4.7					

Table 6.5.4 Radiation and Nitrogen use efficiency total dry matter (g/m2) at panicle initiation at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	629	168	315	**0**	494	135	616	416	0	396
	2	Jaya	346	195	320	**0**	488	90	516	372	0	333
	3	MTU-1010	669	174	339	**0**	486	137	672	259	0	391
	4	Rasi	442	174	344	**0**	343	58	699	166	0	318
	5	Rasi x Jaya/2	454	165	405	**0**	322	98	525	341	0	330
	6	Sampada	648	168	304	**0**	449	115	548	369	0	372
	7	Sampada x Jaya/2	495	203	311	**0**	426	93	714	397	0	377
	8	Sampada x Jaya/3	495	169	330	**0**	472	82	623	429	0	372
	9	Varadhan	466	168	341	**0**	449	110	469	274	0	325
	10	Varadhan x BPT 5204/10	567	181	291	**0**	403	98	819	173	0	362
	11	Varadhan x BPT 5204/6	471	186	336	**0**	515	125	651	282	0	367
	12	Varadhan x MTU 1010/2	470	160	395	**0**	594	102	672	459	0	408
		T1-0 N Mean	**513**	**176**	**336**	**0**	**453**	**104**	**627**	**328**	**0**	**362**
T2 (50 Kg N/ha)	1	BPT-5204	705	172	324	**0**	558	135	805	335	0	433
	2	Jaya	422	194	332	**0**	572	112	826	479	0	420
	3	MTU-1010	745	198	438	**0**	582	137	854	425	0	483
	4	Rasi	518	190	392	**0**	503	88	742	613	0	435
	5	Rasi x Jaya/2	530	173	427	**0**	440	208	483	403	0	381
	6	Sampada	724	186	397	**0**	563	143	1351	325	0	527
	7	Sampada x Jaya/2	572	312	347	**0**	508	152	721	317	0	418
	8	Sampada x Jaya/3	572	173	363	**0**	559	133	639	327	0	395
	9	Varadhan	543	173	379	**0**	516	117	700	417	0	406
	10	Varadhan x BPT 5204/10	643	219	376	**0**	545	170	672	355	0	426
	11	Varadhan x BPT 5204/6	548	203	436	**0**	573	147	630	493	0	433
	12	Varadhan x MTU 1010/2	547	163	344	**0**	706	123	826	611	0	474
		T2-50 N Mean	**589**	**196**	**380**	**0**	**552**	**139**	**771**	**425**	**0**	**436**
T3 (100 Kg N/ha)	1	BPT-5204	574	180	413	**0**	596	163	1631	442	0	571
	2	Jaya	750	241	311	**0**	675	110	1022	367	0	497
	3	MTU-1010	452	239	452	**0**	667	188	1358	431	0	541
	4	Rasi	750	240	404	**0**	620	148	1449	500	0	587
	5	Rasi x Jaya/2	585	160	508	**0**	585	248	861	521	0	496
	6	Sampada	746	216	486	**0**	674	177	770	461	0	504
	7	Sampada x Jaya/2	678	327	358	**0**	616	168	1631	490	0	610
	8	Sampada x Jaya/3	612	166	406	**0**	667	183	1113	441	0	513
	9	Varadhan	560	175	538	**0**	593	165	658	325	0	430
	10	Varadhan x BPT 5204/10	586	242	346	**0**	707	205	1239	449	0	539
	11	Varadhan x BPT 5204/6	531	262	425	**0**	682	165	1470	298	0	548
	12	Varadhan x MTU 1010/2	602	171	418	**0**	771	198	1085	325	0	510
		T3-100 N Mean	**619**	**218**	**422**	**0**	**655**	**177**	**1191**	**421**	**0**	**529**
		Grand Mean	**574**	**197**	**379**	**0**	**553**	**140**	**863**	**391**	**0**	**442**
		LSD (Treatment)					33*					
		LSD (Location x Treatment)					133.1**					
		LSD (Genotype)					ns					
		LSD (Location x Genotype)					115**					
		LSD (Treatment x Genotype)					ns					
		LSD (Location x Treatment x Genotype)					200**					
		CV (Error Treat) (%)					26.2					
		CV (Residual)(%)					27.3					

Table 6.5.5 Radiation and Nitrogen use efficiency total dry matter (g/m2) at flowering at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	752	363	762	1941	664	597	973	486	0	726
	2	Jaya	570	399	1066	1843	586	540	819	438	0	696
	3	MTU-1010	618	316	643	1988	542	420	877	333	0	638
	4	Rasi	570	352	930	2033	438	773	1015	272	0	709
	5	Rasi x Jaya/2	547	404	784	1943	450	513	644	410	0	633
	6	Sampada	771	336	972	2037	519	917	867	451	0	763
	7	Sampada x Jaya/2	639	516	1208	1989	552	797	1194	625	0	836
	8	Sampada x Jaya/3	691	379	1112	1978	536	763	826	522	0	756
	9	Varadhan	426	385	599	2169	567	443	651	397	0	626
	10	Varadhan x BPT 5204/10	694	496	1075	2020	534	795	1042	260	0	768
	11	Varadhan x BPT 5204/6	646	522	810	1922	646	770	966	348	0	737
	12	Varadhan x MTU 1010/2	546	386	614	2090	718	465	1193	588	0	733
		T1-0 N Mean	**622**	**405**	**881**	**1996**	**563**	**649**	**922**	**428**	**0**	**718**
T2 (50 Kg N/ha)	1	BPT-5204	819	443	1150	1889	700	790	1288	429	0	834
	2	Jaya	638	495	1075	2084	666	930	1443	575	0	878
	3	MTU-1010	686	398	834	2076	668	811	1205	510	0	799
	4	Rasi	638	404	1107	1997	663	860	1193	753	0	846
	5	Rasi x Jaya/2	615	501	695	2186	618	738	896	480	0	748
	6	Sampada	839	399	1001	1981	726	1190	1856	386	0	931
	7	Sampada x Jaya/2	707	568	765	2110	655	913	1001	403	0	791
	8	Sampada x Jaya/3	759	415	855	1952	641	968	1029	436	0	784
	9	Varadhan	494	474	817	2092	622	663	868	532	0	729
	10	Varadhan x BPT 5204/10	761	553	1465	2110	666	970	1520	424	0	941
	11	Varadhan x BPT 5204/6	714	535	634	2012	737	968	735	550	0	765
	12	Varadhan x MTU 1010/2	614	472	937	2155	835	822	1267	691	0	866
		T2-50 N Mean	**690**	**471**	**945**	**2054**	**683**	**885**	**1192**	**514**	**0**	**826**
T3 (100 Kg N/ha)	1	BPT-5204	520	472	1056	2018	894	1010	1372	522	0	874
	2	Jaya	865	492	1675	1980	778	1208	2191	417	0	1067
	3	MTU-1010	664	453	1132	2121	746	1002	1638	503	0	918
	4	Rasi	713	463	1312	2063	746	1095	1851	651	0	988
	5	Rasi x Jaya/2	640	548	816	2016	667	772	1337	594	0	821
	6	Sampada	846	493	807	2211	793	1315	1897	534	0	988
	7	Sampada x Jaya/2	788	666	1130	1993	813	1523	2286	559	0	1084
	8	Sampada x Jaya/3	733	461	1342	1299	771	1130	1561	507	0	867
	9	Varadhan	641	512	725	2212	681	763	1358	382	0	808
	10	Varadhan x BPT 5204/10	741	607	1444	2121	839	1342	1733	531	0	1040
	11	Varadhan x BPT 5204/6	688	640	807	2013	828	1054	1939	400	0	930
	12	Varadhan x MTU 1010/2	785	515	1094	1571	890	900	1603	425	0	865
		T3-100 N Mean	**719**	**527**	**1112**	**1968**	**787**	**1093**	**1730**	**502**	**0**	**938**
		Grand Mean	**677**	**468**	**979**	**2006**	**678**	**876**	**1281**	**481**	**0**	**827**
		LSD (Treatment)				48.4*						
		LSD (Location x Treatment)				145.6**						
		LSD (Genotype)				66.59**						
		LSD (Location x Genotype)				199.9**						
		LSD (Treatment x Genotype)				87.7*						
		LSD (Location x Treatment x Genotype)				346**						
		CV (Error Treat) (%)				27.4						
		CV (Residual)(%)				19.84						

Table 6.5.6 Radiation and Nitrogen use efficiency total dry matter at maturity at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	1381	747	884	43	851	1065	1428	902	698	889
	2	Jaya	916	695	892	41	899	1020	1345	810	597	802
	3	MTU-1010	1287	799	1035	44	909	970	1323	592	714	853
	4	Rasi	1012	758	1215	45	805	1128	1355	438	630	821
	5	Rasi x Jaya/2	1001	681	633	43	789	882	1289	750	386	717
	6	Sampada	1419	754	859	45	801	1037	1408	821	608	861
	7	Sampada x Jaya/2	1134	1073	1090	44	804	965	1676	1021	557	929
	8	Sampada x Jaya/3	1186	865	952	44	844	997	1458	952	479	864
	9	Varadhan	892	657	595	48	793	672	1496	671	397	691
	10	Varadhan x BPT 5204/10	1261	747	907	45	853	1035	1463	433	456	800
	11	Varadhan x BPT 5204/6	1118	931	762	43	848	932	1505	630	614	820
	12	Varadhan x MTU 1010/2	1016	801	908	46	821	883	1582	1047	577	853
		T1-0 N Mean	**1135**	**792**	**894**	**44**	**835**	**965**	**1444**	**756**	**559**	**825**
T2 (50 Kg N/ha)	1	BPT-5204	1525	1090	1598	42	939	1283	1545	764	1050	1093
	2	Jaya	1060	1039	1575	46	992	1352	1921	1054	747	1088
	3	MTU-1010	1431	1153	1583	46	955	1303	1589	934	775	1086
	4	Rasi	1156	878	1488	44	991	1383	1652	1366	649	1068
	5	Rasi x Jaya/2	1145	1035	1337	49	888	1100	1339	884	375	906
	6	Sampada	1563	1072	1553	44	991	1447	2083	711	500	1107
	7	Sampada x Jaya/2	1278	1297	1626	47	927	1468	1514	720	840	1080
	8	Sampada x Jaya/3	1330	1223	1421	43	895	1237	1410	763	769	1010
	9	Varadhan	1036	1017	1561	46	933	922	1435	949	446	927
	10	Varadhan x BPT 5204/10	1404	1096	1492	47	949	1357	1885	779	761	1086
	11	Varadhan x BPT 5204/6	1262	1192	1303	45	930	1083	1225	1042	697	975
	12	Varadhan x MTU 1010/2	1160	1276	1576	48	893	1157	1652	1301	782	1094
		T2-50 N Mean	**1279**	**1114**	**1510**	**46**	**940**	**1258**	**1604**	**939**	**699**	**1043**
T3 (100 Kg N/ha)	1	BPT-5204	1095	1492	1672	45	1009	1640	1967	964	969	1206
	2	Jaya	1615	1252	1709	44	1117	1665	1974	784	573	1192
	3	MTU-1010	1117	1368	1831	47	1030	1660	1841	934	586	1157
	4	Rasi	1463	1250	1690	46	1036	1633	1995	1151	711	1219
	5	Rasi x Jaya/2	1225	1362	1401	45	919	1328	1744	1115	399	1060
	6	Sampada	1592	1249	1825	49	1085	1843	2009	995	637	1254
	7	Sampada x Jaya/2	1466	1583	1767	44	1069	1777	1984	1049	1151	1321
	8	Sampada x Jaya/3	1345	1526	1736	29	977	1626	1820	949	836	1205
	9	Varadhan	1202	1162	1490	49	1039	1108	1778	707	439	997
	10	Varadhan x BPT 5204/10	1326	1450	1368	47	1032	1822	2030	980	592	1183
	11	Varadhan x BPT 5204/6	1219	1479	1727	45	1073	1357	1848	698	741	1132
	12	Varadhan x MTU 1010/2	1388	1605	1773	35	968	1498	1946	750	678	1182
		T3-100 N Mean	**1338**	**1398**	**1666**	**44**	**1029**	**1580**	**1911**	**923**	**693**	**1176**
		Grand Mean	**1251**	**1101**	**1357**	**45**	**935**	**1268**	**1653**	**872**	**650**	**1015**
		LSD (Treatment)				43.9**						
		LSD (Location x Treatment)				131.7**						
		LSD (Genotype)				57.96**						
		LSD (Location x Genotype)				173**						
		LSD (Treatment x Genotype)				ns						
		LSD (Location x Treatment x Genotype)				301**						
		CV (Error Treat) (%)				20.26						
		CV (Residual)(%)				14.6						

Table 6.5.7 Radiation and Nitrogen use efficiency flag leaf area at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	45.8	20.7	33.3	19.5	25.4	21.0	30.2	21.4	11.0	25.4
	2	Jaya	24.8	14.2	26.3	20.7	35.1	26.2	31.1	14.4	10.3	22.6
	3	MTU-1010	34.6	20.3	31.0	17.8	26.4	17.0	30.2	18.6	12.2	23.1
	4	Rasi	34.4	21.1	29.5	20.0	28.6	23.7	31.0	16.1	11.4	24.0
	5	Rasi x Jaya/2	21.1	17.6	21.2	20.3	24.9	23.7	20.9	25.5	12.9	20.9
	6	Sampada	31.3	20.2	23.5	18.7	26.8	23.1	26.6	12.8	13.3	21.8
	7	Sampada x Jaya/2	31.6	26.4	26.5	20.0	27.1	27.6	26.3	15.4	10.3	23.4
	8	Sampada x Jaya/3	33.1	21.2	26.8	22.6	25.9	25.6	27.3	22.5	11.4	24.0
	9	Varadhan	29.7	12.9	26.4	23.0	23.0	19.6	17.9	26.2	13.7	21.4
	10	Varadhan x BPT 5204/10	25.2	16.6	30.9	17.2	23.5	26.3	22.6	22.5	10.6	21.7
	11	Varadhan x BPT 5204/6	22.5	19.7	22.7	16.8	21.5	27.3	21.4	13.9	12.2	19.8
	12	Varadhan x MTU 1010/2	29.0	18.5	25.6	19.1	25.2	22.4	21.2	19.5	10.6	21.2
		T1-0 N Mean	**30.2**	**19.1**	**27.0**	**19.6**	**26.1**	**23.6**	**25.6**	**19.1**	**11.7**	**22.4**
T2 (50 Kg N/ha)	1	BPT-5204	41.9	26.9	33.7	20.1	30.0	27.2	36.2	34.5	14.8	29.5
	2	Jaya	23.2	21.5	30.0	22.7	39.5	35.2	43.7	31.0	11.2	28.7
	3	MTU-1010	31.0	27.4	32.0	18.9	35.2	18.5	35.8	32.4	13.5	27.2
	4	Rasi	31.5	25.8	26.2	19.6	38.4	30.3	35.5	31.0	11.8	27.8
	5	Rasi x Jaya/2	19.5	25.8	24.8	19.6	29.0	28.8	27.4	26.3	17.1	24.3
	6	Sampada	28.7	26.1	28.2	20.3	36.3	29.0	50.3	26.5	14.8	28.9
	7	Sampada x Jaya/2	30.9	35.5	27.3	20.1	35.2	33.2	39.5	26.8	11.4	28.9
	8	Sampada x Jaya/3	33.9	31.5	30.5	22.9	35.9	30.4	34.9	26.9	15.2	29.1
	9	Varadhan	28.0	18.1	28.0	23.6	29.2	24.4	25.4	29.5	16.0	24.7
	10	Varadhan x BPT 5204/10	25.5	21.5	32.2	17.3	31.2	31.4	30.6	24.4	10.8	25.0
	11	Varadhan x BPT 5204/6	21.7	23.6	29.3	16.9	27.8	29.3	29.1	24.9	15.6	24.2
	12	Varadhan x MTU 1010/2	26.3	27.1	31.5	17.8	31.7	27.5	28.7	31.5	13.1	26.1
		T2-50 N Mean	**28.5**	**25.9**	**29.5**	**20.0**	**33.3**	**28.8**	**34.7**	**28.8**	**13.8**	**27.0**
T3 (100 Kg N/ha)	1	BPT-5204	46.9	33.2	41.6	20.1	36.7	27.6	35.9	38.3	13.8	32.7
	2	Jaya	35.7	30.0	39.0	23.5	47.6	34.6	46.4	33.2	12.0	33.5
	3	MTU-1010	46.8	36.6	38.7	22.0	47.9	25.5	28.1	24.3	11.2	31.2
	4	Rasi	35.9	34.0	56.3	24.6	44.2	32.0	43.9	29.6	9.3	34.4
	5	Rasi x Jaya/2	30.2	39.1	35.0	21.0	36.8	33.2	28.8	37.8	18.6	31.2
	6	Sampada	42.6	33.8	38.5	22.4	47.3	40.6	46.7	34.8	9.9	35.2
	7	Sampada x Jaya/2	43.1	50.3	32.1	21.7	40.9	36.6	42.1	25.8	9.0	33.5
	8	Sampada x Jaya/3	40.7	47.1	33.7	27.5	48.0	33.0	35.7	37.0	12.9	35.1
	9	Varadhan	32.2	26.8	34.1	25.6	34.4	25.7	30.7	36.2	17.1	29.2
	10	Varadhan x BPT 5204/10	35.6	29.7	39.9	17.5	38.1	46.8	28.9	25.5	12.2	30.5
	11	Varadhan x BPT 5204/6	30.5	30.3	25.8	22.8	33.3	34.8	26.4	25.9	13.7	27.1
	12	Varadhan x MTU 1010/2	39.3	35.4	28.1	18.0	41.1	35.7	30.5	37.4	13.6	31.0
		T3-100 N Mean	**38.3**	**35.5**	**36.9**	**22.2**	**41.4**	**33.8**	**35.3**	**32.2**	**12.8**	**32.0**
		Grand Mean	**32.3**	**26.8**	**31.1**	**20.6**	**33.6**	**28.7**	**31.9**	**26.7**	**12.7**	**27.2**
		LSD (Treatment)						1.51**				
		LSD (Location x Treatment)						4.55**				
		LSD (Genotype)						1.18*				
		LSD (Location x Genotype)						4.69**				
		LSD (Treatment x Genotype)						ns				
		LSD (Location x Treatment x Genotype)						8.12**				
		CV (Error Treat) (%)						26.12				
		CV (Residual) (%)						14.16				

Table 6.5.8 Radiation and Nitrogen use efficiency Leaf Area Index at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	5.30	0.00	1.98	0.00	3.57	2.50	4.00	1.95	0.00	3.22
	2	Jaya	4.20	0.00	3.92	0.00	3.55	3.76	3.00	3.48	0.00	3.65
	3	MTU-1010	4.70	0.00	2.01	0.00	3.87	2.55	3.00	4.55	0.00	3.45
	4	Rasi	4.70	0.00	2.71	0.00	3.67	2.78	3.33	7.10	0.00	4.05
	5	Rasi x Jaya/2	4.50	0.00	2.85	0.00	3.54	1.81	3.25	2.49	0.00	3.07
	6	Sampada	4.30	0.00	3.49	0.00	4.14	4.17	3.67	5.51	0.00	4.21
	7	Sampada x Jaya/2	4.20	0.00	4.03	0.00	4.08	4.37	4.00	2.37	0.00	3.84
	8	Sampada x Jaya/3	4.80	0.00	3.32	0.00	4.11	3.48	3.67	2.14	0.00	3.59
	9	Varadhan	5.10	0.00	1.86	0.00	3.61	1.73	3.75	2.42	0.00	3.08
	10	Varadhan x BPT 5204/10	4.50	0.00	3.30	0.00	3.75	4.17	3.92	3.13	0.00	3.79
	11	Varadhan x BPT 5204/6	4.90	0.00	2.61	0.00	3.46	2.54	3.33	2.86	0.00	3.28
	12	Varadhan x MTU 1010/2	4.30	0.00	2.43	0.00	3.64	3.01	3.25	2.75	0.00	3.23
		T1-0 N Mean	**4.63**	**0.00**	**2.87**	**0.00**	**3.75**	**3.07**	**3.51**	**3.39**	**0.00**	**3.54**
T2 (50 Kg N/ha)	1	BPT-5204	5.60	0.00	4.81	0.00	3.94	4.51	3.00	6.19	0.00	4.68
	2	Jaya	4.50	0.00	3.36	0.00	3.95	5.41	2.92	3.45	0.00	3.93
	3	MTU-1010	5.90	0.00	3.78	0.00	4.55	3.55	3.58	5.31	0.00	4.45
	4	Rasi	5.10	0.00	3.99	0.00	4.40	4.82	3.25	5.37	0.00	4.49
	5	Rasi x Jaya/2	4.80	0.00	2.31	0.00	3.82	3.44	2.75	2.41	0.00	3.25
	6	Sampada	4.60	0.00	3.83	0.00	4.40	5.49	4.08	7.03	0.00	4.91
	7	Sampada x Jaya/2	4.50	0.00	2.80	0.00	4.24	7.14	3.17	3.38	0.00	4.21
	8	Sampada x Jaya/3	5.20	0.00	3.51	0.00	4.73	5.93	2.75	1.94	0.00	4.01
	9	Varadhan	5.40	0.00	3.06	0.00	3.81	2.39	2.75	2.35	0.00	3.29
	10	Varadhan x BPT 5204/10	4.80	0.00	6.14	0.00	4.23	4.66	3.08	5.17	0.00	4.68
	11	Varadhan x BPT 5204/6	5.30	0.00	2.29	0.00	4.18	5.69	2.58	7.25	0.00	4.55
	12	Varadhan x MTU 1010/2	5.90	0.00	3.42	0.00	3.99	3.87	3.25	3.46	0.00	3.98
		T2-50 N Mean	**5.13**	**0.00**	**3.61**	**0.00**	**4.19**	**4.74**	**3.10**	**4.44**	**0.00**	**4.20**
T3 (100 Kg N/ha)	1	BPT-5204	6.20	0.00	5.00	0.00	4.49	4.35	3.08	3.47	0.00	4.43
	2	Jaya	5.10	0.00	8.64	0.00	4.22	6.50	3.58	3.14	0.00	5.20
	3	MTU-1010	6.50	0.00	5.18	0.00	4.94	4.34	3.17	5.47	0.00	4.93
	4	Rasi	5.60	0.00	3.93	0.00	4.70	5.13	3.25	3.37	0.00	4.33
	5	Rasi x Jaya/2	5.40	0.00	3.80	0.00	4.37	4.99	3.17	2.47	0.00	4.03
	6	Sampada	5.20	0.00	4.30	0.00	4.62	6.75	3.50	4.46	0.00	4.80
	7	Sampada x Jaya/2	5.10	0.00	4.91	0.00	4.56	6.59	2.83	4.67	0.00	4.78
	8	Sampada x Jaya/3	5.70	0.00	5.35	0.00	5.11	6.76	2.58	5.80	0.00	5.22
	9	Varadhan	5.90	0.00	3.28	0.00	4.48	2.79	3.58	4.33	0.00	4.06
	10	Varadhan x BPT 5204/10	5.40	0.00	6.83	0.00	4.49	6.92	2.75	5.12	0.00	5.25
	11	Varadhan x BPT 5204/6	5.80	0.00	3.35	0.00	4.79	6.67	3.08	6.67	0.00	5.06
	12	Varadhan x MTU 1010/2	6.50	0.00	4.24	0.00	4.97	4.50	3.00	1.88	0.00	4.18
		T3-100 N Mean	**5.70**	**0.00**	**4.90**	**0.00**	**4.64**	**5.53**	**3.13**	**4.24**	**0.00**	**4.69**
		Grand Mean	**5.15**	**0.00**	**3.79**	**0.00**	**4.19**	**4.45**	**3.25**	**4.02**	**0.00**	**4.14**
		LSD (Treatment)						0.06*				
		LSD (Location x Treatment)						0.196**				
		LSD (Genotype)						ns				
		LSD (Location x Genotype)						0.441**				
		LSD (Treatment x Genotype)						ns				
		LSD (Location x Treatment x Genotype)						0.76**				
		CV (Error Treat) (%)						11.3				
		CV (Residual) (%)						13.12				

Table 6.5.9 Radiation and Nitrogen use efficiency shoot weight (g/m2) maturity at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	1143	0	490	1697	414	632	973	180	539	758
	2	Jaya	867	0	592	1643	487	600	1148	194	600	766
	3	MTU-1010	1292	0	651	1759	451	648	1071	387	592	856
	4	Rasi	1086	0	646	1446	428	666	1029	392	555	781
	5	Rasi x Jaya/2	1054	0	370	1675	427	528	1155	290	270	721
	6	Sampada	1233	0	501	1643	425	638	1204	268	594	813
	7	Sampada x Jaya/2	1133	0	706	1584	439	594	875	267	728	791
	8	Sampada x Jaya/3	1177	0	586	1962	438	577	875	197	698	814
	9	Varadhan	1123	0	334	1716	374	382	1232	233	418	726
	10	Varadhan x BPT 5204/10	1185	0	618	1591	481	618	973	183	647	787
	11	Varadhan x BPT 5204/6	1176	0	437	1596	438	528	896	232	744	756
	12	Varadhan x MTU 1010/2	1171	0	500	1707	425	516	1085	359	468	779
		T1-0 N Mean	**1137**	**0**	**536**	**1668**	**435**	**577**	**1043**	**265**	**571**	**779**
T2 (50 Kg N/ha)	1	BPT-5204	1411	0	766	1706	453	747	812	294	642	854
	2	Jaya	1041	0	670	1539	493	789	868	239	670	789
	3	MTU-1010	1327	0	786	1684	462	876	1022	291	1058	938
	4	Rasi	1113	0	638	1497	527	799	847	274	680	797
	5	Rasi x Jaya/2	1103	0	600	1585	415	673	1232	226	540	797
	6	Sampada	1442	0	665	1687	477	797	959	195	791	877
	7	Sampada x Jaya/2	1213	0	684	1620	535	873	1204	363	788	910
	8	Sampada x Jaya/3	1258	0	729	1831	429	687	1099	302	672	876
	9	Varadhan	1009	0	614	1672	487	576	1330	300	710	837
	10	Varadhan x BPT 5204/10	1314	0	681	1512	529	831	1120	174	713	859
	11	Varadhan x BPT 5204/6	1201	0	527	1618	470	622	1162	261	827	836
	12	Varadhan x MTU 1010/2	1114	0	606	1837	470	616	1274	326	812	882
		T2-50 N Mean	**1212**	**0**	**664**	**1649**	**479**	**740**	**1077**	**270**	**742**	**854**
T3 (100 Kg N/ha)	1	BPT-5204	1056	0	855	1720	527	890	1099	242	614	875
	2	Jaya	1484	0	812	1623	526	896	1127	218	727	927
	3	MTU-1010	1086	0	942	1614	464	1115	987	339	934	935
	4	Rasi	1354	0	757	1521	545	944	1050	234	724	891
	5	Rasi x Jaya/2	1167	0	566	1714	441	858	1225	316	523	851
	6	Sampada	1465	0	942	1648	508	1101	1218	307	789	997
	7	Sampada x Jaya/2	1363	0	808	1662	564	977	1134	642	779	991
	8	Sampada x Jaya/3	1266	0	723	1875	416	936	1008	504	655	923
	9	Varadhan	1148	0	606	1699	496	657	1064	254	716	830
	10	Varadhan x BPT 5204/10	1253	0	648	1501	504	1234	1218	459	712	941
	11	Varadhan x BPT 5204/6	1165	0	646	1552	552	735	1050	350	911	870
	12	Varadhan x MTU 1010/2	1304	0	722	1698	470	789	973	251	547	844
		T3-100 N Mean	**1259**	**0**	**752**	**1652**	**501**	**928**	**1096**	**343**	**719**	**906**
		Grand Mean	**1203**	**0**	**651**	**1657**	**472**	**748**	**1072**	**293**	**677**	**847**
		LSD (Treatment)						16.8**				
		LSD (Location x Treatment)						50.53**				
		LSD (Genotype)						ns				
		LSD (Location x Genotype)						120**				
		LSD (Treatment x Genotype)						ns				
		LSD (Location x Treatment x Genotype)						208**				
		CV (Error Treat) (%)						10.477				
		CV (Residual)(%)						13.11				

Table 6.5.10 Radiation and Nitrogen use efficiency panicle number/m2 at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	239	128	317	0	341	167	231	857	175	273
	2	Jaya	169	226	343	0	330	300	301	850	186	301
	3	MTU-1010	239	211	330	0	352	217	280	615	203	272
	4	Rasi	239	231	357	0	363	283	252	778	218	302
	5	Rasi x Jaya/2	310	188	303	0	363	200	287	605	145	267
	6	Sampada	145	194	360	0	363	283	301	948	197	310
	7	Sampada x Jaya/2	310	223	390	0	352	283	210	1337	234	371
	8	Sampada x Jaya/3	287	166	330	0	352	217	154	665	244	268
	9	Varadhan	334	187	320	0	352	233	364	739	146	297
	10	Varadhan x BPT 5204/10	299	210	343	0	330	167	315	840	204	301
	11	Varadhan x BPT 5204/6	284	214	330	0	374	250	266	680	223	291
	12	Varadhan x MTU 1010/2	310	179	327	0	385	217	273	775	197	296
		T1-0 N Mean	**264**	**197**	**338**	**0**	**355**	**235**	**270**	**807**	**198**	**296**
T2 (50 Kg N/ha)	1	BPT-5204	304	169	380	0	374	267	301	1064	243	345
	2	Jaya	233	283	440	0	407	333	238	1074	215	358
	3	MTU-1010	304	265	403	0	396	267	322	859	225	338
	4	Rasi	303	269	410	0	396	350	203	931	243	345
	5	Rasi x Jaya/2	374	213	437	0	407	317	413	948	179	365
	6	Sampada	209	217	463	0	418	317	266	1038	228	351
	7	Sampada x Jaya/2	374	243	457	0	407	367	357	1343	257	423
	8	Sampada x Jaya/3	351	191	353	0	396	317	343	925	295	352
	9	Varadhan	398	232	433	0	385	267	406	650	159	326
	10	Varadhan x BPT 5204/10	363	237	457	0	407	250	392	943	230	364
	11	Varadhan x BPT 5204/6	348	265	420	0	407	233	287	870	247	342
	12	Varadhan x MTU 1010/2	374	234	393	0	418	233	392	1029	253	370
		T2-50 N Mean	**328**	**235**	**421**	**0**	**402**	**293**	**327**	**973**	**231**	**356**
T3 (100 Kg N/ha)	1	BPT-5204	235	201	340	0	418	300	231	1010	147	320
	2	Jaya	326	340	460	0	418	367	448	1071	175	401
	3	MTU-1010	323	325	380	0	473	283	245	612	202	316
	4	Rasi	377	345	443	0	418	400	252	1700	207	460
	5	Rasi x Jaya/2	423	313	447	0	440	300	350	1179	130	398
	6	Sampada	262	289	460	0	429	400	406	1710	204	462
	7	Sampada x Jaya/2	372	353	467	0	440	417	364	1378	161	439
	8	Sampada x Jaya/3	396	261	383	0	418	317	399	1162	157	388
	9	Varadhan	328	290	540	0	418	367	371	484	136	326
	10	Varadhan x BPT 5204/10	399	342	390	0	429	417	427	1134	139	409
	11	Varadhan x BPT 5204/6	386	342	500	0	451	383	364	1238	151	424
	12	Varadhan x MTU 1010/2	395	312	480	0	429	400	336	869	146	374
		T3-100 N Mean	**352**	**309**	**441**	**0**	**432**	**363**	**349**	**1129**	**163**	**393**
		Grand Mean	**315**	**247**	**400**	**0**	**396**	**297**	**315**	**970**	**197**	**348**
		LSD (Treatment)						33.6**				
		LSD (Location x Treatment)						100.9**				
		LSD (Genotype)						ns				
		LSD (Location x Genotype)						114**				
		LSD (Treatment x Genotype)						ns				
		LSD (Location x Treatment x Genotype)						197**				
		CV (Error Treat) (%)						25.18				
		CV (Residual) (%)						26.98				

Table 6.5.11 Radiation and Nitrogen use efficiency grain number/panicle at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	126	126	80	0	105	100	118	104	148	101
	2	Jaya	133	74	86	0	121	171	144	102	173	112
	3	MTU-1010	142	69	77	0	119	104	113	87	144	95
	4	Rasi	154	94	147	0	121	167	124	86	160	117
	5	Rasi x Jaya/2	108	85	61	0	103	100	66	96	106	80
	6	Sampada	150	103	103	0	107	132	113	99	169	108
	7	Sampada x Jaya/2	195	83	101	0	110	130	159	107	129	113
	8	Sampada x Jaya/3	119	108	68	0	101	99	117	69	155	93
	9	Varadhan	103	72	56	0	105	117	79	92	97	80
	10	Varadhan x BPT 5204/10	165	108	98	0	108	174	136	129	161	120
	11	Varadhan x BPT 5204/6	163	83	65	0	109	117	115	92	152	100
	12	Varadhan x MTU 1010/2	135	96	82	0	95	160	90	115	148	102
		T1-0 N Mean	**141**	**92**	**85**	**0**	**109**	**131**	**114**	**98**	**145**	**102**
T2 (50 Kg N/ha)	1	BPT-5204	140	153	72	0	114	134	118	121	188	116
	2	Jaya	148	96	113	0	123	218	165	105	217	132
	3	MTU-1010	158	91	76	0	121	117	54	87	148	95
	4	Rasi	170	113	126	0	122	209	191	120	173	136
	5	Rasi x Jaya/2	120	104	71	0	103	140	80	82	113	90
	6	Sampada	167	120	108	0	110	193	158	103	185	127
	7	Sampada x Jaya/2	217	104	113	0	119	153	119	121	130	120
	8	Sampada x Jaya/3	132	119	60	0	105	173	111	114	168	109
	9	Varadhan	115	95	93	0	114	128	60	88	108	89
	10	Varadhan x BPT 5204/10	176	130	114	0	116	219	149	128	191	136
	11	Varadhan x BPT 5204/6	181	103	65	0	114	152	78	98	198	110
	12	Varadhan x MTU 1010/2	150	113	89	0	107	197	66	104	172	111
		T2-50 N Mean	**156**	**112**	**92**	**0**	**114**	**169**	**113**	**106**	**166**	**114**
T3 (100 Kg N/ha)	1	BPT-5204	150	182	78	0	114	161	82	102	189	118
	2	Jaya	159	108	108	0	130	238	103	90	165	122
	3	MTU-1010	169	103	91	0	125	151	88	139	130	111
	4	Rasi	183	128	126	0	131	242	101	119	206	137
	5	Rasi x Jaya/2	129	115	81	0	107	196	61	86	147	102
	6	Sampada	179	146	110	0	113	316	94	86	138	131
	7	Sampada x Jaya/2	232	118	114	0	120	182	173	109	160	134
	8	Sampada x Jaya/3	141	131	86	0	105	196	94	104	131	110
	9	Varadhan	123	109	74	0	112	137	71	95	121	93
	10	Varadhan x BPT 5204/10	188	145	120	0	118	243	160	99	177	139
	11	Varadhan x BPT 5204/6	194	119	80	0	123	175	93	132	151	119
	12	Varadhan x MTU 1010/2	161	124	86	0	107	215	54	109	140	111
		T3-100 N Mean	**167**	**127**	**96**	**0**	**117**	**204**	**98**	**106**	**154**	**119**
		Grand Mean	**155**	**110**	**91**	**0**	**113**	**168**	**108**	**103**	**155**	**112**
		LSD (Treatment)					3.02*					
		LSD (Location x Treatment)					12.15**					
		LSD (Genotype)					8.9**					
		LSD (Location x Genotype)					26.6**					
		LSD (Treatment x Genotype)					ns					
		LSD (Location x Treatment x Genotype)					35.0**					
		CV (Error Treat) (%)					16.99					
		CV (Residual) (%)					19.59					

Table 6.5.12 Radiation and Nitrogen use efficiency spikelet number/panicle at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	155	139	105	0	124	117	144	218	180	131
	2	Jaya	170	93	142	0	136	222	198	118	210	143
	3	MTU-1010	156	81	99	0	136	123	128	123	171	113
	4	Rasi	183	105	201	0	137	223	177	244	200	163
	5	Rasi x Jaya/2	121	102	62	0	119	127	83	63	130	90
	6	Sampada	183	114	155	0	123	185	149	171	212	144
	7	Sampada x Jaya/2	227	105	159	0	127	159	205	163	157	145
	8	Sampada x Jaya/3	150	120	89	0	118	130	133	146	190	120
	9	Varadhan	113	90	57	0	124	130	87	147	113	96
	10	Varadhan x BPT 5204/10	196	120	127	0	124	201	208	203	192	152
	11	Varadhan x BPT 5204/6	176	102	83	0	126	130	131	156	186	121
	12	Varadhan x MTU 1010/2	153	106	110	0	113	171	113	248	185	133
		T1-0 N Mean	**165**	**106**	**116**	**0**	**126**	**160**	**146**	**167**	**177**	**129**
T2 (50 Kg N/ha)	1	BPT-5204	174	172	107	0	125	151	138	126	217	135
	2	Jaya	191	114	159	0	135	269	192	231	251	171
	3	MTU-1010	175	105	87	0	137	150	71	147	171	116
	4	Rasi	206	123	187	0	135	258	220	248	199	175
	5	Rasi x Jaya/2	135	125	80	0	114	150	99	116	130	105
	6	Sampada	206	144	164	0	122	236	196	250	211	170
	7	Sampada x Jaya/2	255	141	159	0	132	187	162	173	150	151
	8	Sampada x Jaya/3	169	138	79	0	117	198	159	212	194	141
	9	Varadhan	126	108	115	0	125	138	84	118	124	104
	10	Varadhan x BPT 5204/10	220	156	152	0	130	278	201	200	220	173
	11	Varadhan x BPT 5204/6	197	122	84	0	128	173	93	161	226	132
	12	Varadhan x MTU 1010/2	171	135	116	0	120	217	77	173	195	134
		T2-50 N Mean	**186**	**132**	**124**	**0**	**127**	**201**	**141**	**180**	**191**	**142**
T3 (100 Kg N/ha)	1	BPT-5204	189	205	112	0	123	195	99	162	215	145
	2	Jaya	208	160	162	0	139	289	131	125	188	156
	3	MTU-1010	188	114	108	0	135	174	125	187	149	131
	4	Rasi	222	159	181	0	139	279	128	225	235	174
	5	Rasi x Jaya/2	146	126	87	0	116	243	74	126	168	121
	6	Sampada	222	190	162	0	123	347	129	155	158	165
	7	Sampada x Jaya/2	275	153	155	0	129	218	190	168	184	163
	8	Sampada x Jaya/3	183	161	115	0	114	220	117	147	148	134
	9	Varadhan	136	118	86	0	123	149	92	152	139	110
	10	Varadhan x BPT 5204/10	238	183	155	0	128	303	185	256	201	183
	11	Varadhan x BPT 5204/6	212	160	103	0	133	196	109	222	172	145
	12	Varadhan x MTU 1010/2	184	148	105	0	118	245	94	146	158	133
		T3-100 N Mean	**200**	**156**	**128**	**0**	**127**	**238**	**123**	**173**	**176**	**147**
		Grand Mean	**184**	**132**	**122**	**0**	**126**	**199**	**137**	**173**	**181**	**139**
		LSD (Treatment)				ns						
		LSD (Location x Treatment)				18.94**						
		LSD (Genotype)				10.26**						
		LSD (Location x Genotype)				30.79**						
		LSD (Treatment x Genotype)				ns						
		LSD (Location x Treatment x Genotype)				17.77**						
		CV (Error Treat) (%)				21.2						
		CV (Residual)(%)				18.13						

Table 6.5.13 Radiation and Nitrogen use efficiency grain number/m2 at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	24637	16213	16513	35400	36212	16550	28252	34667	25947	26043
	2	Jaya	18492	16824	19303	35400	40073	51200	49364	7517	32040	30024
	3	MTU-1010	27909	14489	16382	35000	42086	22483	32018	15467	29276	26123
	4	Rasi	29662	21918	33878	38000	43923	47117	30562	38533	34590	35354
	5	Rasi x Jaya/2	27556	16008	11944	34933	37268	19933	18697	10067	15412	21313
	6	Sampada	17938	19952	24182	36667	38709	37800	38052	40067	33233	31844
	7	Sampada x Jaya/2	49454	18611	25537	38200	38830	36900	31941	24133	30183	32643
	8	Sampada x Jaya/3	27782	18019	14720	37000	35134	21467	17458	23437	37678	25855
	9	Varadhan	28273	13426	11671	35600	37180	27517	27202	42567	14039	26386
	10	Varadhan x BPT 5204/10	40217	22750	21801	38400	35475	28983	41300	33667	32427	32780
	11	Varadhan x BPT 5204/6	37749	17833	13871	36333	41052	29250	33432	39000	33655	31353
	12	Varadhan x MTU 1010/2	34431	17156	17415	38533	36531	34550	23702	38533	29208	30007
		T1-0 N Mean	**30342**	**17767**	**18935**	**36622**	**38539**	**31146**	**30998**	**28971**	**28974**	**29144**
T2 (50 Kg N/ha)	1	BPT-5204	34762	24457	27335	36800	42482	35867	35182	8467	45693	32338
	2	Jaya	28379	24621	49656	38067	49929	72717	36554	67633	46904	46051
	3	MTU-1010	39304	22023	30578	33133	48026	31133	16786	36467	33432	32320
	4	Rasi	41819	28210	51704	35933	48037	72933	42070	50467	41850	45892
	5	Rasi x Jaya/2	36925	20448	31253	35067	41866	44467	32067	28967	20327	32376
	6	Sampada	28636	24267	49871	39333	45925	61250	40530	39267	42817	41322
	7	Sampada x Jaya/2	66321	23296	51543	36400	48598	55900	43134	54667	33384	45916
	8	Sampada x Jaya/3	37735	21238	21198	36533	41360	54833	36946	44867	49883	38288
	9	Varadhan	37628	20213	39803	36400	43846	34150	24570	29967	17140	31524
	10	Varadhan x BPT 5204/10	52154	28873	51956	36800	47069	54833	59290	42347	44042	46374
	11	Varadhan x BPT 5204/6	51459	25143	27234	35133	46255	35417	20307	56507	48759	38468
	12	Varadhan x MTU 1010/2	46135	24605	34890	36467	44836	45967	25186	16267	43750	35345
		T2-50 N Mean	**41771**	**23949**	**38918**	**36339**	**45686**	**49956**	**34385**	**39657**	**38998**	**38851**
T3 (100 Kg N/ha)	1	BPT-5204	38418	34572	26447	36600	47619	48217	17318	33867	27628	34521
	2	Jaya	45003	33320	49789	36867	54582	87083	46501	25227	28956	45259
	3	MTU-1010	56559	30875	34552	36200	59180	42817	19236	55867	26808	40233
	4	Rasi	51399	40710	55864	35867	54538	97050	25172	67267	42735	52289
	5	Rasi x Jaya/2	33128	32552	35237	36667	46882	58900	21504	31687	19001	35062
	6	Sampada	42511	39259	50330	37333	48554	127700	41251	64867	28915	53413
	7	Sampada x Jaya/2	45665	37771	53076	36400	52668	75817	66563	21667	25705	46148
	8	Sampada x Jaya/3	52317	31581	32802	36867	43802	62200	37926	18467	21131	37455
	9	Varadhan	28876	28677	38435	35933	47234	50300	28539	72567	16601	38574
	10	Varadhan x BPT 5204/10	70567	46215	47181	34067	50677	101217	71092	39587	24477	53898
	11	Varadhan x BPT 5204/6	61297	37242	39596	35667	55561	67267	35224	36067	22796	43413
	12	Varadhan x MTU 1010/2	44698	35568	41293	37200	46013	85950	17738	55067	20053	42620
		T3-100 N Mean	**47536**	**35695**	**42050**	**36306**	**50609**	**75376**	**35672**	**43517**	**25400**	**43574**
		Grand Mean	**39883**	**25804**	**33301**	**36422**	**44945**	**52159**	**33685**	**37382**	**31124**	**37189**
		LSD (Treatment)				2004**						
		LSD (Location x Treatment)				6012**						
		LSD (Genotype)				3512**						
		LSD (Location x Genotype)				10537**						
		LSD (Treatment x Genotype)				ns						
		LSD (Location x Treatment x Genotype)				18252**						
		CV (Error Treat) (%)				25.22						
		CV (Residual) (%)				23.26						

Table 6.5.14 Radiation and Nitrogen use efficiency spikelet number/m2 at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	27737	17838	21537	0	42504	19500	34699	41800	31613	26359
	2	Jaya	21638	21049	31804	0	45089	66600	64477	13583	39015	33695
	3	MTU-1010	28016	17091	21206	0	47630	26733	36505	15000	34945	25236
	4	Rasi	32358	20790	46265	0	49852	63067	41412	59083	43397	39580
	5	Rasi x Jaya/2	28030	19210	12153	0	43197	25467	23492	13350	18899	20422
	6	Sampada	19901	22154	36295	0	44429	52850	49189	55133	41834	35754
	7	Sampada x Jaya/2	52690	23450	40452	0	44759	44850	41496	32100	36625	35158
	8	Sampada x Jaya/3	32184	19960	18981	0	41294	28200	20195	30517	46212	26394
	9	Varadhan	28292	16860	11826	0	43648	30500	29743	47867	16509	25027
	10	Varadhan x BPT 5204/10	43809	25200	28212	0	40942	33400	66850	34107	38588	34567
	11	Varadhan x BPT 5204/6	37422	21828	17651	0	47256	32417	37968	50567	41318	31825
	12	Varadhan x MTU 1010/2	35496	19009	22994	0	43406	37017	29624	52183	36535	30696
		T1-0 N Mean	**32298**	**20370**	**25781**	**0**	**44501**	**38383**	**39638**	**37108**	**35457**	**30393**
T2 (50 Kg N/ha)	1	BPT-5204	39546	27324	40726	0	46838	40367	50169	14787	52773	34725
	2	Jaya	33576	29432	70090	0	54835	89717	41594	78500	54482	50247
	3	MTU-1010	39792	25207	35154	0	54010	40117	22127	41867	38601	32986
	4	Rasi	46237	30359	76613	0	53350	90383	47775	82000	48333	52783
	5	Rasi x Jaya/2	37929	22365	34810	0	46618	47517	39389	39767	23361	32417
	6	Sampada	32231	29033	75895	0	50787	74833	50421	69247	48793	47916
	7	Sampada x Jaya/2	71431	31789	72420	0	53625	68633	57659	75717	38493	52196
	8	Sampada x Jaya/3	44378	24491	28005	0	45969	62733	56665	60133	57762	42237
	9	Varadhan	37812	22769	49916	0	48224	36750	35399	32067	19630	31396
	10	Varadhan x BPT 5204/10	59882	34553	69583	0	52998	69583	75278	56333	50623	52093
	11	Varadhan x BPT 5204/6	51403	29643	35050	0	52041	40333	24388	52767	55796	37936
	12	Varadhan x MTU 1010/2	47871	29292	45516	0	50424	50717	29260	19400	49650	35792
		T2-50 N Mean	**45174**	**28021**	**52815**	**0**	**50810**	**59307**	**44177**	**51882**	**44858**	**41894**
T3 (100 Kg N/ha)	1	BPT-5204	43562	37185	37988	0	51513	58217	21406	42167	31493	35948
	2	Jaya	45680	40800	74388	0	58080	105783	58576	42353	33081	50971
	3	MTU-1010	63009	31850	40871	0	64174	49467	27496	68133	30734	41748
	4	Rasi	57115	44505	80181	0	58080	111650	32746	105133	48793	59800
	5	Rasi x Jaya/2	33533	33178	37919	0	50974	72800	25886	44000	21760	35561
	6	Sampada	50886	44743	74474	0	52580	140400	56924	85687	33167	59873
	7	Sampada x Jaya/2	54303	43419	72496	0	56617	90633	73612	43150	29497	51525
	8	Sampada x Jaya/3	54644	36801	44176	0	47520	69667	47355	24337	23803	38700
	9	Varadhan	33181	29546	45421	0	51722	54650	36757	88333	19176	39865
	10	Varadhan x BPT 5204/10	76564	52377	59870	0	54659	126067	82586	55767	27813	59522
	11	Varadhan x BPT 5204/6	71037	41000	51111	0	60049	75267	41216	41983	26006	45297
	12	Varadhan x MTU 1010/2	46087	39936	50142	0	50468	97917	30380	67150	22672	44972
		T3-100 N Mean	**52467**	**39612**	**55753**	**0**	**54703**	**87710**	**44578**	**59016**	**29000**	**46982**
		Grand Mean	**43313**	**29334**	**44783**	**0**	**50004**	**61800**	**42798**	**49335**	**36438**	**39756**
		LSD (Treatment)					2971**					
		LSD (Location x Treatment)					8913**					
		LSD (Genotype)					4186**					
		LSD (Location x Genotype)					12559**					
		LSD (Treatment x Genotype)					ns					
		LSD (Location x Treatment x Genotype)					21753**					
		CV (Error Treat) (%)					34					
		CV (Residual) (%)					25					

Table 6.5.15 Radiation and Nitrogen use efficiency grain yield (g/m2) at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	515.7	389.0	393.5	601.3	332.7	433.3	256.7	560.7	420.7	433.7
	2	Jaya	391.7	286.3	300.3	612.7	422.0	420.0	555.0	352.2	437.3	419.7
	3	MTU-1010	541.7	333.0	384.4	602.7	392.3	322.0	260.3	181.7	367.7	376.2
	4	Rasi	467.0	348.0	568.7	620.7	387.0	462.7	377.0	327.3	405.7	440.4
	5	Rasi x Jaya/2	359.7	352.3	263.5	634.0	366.7	353.7	255.0	345.8	218.0	349.8
	6	Sampada	536.3	299.3	358.2	586.3	370.0	399.0	423.7	433.0	426.7	425.8
	7	Sampada x Jaya/2	505.3	316.7	384.2	539.0	379.0	371.0	471.7	251.0	437.0	406.1
	8	Sampada x Jaya/3	426.7	442.0	366.4	516.3	366.3	420.0	343.7	391.3	406.7	408.8
	9	Varadhan	504.3	281.7	261.1	619.7	347.3	290.0	360.3	377.0	212.3	361.5
	10	Varadhan x BPT 5204/10	539.7	318.7	288.8	612.3	379.7	417.0	453.0	323.7	384.0	413.0
	11	Varadhan x BPT 5204/6	428.7	374.7	324.8	649.7	403.3	403.3	363.0	219.2	422.7	398.8
	12	Varadhan x MTU 1010/2	402.7	377.3	408.0	574.7	374.7	367.0	326.7	461.3	370.0	406.9
		T1-0 N Mean	468.3	343.3	358.5	597.4	376.8	388.3	370.5	352.0	375.7	403.4
T2 (50 Kg N/ha)	1	BPT-5204	643.7	563.7	725.0	616.0	460.0	536.7	773.3	294.5	584.3	577.5
	2	Jaya	519.7	418.7	767.7	551.0	456.7	562.3	610.3	486.0	508.0	542.3
	3	MTU-1010	669.7	506.7	724.3	655.0	463.7	427.7	309.0	426.8	407.7	510.1
	4	Rasi	595.3	451.3	730.7	640.0	480.3	584.7	528.7	482.5	452.3	549.5
	5	Rasi x Jaya/2	487.7	450.0	678.7	657.0	421.7	427.0	229.0	243.0	273.0	429.7
	6	Sampada	664.7	364.0	754.0	669.3	437.0	650.0	369.7	524.8	494.3	547.5
	7	Sampada x Jaya/2	633.7	396.3	802.3	597.0	454.3	595.7	322.3	435.3	477.0	523.8
	8	Sampada x Jaya/3	554.7	552.0	592.3	680.7	461.3	549.3	534.3	374.8	493.0	532.5
	9	Varadhan	632.7	424.7	857.0	544.7	445.3	346.0	245.0	312.5	232.3	448.9
	10	Varadhan x BPT 5204/10	667.7	404.0	696.0	589.0	445.3	525.7	469.3	357.0	432.0	509.6
	11	Varadhan x BPT 5204/6	557.0	528.3	660.7	727.3	449.0	461.3	303.7	419.0	463.0	507.7
	12	Varadhan x MTU 1010/2	531.0	541.7	830.0	541.0	447.0	541.0	287.3	184.7	476.7	486.7
		T2-50 N Mean	596.4	466.8	734.9	622.3	451.8	517.3	415.2	378.4	441.1	513.8
T3 (100 Kg N/ha)	1	BPT-5204	652.0	790.0	690.3	667.0	530.7	750.0	318.0	425.5	583.3	600.8
	2	Jaya	528.0	566.7	758.3	693.7	570.0	769.0	453.3	334.5	555.0	580.9
	3	MTU-1010	678.0	710.3	801.0	611.0	541.0	544.7	139.0	263.7	431.0	524.4
	4	Rasi	603.7	651.3	816.0	614.0	560.0	689.3	375.7	384.6	473.3	574.2
	5	Rasi x Jaya/2	496.0	716.3	778.3	549.7	501.0	470.3	204.0	431.5	273.3	491.2
	6	Sampada	672.7	589.0	745.0	574.3	525.7	742.7	465.3	369.2	486.3	574.5
	7	Sampada x Jaya/2	641.7	642.3	822.3	674.7	532.7	799.7	392.7	243.7	480.0	581.1
	8	Sampada x Jaya/3	563.0	797.7	895.3	553.3	503.3	689.7	272.3	426.0	525.0	580.6
	9	Varadhan	640.7	602.3	781.7	641.7	523.7	451.0	149.7	195.2	249.0	470.5
	10	Varadhan x BPT 5204/10	675.7	647.0	625.0	620.3	542.7	588.0	285.3	377.2	439.0	533.4
	11	Varadhan x BPT 5204/6	565.3	772.0	955.0	716.0	524.3	622.0	375.3	520.7	457.7	612.0
	12	Varadhan x MTU 1010/2	539.7	782.3	955.3	547.7	495.7	709.0	308.0	544.0	442.0	591.5
		T3-100 N Mean	604.7	688.9	802.0	621.9	529.2	652.1	311.6	376.3	449.6	559.6
		Grand Mean	**556**	**500**	**632**	**614**	**453**	**519**	**366**	**369**	**422**	**492**
		LSD (Treatment)					19**					
		LSD (Location x Treatment)					57.9**					
		LSD (Genotype)					31.14**					
		LSD (Location x Genotype)					93.4**					
		LSD (Treatment x Genotype)					ns					
		LSD (Location x Treatment x Genotype)					161.8**					
		CV (Error Treat) (%)					18.35					
		CV (Residual) (%)					15.58					

Table 6.5.16 Radiation and Nitrogen use efficiency 1000 grain weight (g) at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	27.6	20.5	23.9	28.3	19.3	22.4	28.3	23.0	30.0	24.8
	2	Jaya	18.5	15.0	15.6	17.4	18.9	15.2	16.7	15.3	18.0	16.7
	3	MTU-1010	25.6	22.3	23.5	28.5	18.5	23.1	20.0	21.0	18.7	22.4
	4	Rasi	14.8	16.6	14.2	16.8	17.3	20.3	20.0	13.0	16.0	16.6
	5	Rasi x Jaya/2	22.1	20.9	22.1	24.5	18.0	21.1	21.7	18.7	19.3	20.9
	6	Sampada	17.4	16.0	14.8	15.5	18.4	15.3	18.3	14.7	16.3	16.3
	7	Sampada x Jaya/2	17.6	14.4	15.1	17.4	17.8	15.1	16.7	15.0	17.7	16.3
	8	Sampada x Jaya/3	30.8	24.3	24.9	29.3	16.6	24.5	26.7	24.7	26.3	25.3
	9	Varadhan	21.3	19.6	22.4	23.2	18.3	20.6	21.7	19.7	20.0	20.8
	10	Varadhan x BPT 5204/10	17.6	14.2	13.3	18.5	18.2	17.6	11.7	14.7	15.3	15.7
	11	Varadhan x BPT 5204/6	25.3	17.9	23.4	26.6	18.5	18.8	21.7	18.7	21.7	21.4
	12	Varadhan x MTU 1010/2	25.5	19.4	23.4	24.4	18.9	24.0	23.3	20.7	20.3	22.2
		T1-0 N Mean	**22.0**	**18.4**	**19.7**	**22.5**	**18.2**	**19.8**	**20.6**	**18.3**	**20.0**	**19.9**
T2 (50 Kg N/ha)	1	BPT-5204	29.9	23.9	26.5	28.4	19.5	24.5	21.7	24.0	30.7	25.5
	2	Jaya	20.8	15.7	15.4	17.3	22.0	16.4	16.7	15.7	21.7	18.0
	3	MTU-1010	27.9	26.3	23.7	29.4	20.6	24.2	22.7	21.3	18.0	23.8
	4	Rasi	17.1	17.9	14.1	14.6	21.8	23.8	13.3	13.3	17.3	17.0
	5	Rasi x Jaya/2	24.4	23.6	21.8	24.3	18.8	22.8	20.0	19.0	21.0	21.7
	6	Sampada	19.7	16.7	15.2	16.5	18.7	16.6	20.0	13.0	16.0	16.9
	7	Sampada x Jaya/2	19.9	16.2	15.6	17.4	19.3	17.4	23.3	14.7	20.0	18.2
	8	Sampada x Jaya/3	33.1	25.6	27.9	29.4	17.8	27.5	30.0	24.0	31.3	27.4
	9	Varadhan	23.6	22.0	21.6	23.2	18.3	22.5	16.7	19.0	21.3	20.9
	10	Varadhan x BPT 5204/10	19.9	16.6	13.4	18.0	19.5	15.8	15.0	13.3	16.0	16.4
	11	Varadhan x BPT 5204/6	27.6	19.2	24.3	26.3	18.5	21.6	23.3	21.0	24.3	22.9
	12	Varadhan x MTU 1010/2	27.8	21.1	23.8	24.1	18.2	24.7	21.7	20.7	21.3	22.6
		T2-50 N Mean	**24.3**	**20.4**	**20.3**	**22.4**	**19.4**	**21.5**	**20.4**	**18.3**	**21.6**	**20.9**
T3 (100 Kg N/ha)	1	BPT-5204	32.3	24.2	26.1	28.2	22.9	26.8	26.7	23.0	30.7	26.8
	2	Jaya	23.1	17.1	15.2	17.4	21.3	18.9	23.3	16.0	21.0	19.3
	3	MTU-1010	30.2	23.4	23.2	28.1	22.7	26.6	23.3	21.0	20.7	24.4
	4	Rasi	19.4	15.9	14.6	20.9	22.0	25.3	10.0	12.7	18.0	17.6
	5	Rasi x Jaya/2	26.7	22.4	22.1	24.4	21.7	23.8	16.7	18.0	19.0	21.6
	6	Sampada	22.0	15.8	14.8	16.4	21.3	18.6	16.7	16.3	17.0	17.7
	7	Sampada x Jaya/2	22.2	16.7	15.5	17.7	21.8	18.7	23.3	13.3	20.3	18.8
	8	Sampada x Jaya/3	35.5	26.4	27.4	28.1	21.0	29.3	23.3	25.3	30.0	27.4
	9	Varadhan	26.0	21.4	20.6	23.4	21.5	24.4	16.7	18.7	21.0	21.5
	10	Varadhan x BPT 5204/10	22.2	14.8	13.3	18.8	20.7	14.5	20.0	13.3	16.0	17.1
	11	Varadhan x BPT 5204/6	29.9	20.3	24.1	27.0	21.3	22.5	23.3	21.0	23.0	23.6
	12	Varadhan x MTU 1010/2	30.2	22.6	23.1	24.4	20.9	26.8	26.7	21.0	20.0	24.0
		T3-100 N Mean	**26.6**	**20.1**	**20.0**	**22.9**	**21.6**	**23.0**	**20.8**	**18.3**	**21.4**	**21.6**
		Grand Mean	**24.3**	**19.6**	**20.0**	**22.6**	**19.7**	**21.4**	**20.6**	**18.3**	**21.0**	**20.8**
		LSD (Treatment)					0.75**					
		LSD (Location x Treatment)					1.67*					
		LSD (Genotype)					0.93**					
		LSD (Location x Genotype)					2.77**					
		LSD (Treatment x Genotype)					ns					
		LSD (Location x Treatment x Genotype)					ns					
		CV (Error Treat) (%)					16.73					
		CV (Residual) (%)					10.8					

Table 6.5.17 Radiation and Nitrogen use efficiency harvest index (%) at different locations Kharif 2018

Treat.	S.No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB	Grand Mean
T1 (0 Kg N/ha)	1	BPT-5204	37.4	52.0	50.8	0.0	38.9	40.7	42.0	0.0	43.9	34.0
	2	Jaya	42.7	41.3	39.2	0.0	47.0	41.2	36.0	0.0	42.2	32.2
	3	MTU-1010	42.1	41.3	44.9	0.0	43.1	33.2	20.0	0.0	38.3	29.2
	4	Rasi	46.5	46.0	49.8	0.0	48.0	41.0	36.0	0.0	42.3	34.4
	5	Rasi x Jaya/2	36.0	51.7	49.6	0.0	46.4	40.1	33.0	0.0	44.9	33.5
	6	Sampada	37.8	39.7	47.5	0.0	46.1	38.5	35.7	0.0	41.8	31.9
	7	Sampada x Jaya/2	44.6	29.3	42.9	0.0	47.2	38.5	34.7	0.0	37.5	30.5
	8	Sampada x Jaya/3	36.0	51.0	45.3	0.0	43.4	42.1	39.0	0.0	37.4	32.7
	9	Varadhan	56.5	42.7	51.8	0.0	43.6	43.2	30.7	0.0	33.7	33.6
	10	Varadhan x BPT 5204/10	42.8	42.3	39.3	0.0	44.5	40.3	29.3	0.0	37.1	30.6
	11	Varadhan x BPT 5204/6	38.4	40.3	48.6	0.0	47.6	43.3	31.7	0.0	36.4	31.8
	12	Varadhan x MTU 1010/2	39.6	47.0	52.1	0.0	45.6	41.5	33.7	0.0	44.1	33.7
		T1-0 N Mean	**41.7**	**43.7**	**46.8**	**0.0**	**45.1**	**40.3**	**33.5**	**0.0**	**40.0**	**32.3**
T2 (50 Kg N/ha)	1	BPT-5204	42.3	51.7	45.3	0.0	48.7	42.0	35.3	0.0	47.7	34.8
	2	Jaya	49.0	40.3	48.7	0.0	46.4	41.6	31.0	0.0	43.0	33.3
	3	MTU-1010	46.8	44.0	45.8	0.0	48.4	32.8	17.7	0.0	27.8	29.3
	4	Rasi	51.8	51.3	49.1	0.0	48.4	42.3	25.3	0.0	40.0	34.2
	5	Rasi x Jaya/2	42.6	43.3	51.3	0.0	47.1	38.8	23.3	0.0	33.7	31.1
	6	Sampada	42.6	34.3	48.8	0.0	44.1	45.0	30.3	0.0	38.7	31.5
	7	Sampada x Jaya/2	49.6	30.7	49.3	0.0	49.0	40.6	28.7	0.0	37.7	31.7
	8	Sampada x Jaya/3	41.7	45.0	41.8	0.0	51.7	44.4	31.3	0.0	42.3	33.1
	9	Varadhan	61.1	41.7	54.7	0.0	47.4	37.6	25.3	0.0	24.7	32.5
	10	Varadhan x BPT 5204/10	47.6	36.7	46.7	0.0	46.9	38.8	28.0	0.0	37.7	31.4
	11	Varadhan x BPT 5204/6	44.2	44.0	50.9	0.0	48.3	42.6	20.3	0.0	36.0	31.8
	12	Varadhan x MTU 1010/2	45.8	42.3	52.6	0.0	50.1	46.8	23.0	0.0	37.3	33.1
		T2-50 N Mean	**47.1**	**42.1**	**48.7**	**0.0**	**48.0**	**41.1**	**26.6**	**0.0**	**37.2**	**32.3**
T3 (100 Kg N/ha)	1	BPT-5204	59.6	53.0	41.3	0.0	52.1	45.8	17.7	0.0	48.7	35.3
	2	Jaya	32.7	45.3	44.4	0.0	51.0	46.2	24.7	0.0	43.3	32.0
	3	MTU-1010	60.7	52.0	43.8	0.0	52.5	32.8	9.0	0.0	31.8	31.4
	4	Rasi	41.3	52.3	48.3	0.0	54.0	42.2	23.0	0.0	39.5	33.4
	5	Rasi x Jaya/2	40.5	52.7	55.6	0.0	54.7	35.4	17.7	0.0	36.4	32.5
	6	Sampada	42.4	47.3	40.8	0.0	48.3	40.3	30.0	0.0	38.1	31.9
	7	Sampada x Jaya/2	43.8	40.3	46.6	0.0	50.0	45.0	21.7	0.0	38.1	31.7
	8	Sampada x Jaya/3	41.9	52.3	51.7	0.0	51.6	42.4	25.0	0.0	44.4	34.4
	9	Varadhan	53.3	51.7	52.2	0.0	50.0	40.7	25.0	0.0	26.1	33.2
	10	Varadhan x BPT 5204/10	51.0	44.7	45.5	0.0	52.6	32.3	23.0	0.0	38.1	31.9
	11	Varadhan x BPT 5204/6	46.6	52.3	55.3	0.0	48.9	45.8	22.3	0.0	33.5	33.9
	12	Varadhan x MTU 1010/2	38.9	48.7	53.9	0.0	51.2	47.3	20.3	0.0	44.6	33.9
		T3-100 N Mean	**46.1**	**49.4**	**48.3**	**0.0**	**51.4**	**41.4**	**21.6**	**0.0**	**38.6**	**33.0**
		Grand Mean	**44.9**	**45.1**	**47.9**	**0.0**	**48.2**	**40.9**	**27.2**	**0.0**	**38.6**	**32.5**
		LSD (Treatment)					ns					
		LSD (Location x Treatment)					1.82**					
		LSD (Genotype)					ns					
		LSD (Location x Genotype)					3.27**					
		LSD (Treatment x Genotype)					ns					
		LSD (Location x Treatment x Genotype)					5.66**					
		CV (Error Treat) (%)					8.7					
		CV (Residual) (%)					8.25					

Table 6.5.18: Combine variance analysis of Grain yield in 12 rice genotypes grown at 9 locations during kharif 2018 season.

Source of Variation	0 kg N ha^{-1}				Source of Variation	50 kg N ha^{-1}			
	Df	Sum. Sq.	Mean Sq	F value		Df	Sum. Sq.	Mean Sq	F value
ENVIRONMENT	8	1388727	173591	18.8826***	ENVIRONMENT	8	3118714	389839	68.3743***
REP(ENV)	18	165477	9193	2.3087**	REP(ENV)	18	102628	5702	0.9416
GENOTYPE	11	745250	67750	17.0141***	GENOTYPE	11	805762	73251	12.0975***
ENV:GEN	88	1027998	11682	2.9337***	ENV:GEN	88	1604635	18234	3.0114***
Residuals	197	784453	3982		Residuals	198	1198906	6055	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Table 6.5.19 : Analysis of variance of principle components of biplot genotype x location of 12 rice genotypes grown at 9 locations during kharif 2018 season

	0 kg N ha^{-1}								50 kg N ha^{-1}							
	percent	acum	Df	Sum.Sq	Mean.Sq	F.value	Pr.F		percent	acum	Df	Sum.Sq	Mean.Sq	F.value	Pr.F
PC1	34.4	34.4	18	355032.2	19724.01	4.95	0	PC1	48.5	48.5	18	777506.6	43194.81	7.13	0
PC2	23.9	58.3	16	246417.6	15401.1	3.87	0	PC2	17.7	66.2	16	284005.3	17750.33	2.93	0.0002
PC3	19.2	77.5	14	197519.7	14108.55	3.54	0	PC3	16.3	82.5	14	261652.4	18689.46	3.09	0.0002
PC4	9.9	87.4	12	102287	8523.916	2.14	0.0161	PC4	9.8	92.3	12	157210.2	13100.85	2.16	0.015
PC5	8.5	95.9	10	87462.28	8746.228	2.2	0.0193	PC5	4.1	96.3	10	65343.84	6534.384	1.08	0.3792
PC6	2.2	98.1	8	22366.41	2795.801	0.7	0.6913	PC6	3	99.3	8	47697.81	5962.226	0.98	0.4528
PC7	1.4	99.4	6	14148.26	2358.043	0.59	0.7381	PC7	0.5	99.8	6	8098.709	1349.785	0.22	0.97

Table 6.5.20: Combine variance analysis of Grain yield in 12 rice genotypes grown at 9 locations during kharif 2018 season.

Source of Variation	0 kg N ha^{-1}				Source of Variation	50 kg N ha^{-1}			
	Df	Sum. Sq.	Mean Sq	F value		Df	Sum. Sq.	Mean Sq	F value
ENVIRONMENT	8	1388727	173591	18.8826***	ENVIRONMENT	8	3118714	389839	68.3743***
REP(ENV)	18	165477	9193	2.3087**	REP(ENV)	18	102628	5702	0.9416
GENOTYPE	11	745250	67750	17.0141***	GENOTYPE	11	805762	73251	12.0975***
ENV:GEN	88	1027998	11682	2.9337***	ENV:GEN	88	1604635	18234	3.0114***
Residuals	197	784453	3982		Residuals	198	1198906	6055	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Table 6.5.21: Analysis of variance of principle components of biplot genotype x location of 12 rice genotypes grown at 9 locations during kharif 2018 season

	0 kg N ha^{-1}								50 kg N ha^{-1}						
	percent	acum	Df	Sum.Sq	Mean.Sq	F.value	Pr.F		percent	acum	Df	Sum.Sq	Mean.Sq	F.value	Pr.F
PC1	34.4	34.4	18	355032.2	19724.01	4.95	0	PC1	48.5	48.5	18	777506.6	43194.81	7.13	0
PC2	23.9	58.3	16	246417.6	15401.1	3.87	0	PC2	17.7	66.2	16	284005.3	17750.33	2.93	0.0002
PC3	19.2	77.5	14	197519.7	14108.55	3.54	0	PC3	16.3	82.5	14	261652.4	18689.46	3.09	0.0002
PC4	9.9	87.4	12	102287	8523.916	2.14	0.0161	PC4	9.8	92.3	12	157210.2	13100.85	2.16	0.015
PC5	8.5	95.9	10	87462.28	8746.228	2.2	0.0193	PC5	4.1	96.3	10	65343.84	6534.384	1.08	0.3792
PC6	2.2	98.1	8	22366.41	2795.801	0.7	0.6913	PC6	3	99.3	8	47697.81	5962.226	0.98	0.4528
PC7	1.4	99.4	6	14148.26	2358.043	0.59	0.7381	PC7	0.5	99.8	6	8098.709	1349.785	0.22	0.97

Table 6.5.22. Mean grain yield, AMMI Stability values (ASV), Stability index(YSI) and ranking orders of 12 rice genotypes
 # Crops with improved stability according AMMI

0 kg N ha^{-1}						50 kg N ha^{-1}					
Genotype	ASV	YSI	rASV	rYSI	Yield (g m^{-2})	**Genotype**	ASV	YSI	rASV	rYSI	Yield (g m^{-2})
Sampada	5.11	10	1	9	323.9	Varadhan x BPT 5204/10	4.84	4	1	3	509.6
Sampada x Jaya/3	5.30	4	2	2	408.8	MTU-1010	7.17	13	2	11	408.0
MTU-1010	6.67	14	3	11	283.4	Sampada	7.39	11	3	8	438.0
Rasi x Jaya/2	7.18	10	4	6	346.7	Sampada x Jaya/2	10.36	6	4	2	523.8
Varadhan	7.24	17	5	12	274.3	Varadhan x BPT 5204/6	12.45	9	5	4	504.3
Jaya	8.29	16	6	10	319.9	Rasi	14.25	13	6	7	439.6
Varadhan x BPT 5204/10	8.38	8	7	1	413.0	Sampada x Jaya/3	18.65	8	7	1	543.4
Varadhan x BPT 5204/6	9.05	13	8	5	391.2	Rasi x Jaya/2	22.69	18	8	10	426.7
Varadhan x MTU 1010/2	9.47	12	9	3	406.9	Jaya	23.31	18	9	9	433.8
Rasi	11.28	17	10	7	342.1	Varadhan	23.37	22	10	12	369.1
Sampada x Jaya/2	12.43	15	11	4	406.1	Varadhan x MTU 1010/2	25.15	16	11	5	486.7
CV(%)	**17.84**			**Mean**	**354.1**	**CV(%)**	**16.81**			**Mean**	**462.9**

Table 6.5.23. Mean grain yield, AMMI Stability values (ASV), Stability index(YSI) and ranking orders of 12 rice genotypes
 # Crops with better response and improved stability according AMMI.

	0 kg N ha^{-1}						50 kg N ha^{-1}				
Genotype	ASV	YSI	rASV	rYSI	Yield (g m^{-2})	**Genotype**	ASV	YSI	rASV	rYSI	Yield (g m^{-2})
Varadhan x BPT 5204/10	8.38	8	7	1	413	Sampada x Jaya/3	18.65	8	7	1	543.4
Sampada x Jaya/3	5.3	4	2	2	408.8	Sampada x Jaya/2	10.36	6	4	2	523.8
Varadhan x MTU 1010/2	9.47	12	9	3	406.9	Varadhan x BPT 5204/10	4.84	4	1	3	509.6
Sampada x Jaya/2	12.43	15	11	4	406.1	Varadhan x BPT 5204/6	12.45	9	5	4	504.3
Varadhan x BPT 5204/6	9.05	13	8	5	391.2	Varadhan x MTU 1010/2	25.15	16	11	5	486.7
Rasi x Jaya/2	7.18	10	4	6	346.7	BPT-5204	30.72	18	12	6	472.1
Rasi	11.28	17	10	7	342.1	Rasi	14.25	13	6	7	439.6
BPT-5204	14.34	20	12	8	327.9	Sampada	7.39	11	3	8	438
Sampada	5.11	10	1	9	323.9	Jaya	23.31	18	9	9	433.8
Jaya	8.29	16	6	10	319.9	Rasi x Jaya/2	22.69	18	8	10	426.7
MTU-1010	6.67	14	3	11	283.4	MTU-1010	7.17	13	2	11	408
CV(%)	**17.84**			**Mean**	**354.1**	**CV(%)**	**16.81**			**Mean**	**462.9**

Table 6.5.24 Variation in RUE_m of rice genotypes across nine locations Kharif 2018

Treat.	S. No.	Genotypes	CBT	FZB	IIRR	KJT	MTU	PNR	PTB	RPR	TTB
			RUE_m	RUE_m	RUE_m	RUE_m	RUE_m	RUE_m	RUE_m	RUE_m	RUE_m
T1 (0 Kg N/ha)	1	BPT-5204	0.28	0.20	0.22	0.15	0.27	0.22	0.14	0.33	0.37
	2	Jaya	0.26	0.21	0.30	0.14	0.30	0.19	0.13	0.28	0.50
	3	MTU-1010	0.24	0.19	0.23	0.18	0.30	0.20	0.16	0.28	0.27
	4	Rasi	0.27	0.20	0.23	0.62	0.31	0.20	0.13	0.28	0.34
	5	Rasi x Jaya/2	0.25	0.19	0.21	0.21	0.30	0.21	0.19	0.32	0.45
	6	Sampada	0.27	0.20	0.25	0.14	0.30	0.18	0.21	0.22	0.64
	7	Sampada x Jaya/2	0.28	0.23	0.25	0.16	0.26	0.24	0.21	0.36	0.57
	8	Sampada x Jaya/3	0.33	0.20	0.24	0.18	0.31	0.20	0.18	0.27	0.30
	9	Varadhan	0.22	0.24	0.22	0.16	0.29	0.18	0.18	0.27	0.48
	10	Varadhan x BPT 5204/10	0.22	0.25	0.24	0.18	0.29	0.20	0.19	0.39	0.53
	11	Varadhan x BPT 5204/6	0.30	0.21	0.20	0.17	0.27	0.19	0.20	0.28	0.43
	12	Varadhan x MTU 1010/2	0.23	0.25	0.24	0.17	0.31	0.22	0.17	0.26	0.43
		Mean	**0.26**	**0.21**	**0.23**	**0.17**	**0.29**	**0.20**	**0.17**	**0.29**	**0.44**
T2(50 Kg N/ha)	1	BPT-5204	0.28	0.24	0.28	0.15	0.31	0.28	0.32	0.25	0.39
	2	Jaya	0.25	0.28	0.27	0.14	0.32	0.25	0.18	0.38	0.37
	3	MTU-1010	0.27	0.23	0.25	0.17	0.34	0.25	0.24	0.38	0.37
	4	Rasi	0.27	0.24	0.27	0.15	0.34	0.26	0.25	0.34	0.38
	5	Rasi x Jaya/2	0.30	0.23	0.23	0.13	0.32	0.28	0.22	0.17	0.34
	6	Sampada	0.29	0.26	0.27	0.14	0.31	0.22	0.27	0.25	0.69
	7	Sampada x Jaya/2	0.33	0.26	0.22	0.17	0.29	0.29	0.26	0.25	0.56
	8	Sampada x Jaya/3	0.24	0.26	0.24	0.19	0.33	0.25	0.23	0.34	0.27
	9	Varadhan	0.22	0.27	0.26	0.18	0.32	0.24	0.17	0.42	0.60
	10	Varadhan x BPT 5204/10	0.34	0.29	0.26	0.17	0.33	0.25	0.19	0.27	0.41
	11	Varadhan x BPT 5204/6	0.23	0.24	0.23	0.17	0.29	0.24	0.23	0.33	0.33
	12	Varadhan x MTU 1010/2	0.29	0.35	0.27	0.18	0.32	0.26	0.23	0.20	0.47
		Mean	**0.28**	**0.26**	**0.26**	**0.16**	**0.32**	**0.26**	**0.23**	**0.30**	**0.43**
T3(100 Kg N/ha)	1	BPT-5204	0.32	0.30	0.35	0.15	0.33	0.32	0.24	0.37	0.44
	2	Jaya	0.28	0.40	0.36	0.14	0.35	0.33	0.26	0.59	0.60
	3	MTU-1010	0.32	0.27	0.29	0.18	0.40	0.37	0.23	0.26	0.55
	4	Rasi	0.31	0.34	0.30	0.15	0.34	0.33	0.23	0.29	0.59
	5	Rasi x Jaya/2	0.34	0.36	0.30	0.15	0.35	0.36	0.23	0.22	0.46
	6	Sampada	0.34	0.38	0.42	0.16	0.34	0.28	0.29	0.30	0.69
	7	Sampada x Jaya/2	0.39	0.39	0.44	0.15	0.33	0.40	0.25	0.34	0.63
	8	Sampada x Jaya/3	0.26	0.38	0.33	0.18	0.36	0.31	0.24	0.28	0.41
	9	Varadhan	0.25	0.38	0.34	0.18	0.39	0.33	0.25	0.33	0.51
	10	Varadhan x BPT 5204/10	0.40	0.42	0.34	0.19	0.35	0.33	0.27	0.33	0.50
	11	Varadhan x BPT 5204/6	0.26	0.34	0.28	0.18	0.30	0.32	0.27	0.45	0.36
	12	Varadhan x MTU 1010/2	0.34	0.41	0.27	0.18	0.40	0.32	0.27	0.58	0.49
		Mean	**0.32**	**0.36**	**0.33**	**0.21**	**0.35**	**0.33**	**0.25**	**0.36**	**0.52**

6.6 Screening of elite rice germplasm for low light stress tolerance

Locations: IIRR, KJT, MTU, PNR, RPR (Raipur) and TTB

Light intensity varies throughout the year, causing a significant effect on the growth and productivity of rice. The yield of field-grown rice mainly depends on the solar radiation throughout the growth period, especially during the reproductive and/or grain filling stages. Low irradiance (LI) during the reproductive and/or ripening stages has an adverse effect on potential yield because the photosynthetic activity in the leaves of rice cultivars decreases In addition, rice plants in low irradiance environments have shown physiological responses such as: changes in chlorophyll and rubisco content. In view of the importance of low light tolerance in rice crop, the Research Advisory Committee for IIRR & AICRIP recommended to initiate work on identification of varieties for climate resilience like "heat tolerance and low light intensity". Consequently, a new trial was formulated during the 51st Annual Rice workers Group Meeting of AICRIP held at IGKVV, Raipur. The trial was conducted in 6 AICRIP centres with 16 rice genotypes, consisting of IVT. The trial was conducted in split-plot RCBD design with 3 replications with light regimes as main plot treatment and genotypes as subplot treatment. Low light treatments were imposed immediately after transplanting by enclosing the plots in shade-net (50% transmittance). The shade net was supported by metal/bamboo poles.

Low light levels during crop growth had not significantly altered the days to 50% flowering in the rice genotypes. The mean of all locations and varieties under normal irradiation conditions was 108 days where as under low-light conditions it was 110 days. The differences in days to flowering (DF) amongst genotypes was significant ($p<0.01$). It varied between a maximum of 118 days (IET 27550 and IET 27577) to 99 days (IET 27638) (Table 6.6.1).

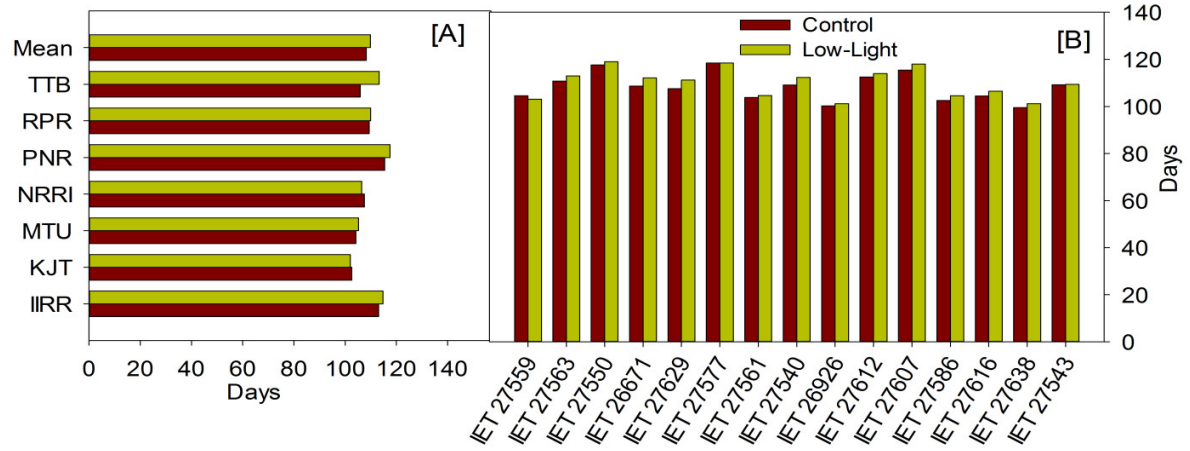


Fig.1: Effect of low light stress on days to flowering. [A] Mean of all genotypes [B] Mean of all locations. Each bar represents the mean of 3 replications.

Similarly, low-light stress had no significant influence on days to maturity (DM). The mean DM under ambient light condition was 127 days where as under low-light condition the mean days to maturity is 128 days (Table 6.6.2). Significant differences were observed amongst the genotypes. The mean of all locations varied between 146 days (IET 27577) to 131 days (IET 27638) under normal light condition, whereas under low light condition the mean days to maturity for all locations varied between a maximum of 148 days (IET 27577 and IET 27550) to 135 days (IET 26926). The interaction between Location x Genotype was found to be significant ($p<0.01$), similarly, the interaction between Location x Treatment was also significant. However, the Genotype x Treatment interaction was found to be non-significant indicating that the genotypes did not differ in their response to treatment.

Results on influence of low-light stress on plant height (cm) were presented in (Table 6.6.3). The results indicate that the mean plant height for all the varieties under normal light condition is 112 cm where as under low-light treatment it was 117 cm. The mean plant height for all the varieties was highest at PNR (126 cm) followed by RPR (119 cm). The mean plant height was minimum at NRRI (105 cm). Results of analysis of variation indicate that the interaction between Location x Treatment was non significant. However, the interaction between Entry X Treatment was significant (Table 6.6.3). The differences amongst the varieties was significant ($p<0.01$). The interaction between Centre x Treatment x Entry was also found to be non-significant. The mean plant height was highest in IET2761 and the plant height of IET 26671 was lowest amongst all the tested entries under low light condition (Table 6.6.3)

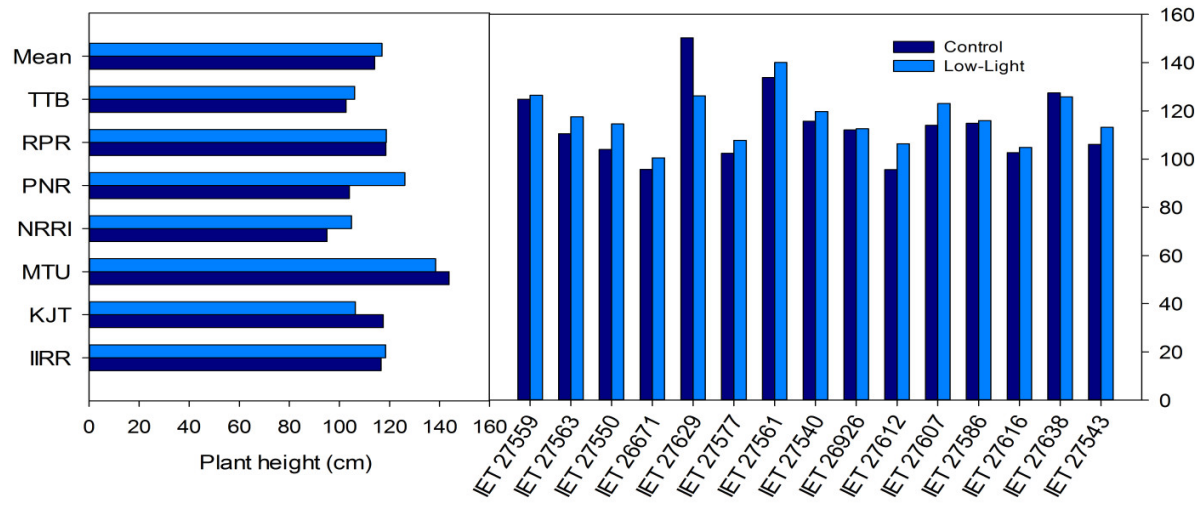


Fig.2: Effect of low-light stress on plant height in selected rice genotypes. Each bar represents the mean of 3 replications. [A] Mean of all genotypes [B] Mean of all locations.

Leaf pigment content was estimated at PI and flowering stages at NRRI. Exposure to low-light during the crop growth had significantly affected the leaf chlorophyll content. Mean chl a content was 30% higher under low-light treatment. Significant differences were observed in

chl a content between the genotypes. IET27540 showed maximum increase in chl a content was observed in IET 27612 followed by IET27638I and ET 27577 (Fig. 3).

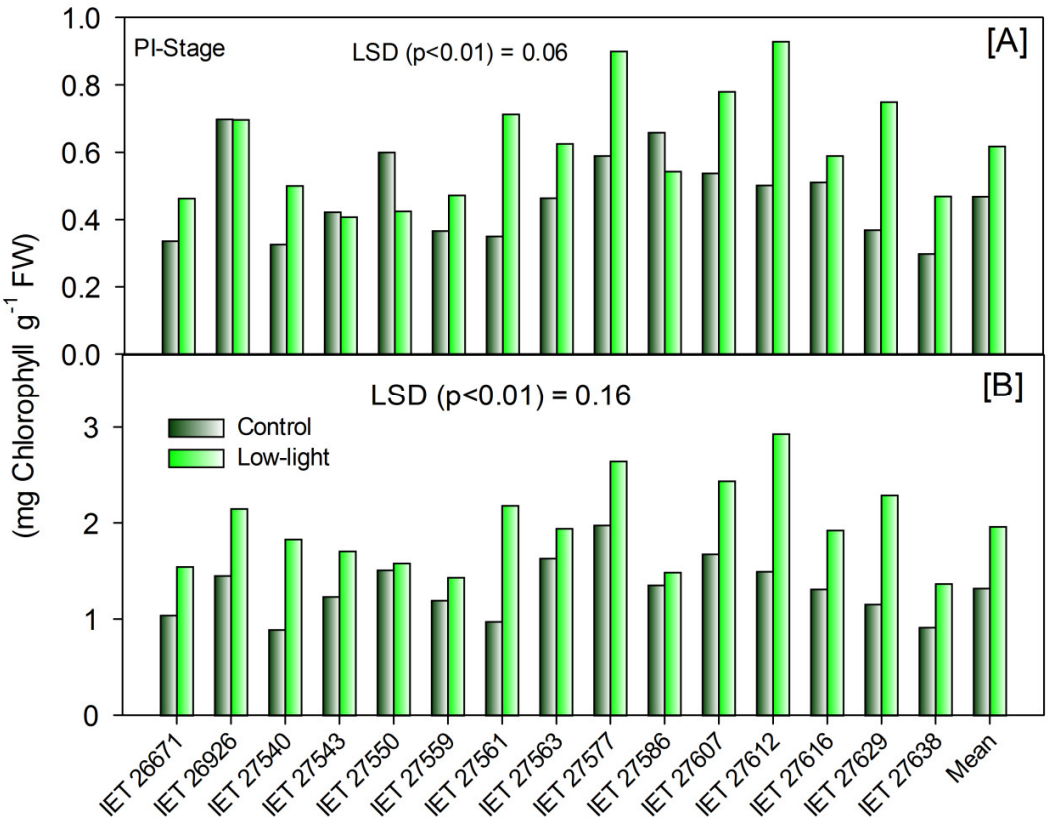


Fig.3 Effect of low-light stress on [A] leaf chlorophyll a content [B] chlorophyll b content measured at PI stage. Each bar represents the mean of three replications.

Similarly, chlorophyll b content was significantly higher under low light stress condition in all genotypes. The mean chlorophyll b content for all genotypes had increased by >48% under low-light treatment. IET 27612 followed by IET 27577 recorded highest chl b content at PI stage. The chl b content was lowest in IET 26671 and IET 27559 (Fig.3). Similar trend was observed in chl a and chl b contents when measured at flowering stage. Chlorophyll a & b content show significant increase under low-light stress. Chl a recorded an increase of 10% over ambient light condition. The mean chl b content increased by 19% over control light treatment under low light stress (Fig.4). Significant genotypic differences were observed. Under low-light treatment Chl a was highest in IET27543 followed by IET 27540, the chl a content was minimum in IET 27550 followed by IET 26926. Similarly, significant ($p<0.01$) differences were observed amongst the varieties in chl b content also.

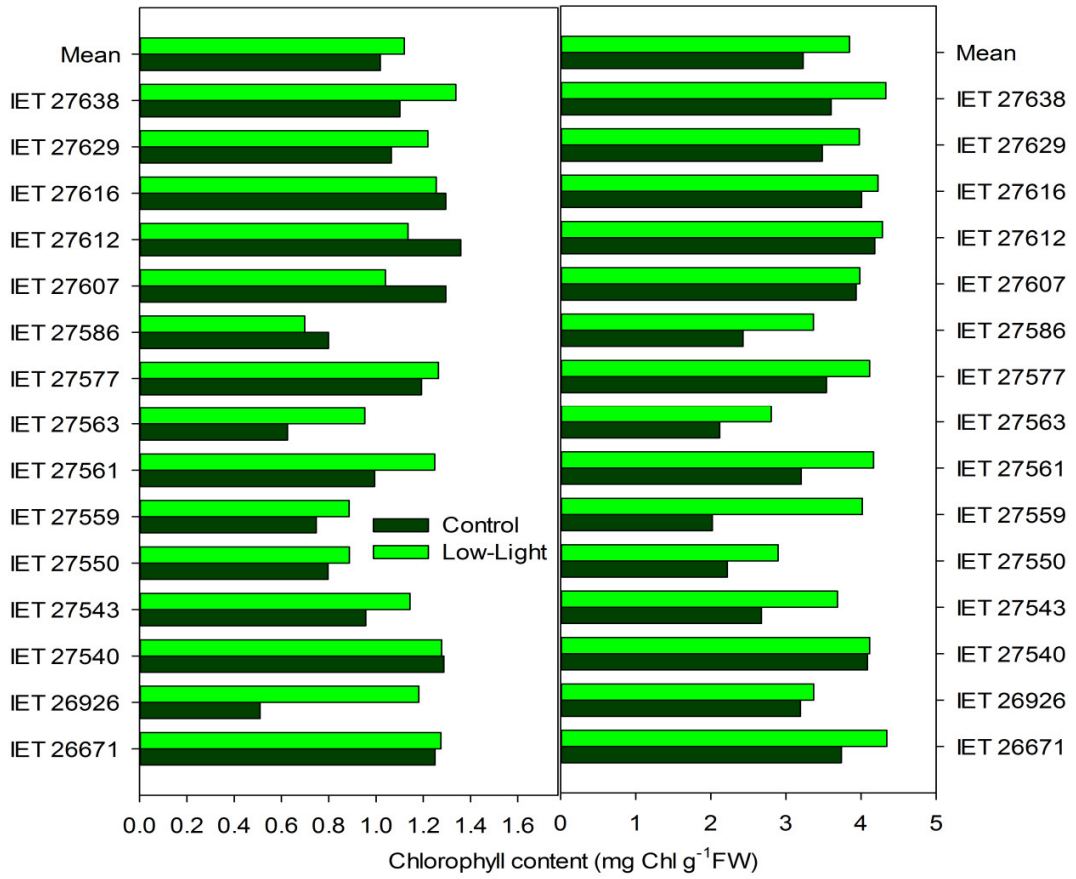


Fig.4: Effect of low light stress on [A) chlorophyll a and [B] chlorophyll b content measured at flowering stage at NRRI during kharif -2018.

Chlorophyll b content was highest in IET 26671 followed by IET 27638. The chl b content was lower in IET 27556 (Fig.4).

Total chlorophyll content was also significantly affected by the low light treatment. Total chlorophyll content had increased by 16.9% under low light. Significant differences were observed amongst the genotypes the mean chlorophyll content varied between 5.4 (IET 27612) to a minimum of 3.2 (IET 27612) followed by IET 27550 and IET27563 (Fig.5). Similarly, the chlorophyll a/b ratio was also significantly affected by the low light treatment. The mean chl a/b ratio for all genotypes had recorded a reduction of 7.9% over ambient light control treatment indicating that chl b content had increased more than chl a content under low light to cope with the low ambient light conditions to absorb more light.

Shoot weight was recorded after harvest. The mean shoot weight (mean of all varieties) under normal ambient light conditions was 978 g m^{-2} where as under low-light condition it was reduced to 843 g m^{-2} (13% reduction over control) (Table 6.6.11). The differences in the mean shoot weight among the genotypes were non-significant. Maximum reduction in mean shoot weight was observed in IET 27586. The reduction is only marginal in case of IET 27559 and in IET 26926 a non-significant increase in shoot weight under low light condition was observed (Fig.6). The interaction between Location x Genotype was significant ($p<0.01$) indicating that the genotypes behaved different at different locations. Maximum reduction in shoot was observed at TTB and NRRI where as at KJT no reduction was noticed.

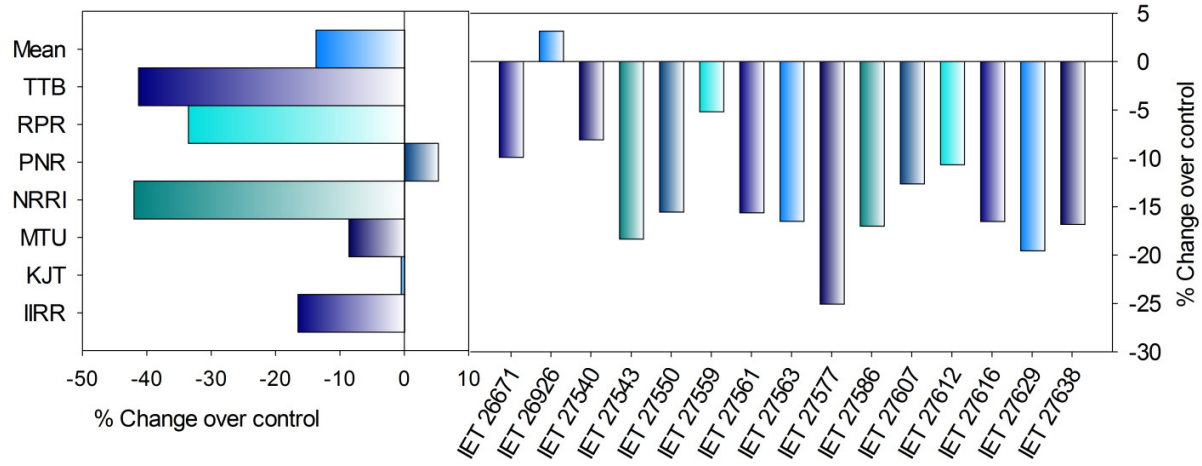


Fig.6 Effect of low stress on shoot weight of different rice genotypes at different locations. [A] Mean of all genotypes [B] Mean of all locations.

No. of panicles m^{-2} is an important yield contributing character which was significantly ($p<0.05$) affected by low light stress (Table 6.6.5). The mean panicle number was reduced by 16.9% over control under low-light treatment. Maximum reduction in panicle no. was observed for IET 27559 (>35% reduction) and minimum reduction was observed in IET 27543. The reduction in panicle number is marginal in IET 27638 and IET 27616 (Fig. 7). However, the variation in the mean panicle number (mean of all location and treatment) was found to be non-significant. Significant variation was noticed in the mean panicle number (mean of all genotypes) across the locations. The reduction in mean number of panicles is highest at NRRI (>32% over control) followed by RPR. Minimum reduction was noticed at IIRR (Fig.7).

No. of grains per panicle is very important yield contributing trait which was significantly affected by the light regimes. The mean (mean of all locations and genotypes) grain number of panicles was reduced by > 18% under low light treatment (Table 6.6.6). The interaction between

Location and Treatment was statistically significant ($p<0.01$). The reduction in number of grains was very high at PNR centre (>50% reduction over control) followed by NRRI (>38%) and IIRR (>26%). Minimum reduction was observed at MTU (<10% over control) (Fig.8).

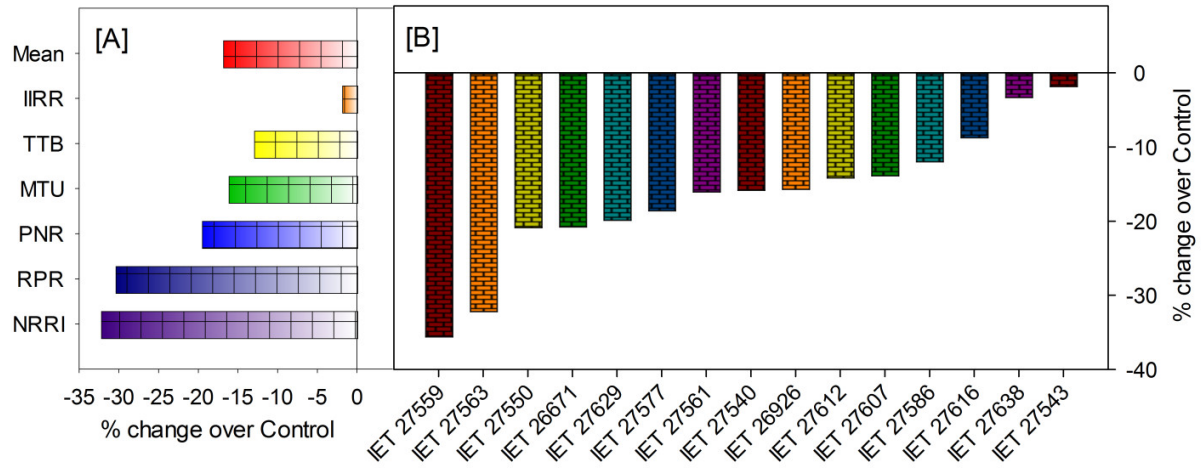


Fig.7 Influence of low light stress on No of panicles m^{-2} [A] Mean of all genotypes [B] Mean of all locations. Each bar represents the mean of 3 replications.

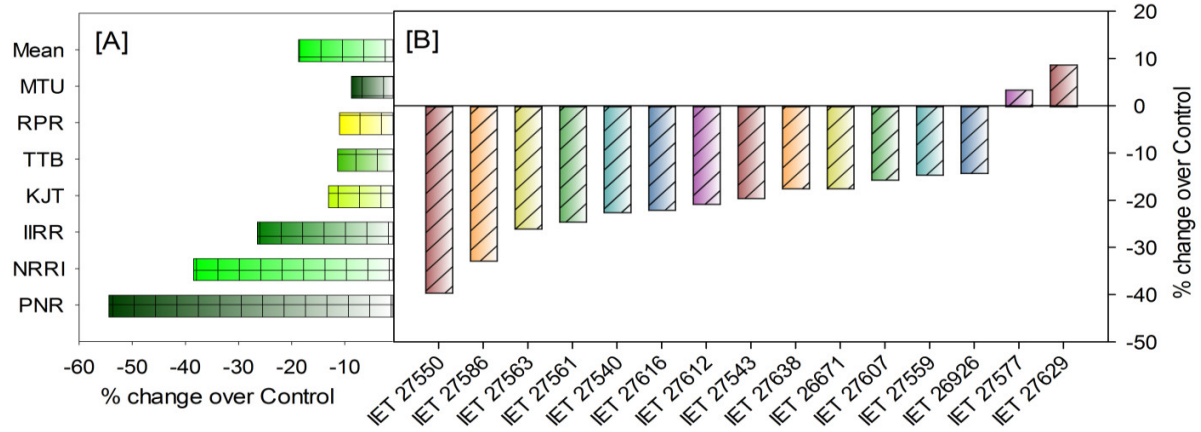


Fig. 8 *Influence of low light stress on No of grains paniclce^{-1} [A] Mean of all genotypes [B] Mean of all locations. Each bar represents the mean of 3 replications.*

The mean Spikelet No. per panicle was not significantly affected by the low light treatments (Table 6.6.7). The mean spikelet number was reduced by >10% under low light treatment. The interaction between Location x Treatment was highly significant ($p<0.01$).

Maximum reduction in spikelet number was observed at NRRI (>20% reduction over control) followed by IIRR (>20%). Minimum reduction was observed at MTU and TTB (Table 6.6.7 & Fig.9).

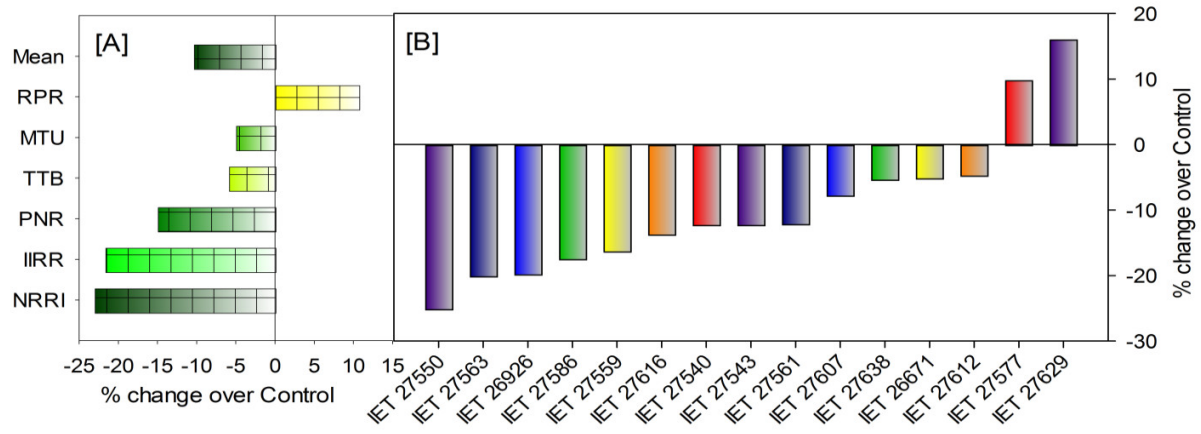


Fig. 9 Effect of low light on No. of spikelets per panicle [A] Mean of all genotypes [B] Mean of all locations.

At APR the mean spikelets per panicles show an increase of 10% over control treatment. Maximum reduction in mean spikelet number was observed in IET 27550 followed by IET 27563 and IET 26926. The reduction was marginal in case of IET27638, 27612 and IET 27612. However, in case of IET 27577 and IET 27629 an increase in spikelet number was noticed under low light treatment (Fig. 9).

Exposure to low light during growth period of rice plants resulted in significant reduction in grain yield. The mean grain yield (mean of all locations and genotypes) was significantly reduced ($p<0.01$). The mean grain yield was reduced by 45% under low light treatment. The interaction between Location x Genotype was found to be significant ($p<0.01$). Maximum reduction in grain yield under low light treatment was observed at NRRI followed by RPR and PNR where the reduction in grain yield is >50%. The reduction in grain yield was minimum at MTU (20% reduction over control). The difference in the mean grain yield (mean of all locations) is non-significant. However, the extent of reduction in grain yield under low light varied with genotype (Fig. 10). The reduction in grain yield was highest in IET 27543 followed by IET 27563 and IET 27550 (Table 6.6.12). The reduction was minimum in case of IET 27559 (>27% reduction) over control. In case of the remaining genotypes the reduction in grain yield is very high <35% over control, suggesting that none of the tested genotypes are tolerant to low light stress. Amongst the 15 entries tested only IET 27559 show relative tolerance to low light stress.

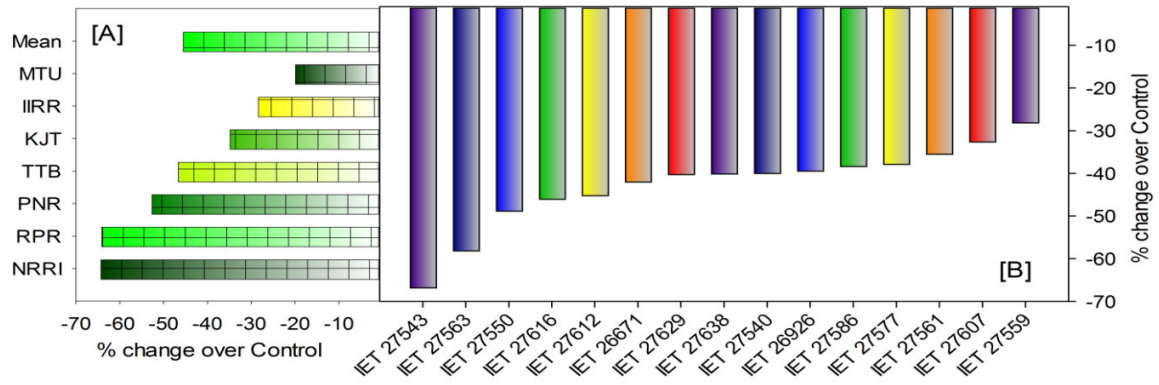


Fig. 10 Influence of low light stress on grain yield of different rice genotypes. [A] Mean of all genotypes [B] Mean of all locations.

Exposure to low light stress had resulted in marginal and non-significant reduction in harvest index (HI). The mean (mean of all genotypes and locations) was reduced by >5.8% under low light treatment. The interaction between Location x Genotype was found to be significant the reduction in HI was maximum at PNR followed by NRRI. Except at KJT the mean of all genotypes was reduced under low light (Table 6.6.13). At KJT centre a minor increase in HI was observed. The change in HI under low light varied between 20% (IE27543) followed by IET 27563 (15% reduction over control). The reduction in the remaining entries is <10%. The reduction is < 1% in IET 27638, IET 27561 and IET 27607 . The interaction between Location x Genotype was found to be significant. The three way interaction between Location x Genotype x Treatment was also significant ($p<0.01$) indicating that the genotypes behaved differently at different locations.

The test weight (1000 grain weight) was reduced by >10% under low light conditions. The interaction between Location x treatment was significant ($p<0.01$). The reduction in mean test weight was highest at PNR followed by MTU and minimum reduction was noticed in IIRR. A minor increase in test weight was observed at RPR. The reduction in mean test weight was highest in IET 27586 followed by IET 27550 and the reduction was negligible in IET 27563, 27616, 27559, 26629 and 27577. However, IET 27543 recorded >12% increase in test weight under low light condition (Table 6.6.10 & Fig. 11).

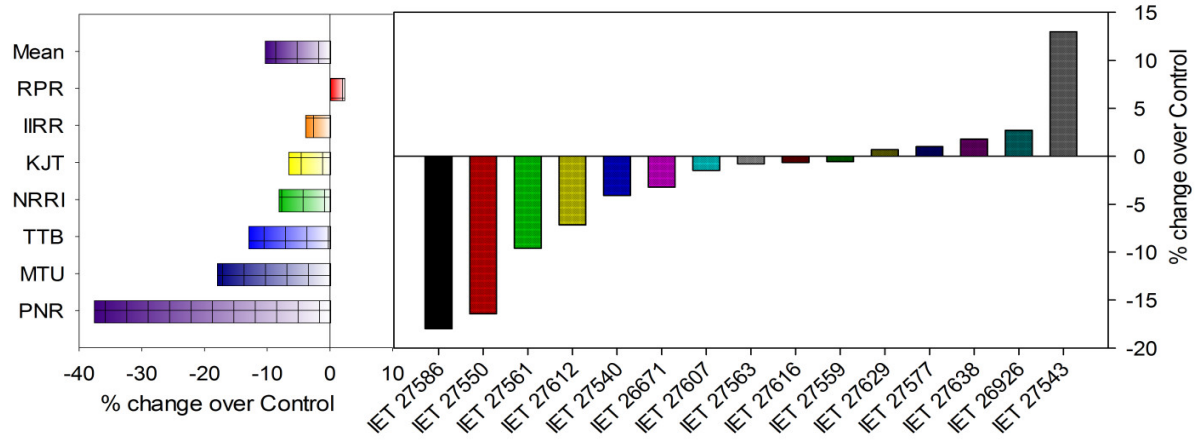


Fig. 11 Influence of low light stress on 1000 grain weight (g) [A] Mean of all genotypes [B] Mean of all locations.

Summary & Conclusion

Light intensity is one of the most important environmental factors that determine the basic characteristics of rice development. . In view of the importance of low light tolerance in rice crop a new trial was formulated during the 51st Annual Rice workers Group Meeting of AICRIP held at IGKVV, Raipur. During this year 15 AVT entries were tested at 7 locations. The mean grain yield was reduced by 45% under low light treatment. Maximum reduction in grain yield under low light treatment was observed at NRRI followed by RPR and PNR where the reduction in grain yield is >50%. The reduction in grain yield was highest in IET 27543 followed by IET 27563 and IET 27550. The reduction was minimum in case of IET 27559 (>27% reduction) over control. In case of the remaining genotypes the reduction in grain yield is very high <35% over control, suggesting that none of the tested genotypes are tolerant to low light stress. Amongst the 15 entries tested only IET 27559 show relative tolerance to low light stress.

Table 6.6.1 Influence of Low-light stress on days to flowering in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	104	104	103	102	112	104	103	105	106	105	99	102	112	105	93	103
2	IET 27543	116	104	111	113	113	114	105	111	117	103	112	113	117	117	112	113
3	IET 27586	128	101	103	117	141	120	113	118	131	103	104	117	142	117	119	119
4	IET 27550	116	105	103	112	108	112	105	109	119	104	108	112	110	117	114	112
5	IET 27559	117	103	102	105	109	112	105	108	119	103	106	105	119	112	114	111
6	IET 27563	128	104	103	121	141	120	112	118	131	104	107	117	134	116	120	118
7	IET 27607	106	103	104	101	106	105	101	104	108	102	100	101	108	105	109	105
8	IET 27577	117	100	105	108	111	112	111	109	119	97	110	108	115	117	120	112
9	IET 26671	97	102	104	101	98	100	99	100	98	100	102	101	99	100	108	101
10	IET 27629	116	101	108	110	133	112	107	112	116	101	110	108	135	112	116	114
11	IET 26926	117	102	103	117	132	120	117	115	119	102	110	119	132	117	127	118
12	IET 27638	106	103	100	100	103	105	101	103	108	103	101	95	109	105	110	105
13	IET 27612	116	102	103	105	107	95	103	104	116	103	104	101	111	99	112	106
14	IET 27540	105	105	100	95	101	95	95	99	107	100	102	93	101	99	106	101
15	IET 27616	106	100	110	105	117	115	111	109	108	100	103	105	119	112	119	109
	Mean	**113**	**103**	**104**	**107**	**115**	**109**	**106**	**108**	**115**	**102**	**105**	**106**	**118**	**110**	**113**	**110**
	LSD(Treatment)				NS					LSD (Treatment x Genotype)				NS			
	LSD(Location x Treatment)				0.82**					LSD (Location x Treatment x Genotype)				2.70**			
	LSD (Genotype)				0.723**					CV (Error Treat) (%)				1.2			
	LSD (Location x Genotype)				1.915**					CV (Residual) (%)				1.75			

Table 6.6.2 Influence of Low-light stress on days to maturity in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	133	132	132	136	144	134	137	135	138	130	128	136	146	146	144	138
2	IET 27543	146	132	140	146	146	134	138	140	153	133	141	146	0	150	143	144
3	IET 27586	146	126	132	149	0	150	146	142	163	133	133	149	0	150	157	148
4	IET 27550	146	133	132	146	141	144	139	140	148	129	137	146	146	144	154	144
5	IET 27559	146	133	132	136	145	140	138	139	152	128	136	136	0	142	150	141
6	IET 27563	156	136	133	153	0	150	146	146	163	134	136	149	0	150	156	148
7	IET 27607	135	131	134	136	0	135	134	134	140	130	129	136	0	151	147	139
8	IET 27577	148	125	134	141	0	132	144	137	152	125	141	141	0	150	154	144
9	IET 26671	127	132	134	136	133	139	133	133	130	125	132	136	139	140	143	135
10	IET 27629	145	131	138	141	0	151	140	141	147	129	139	141	0	146	150	142
11	IET 26926	146	127	132	149	0	146	152	142	151	132	139	149	0	150	159	147
12	IET 27638	135	128	129	131	0	135	134	132	140	135	130	131	0	151	145	139
13	IET 27612	146	132	133	136	141	135	138	137	148	133	133	136	142	140	150	140
14	IET 27540	134	130	130	125	131	135	130	131	139	131	132	125	139	140	140	135
15	IET 27616	135	128	139	136	0	147	145	138	140	128	133	136	0	151	155	140
	Mean	**142**	**130**	**134**	**140**	**65**	**140**	**140**	**127**	**147**	**130**	**135**	**140**	**47**	**147**	**150**	**128**
	LSD(Treatment)			NS						LSD (Treatment x Genotype)				NS			
	LSD(Location x Treatment)			0.82**						LSD (Location x Treatment x Genotype)				2.70**			
	LSD (Genotype)			0.723**						CV (Error Treat) (%)				1.2			
	LSD (Location x Genotype)			1.915**						CV (Residual) (%)				1.75			

Table 6.6.3 Influence of Low-light stress on plant height (cm) at flowering in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	130	114	161	108	114	119	130	126	128	108	147	126	138	112	127	126
2	IET 27543	115	95	148	97	106	112	100	111	126	107	139	103	134	113	100	118
3	IET 27586	112	92	126	86	105	117	90	104	121	99	132	101	127	118	103	115
4	IET 27550	101	87	133	80	88	100	80	96	107	93	120	79	104	113	89	101
5	IET 27559	148	90	168	90	92	108	95	114	137	147	164	117	119	113	88	126
6	IET 27563	109	97	132	88	90	110	91	102	117	99	121	104	114	109	90	108
7	IET 27607	133	126	178	98	131	144	125	134	143	133	170	121	149	136	128	140
8	IET 27577	124	102	138	99	108	135	106	116	116	105	138	111	126	121	120	120
9	IET 26671	107	115	138	97	113	110	105	112	105	103	142	101	120	109	108	113
10	IET 27629	96	85	118	97	82	95	98	96	102	89	123	99	124	115	92	106
11	IET 26926	108	101	167	96	106	124	95	114	134	105	154	101	131	129	106	123
12	IET 27638	123	101	131	99	110	127	113	115	109	105	130	104	119	124	119	116
13	IET 27612	106	89	138	87	92	110	97	103	103	98	126	87	118	105	97	105
14	IET 27540	130	115	148	102	125	147	125	127	122	95	139	115	146	138	126	126
15	IET 27616	109	91	133	100	97	120	92	106	107	109	131	101	122	125	98	113
	Mean	**117**	**100**	**144**	**95**	**104**	**119**	**103**	**112**	**118**	**106**	**138**	**105**	**126**	**119**	**106**	**117**
	LSD (Treatment)									LSD (Treatment x Genotype)							
	LSD (Location x Treatment)									LSD (Location x Treatment x Genotype)							
	LSD (Genotype)									CV (Error Treat) (%)							
	LSD (Location x Genotype)									CV (Residual) (%)							

Table 6.6.4 Influence of Low-light stress on Panicle weight (g/m2) in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	1030	600	493	598	412	317	487	562	889	447	371	234	249	240	350	397
2	IET 27543	918	699	464	605	309	267	478	534	612	255	417	222	184	377	342	344
3	IET 27586	917	624	535	480	311	368	385	517	688	528	440	262	234	292	179	375
4	IET 27550	690	621	486	570	386	312	475	506	706	588	375	171	193	271	199	358
5	IET 27559	1335	588	531	985	437	373	610	694	1076	195	426	374	189	228	289	397
6	IET 27563	895	465	437	683	194	257	511	492	272	522	369	203	313	253	229	309
7	IET 27607	1298	678	483	513	342	390	508	602	1092	399	343	311	329	228	353	436
8	IET 27577	848	636	502	496	380	240	439	506	800	369	441	282	298	261	263	388
9	IET 26671	1059	732	618	605	402	389	467	610	760	330	552	152	385	227	264	381
10	IET 27629	676	375	461	631	340	293	604	483	580	626	367	248	215	138	292	352
11	IET 26926	1166	561	447	564	168	371	501	540	693	510	372	250	160	215	344	363
12	IET 27638	1311	597	467	581	248	314	540	580	708	549	432	284	234	91	379	382
13	IET 27612	775	606	509	603	374	339	636	549	616	589	399	266	308	203	465	407
14	IET 27540	1202	726	437	540	848	251	562	652	772	562	386	272	420	273	352	434
15	IET 27616	1039	600	559	895	214	214	365	555	742	447	426	303	171	390	219	385
	Mean	**1011**	**607**	**495**	**623**	**358**	**313**	**505**	**559**	**734**	**461**	**408**	**256**	**259**	**246**	**301**	**381**
	LSD (Treatment)				37**					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				98**					LSD (Location x Treatment x Genotype)				202**			
	LSD (Genotype)				ns					CV (Error Treat) (%)				29.3			
	LSD (Location x Genotype)				143**					CV (Residual) (%)				20.43			

Table 6.6.5 Influence of Low-light stress on Panicle number/m2 in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	457	0	385	194	283	200	290	302	453	0	308	123	150	263	224	254
2	IET 27543	470	0	396	219	233	270	233	304	463	0	330	149	250	280	318	298
3	IET 27586	483	0	374	198	250	283	243	305	430	0	363	168	200	263	190	269
4	IET 27550	360	0	418	256	317	340	255	324	523	0	363	158	183	197	120	257
5	IET 27559	477	0	407	243	267	350	443	364	280	0	330	139	200	197	266	235
6	IET 27563	537	0	352	292	300	303	255	340	377	0	264	167	217	190	171	231
7	IET 27607	427	0	374	150	267	215	288	287	450	0	297	138	183	170	246	247
8	IET 27577	413	0	363	213	350	317	177	306	417	0	363	144	283	160	128	249
9	IET 26671	613	0	418	240	250	267	247	339	517	0	341	168	233	190	167	269
10	IET 27629	507	0	418	283	250	283	403	357	457	0	308	180	250	210	317	287
11	IET 26926	380	0	374	202	200	300	266	287	417	0	297	164	183	173	220	242
12	IET 27638	487	0	418	209	217	253	295	313	500	0	374	160	217	230	338	303
13	IET 27612	413	0	385	223	233	307	361	320	423	0	330	155	183	127	435	276
14	IET 27540	473	0	418	242	383	363	273	359	513	0	341	200	233	167	362	303
15	IET 27616	360	0	396	319	200	297	209	297	507	0	330	147	250	207	187	271
	Mean	**457**	**0**	**393**	**232**	**267**	**290**	**283**	**320**	**448**	**0**	**329**	**157**	**214**	**202**	**246**	**266**
	LSD (Treatment)				13.0*					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				34.4*					LSD (Location x Treatment x Genotype)				99.5**			
	LSD (Genotype)				ns					CV (Error Treat) (%)				30.27			
	LSD (Location x Genotype)				70.34**					CV (Residual) (%)				18.72			

Table 6.6.6 Influence of Low-light stress on Grain number/panicle in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	92	142	91	163	16	158	193	122	83	108	84	88	22	125	136	92
2	IET 27543	97	152	129	172	23	167	189	132	68	149	122	72	0	128	209	107
3	IET 27586	68	151	127	130	0	227	173	125	66	132	115	82	0	127	67	84
4	IET 27550	137	139	127	120	23	195	158	128	64	130	115	97	3	106	29	78
5	IET 27559	130	185	128	213	17	153	163	141	154	158	109	117	0	174	133	121
6	IET 27563	75	148	131	147	0	125	152	111	30	127	125	66	0	136	92	82
7	IET 27607	150	153	124	156	0	155	223	137	127	101	115	122	0	170	179	116
8	IET 27577	86	103	87	118	0	165	119	97	86	142	79	80	0	136	180	100
9	IET 26671	72	144	129	120	78	206	147	128	70	116	111	51	59	164	170	106
10	IET 27629	70	127	124	120	0	147	132	103	67	91	114	100	0	190	220	112
11	IET 26926	167	150	129	146	0	160	139	127	85	113	119	115	0	191	142	109
12	IET 27638	119	134	121	171	0	167	191	129	67	121	112	97	0	141	209	107
13	IET 27612	110	180	117	174	36	188	189	142	83	157	102	128	13	174	134	113
14	IET 27540	105	183	129	119	105	170	164	139	66	154	120	52	38	146	180	108
15	IET 27616	147	105	128	194	0	177	118	124	76	107	116	123	0	166	91	97
	Mean	**108**	**146**	**121**	**151**	**20**	**171**	**163**	**126**	**80**	**127**	**110**	**93**	**9**	**152**	**145**	**102**
	LSD (Treatment)				9.02**					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				53.8*					LSD (Location x Treatment x Genotype)				55.8**			
	LSD (Genotype)				ns					CV (Error Treat) (%)				33.3			
	LSD (Location x Genotype)				39.5**					CV (Residual) (%)				23.19			

Table 6.6.7 Influence of Low-light stress on Spikelet number/panicle in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	129	0	99	178	231	151	207	166	110	0	95	133	175	198	164	146
2	IET 27543	126	0	138	209	191	213	206	180	98	0	136	126	201	151	239	158
3	IET 27586	105	0	137	153	169	138	194	149	93	0	129	125	136	169	88	123
4	IET 27550	193	0	138	166	223	117	170	168	92	0	130	157	156	156	64	126
5	IET 27559	153	0	138	287	198	182	201	193	229	0	123	179	118	175	147	162
6	IET 27563	103	0	142	178	187	157	171	156	75	0	139	122	161	147	106	125
7	IET 27607	158	0	134	198	273	130	240	189	133	0	128	164	244	153	224	174
8	IET 27577	115	0	96	144	122	181	134	132	118	0	92	144	158	163	196	145
9	IET 26671	113	0	137	166	109	199	160	147	87	0	124	99	135	202	191	140
10	IET 27629	103	0	134	147	124	135	145	131	103	0	128	131	99	200	253	152
11	IET 26926	211	0	136	183	253	158	158	183	109	0	132	173	126	178	163	147
12	IET 27638	129	0	128	205	220	170	208	176	87	0	123	148	213	198	233	167
13	IET 27612	150	0	127	205	204	147	209	174	127	0	116	183	183	208	176	166
14	IET 27540	133	0	139	163	195	182	179	165	76	0	137	90	189	170	207	145
15	IET 27616	173	0	139	238	254	123	132	176	102	0	130	195	214	170	103	152
	Mean	**140**	**0**	**131**	**188**	**197**	**159**	**181**	**166**	**109**	**0**	**124**	**145**	**167**	**176**	**170**	**149**
	LSD (Treatment)				ns					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				20.09**					LSD (Location x Treatment x Genotype)				64.2			
	LSD (Genotype)				ns					CV (Error Treat) (%)				23.7			
	LSD (Location x Genotype)				45.3**					CV (Residual) (%)				22.5			

Table 6.6.8 Influence of Low-light stress on Grain number/m2 in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	25228	0	34947	31597	4550	33610	56027	30993	22674	0	26136	10877	3300	49470	31453	23985
2	IET 27543	26660	0	50886	37562	5317	29163	44785	32395	18627	0	40315	10672	0	42263	68164	36008
3	IET 27586	19804	0	47168	25798	0	23417	42338	31705	16916	0	41866	13736	0	43617	12787	25784
4	IET 27550	21073	0	53031	30815	7217	24633	40461	29538	20254	0	41613	15172	600	57197	3502	23056
5	IET 27559	37354	0	52008	51923	4367	32037	70729	41403	25729	0	35948	16339	0	30633	34150	28560
6	IET 27563	23946	0	46244	42937	0	32087	38442	36731	6668	0	33066	11037	0	49277	15916	23193
7	IET 27607	38247	0	46486	23629	0	35570	64995	41785	34386	0	34210	16775	0	33050	46025	32889
8	IET 27577	21381	0	31768	25395	0	31100	21157	26160	21124	0	28556	11685	0	26700	23674	22348
9	IET 26671	26653	0	53735	28886	19583	39000	35325	29026	21736	0	37873	8501	13683	44683	28046	25754
10	IET 27629	21302	0	51766	34103	0	28567	53413	37830	18152	0	34991	18223	0	48517	69325	37841
11	IET 26926	37694	0	48202	29289	0	20120	37892	34639	21131	0	35233	18991	0	28150	31228	26947
12	IET 27638	34758	0	50358	35716	0	31083	56123	41608	20096	0	41756	15314	0	37373	70712	37051
13	IET 27612	26565	0	45133	38506	8500	31600	67122	36238	20989	0	33132	19950	2333	34030	57747	28030
14	IET 27540	29813	0	54032	28799	40250	28900	44972	37794	20074	0	40931	10123	8933	45900	64685	31774
15	IET 27616	31483	0	50545	61143	0	24900	24514	38517	22992	0	38093	18366	0	36733	16977	26632
	Mean	**28131**	**0**	**47754**	**35073**	**5986**	**29719**	**46553**	**27602**	**20770**	**0**	**36248**	**14384**	**1923**	**40506**	**38293**	**25354**
	LSD (Treatment)				ns					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				1050**					LSD (Location x Treatment x Genotype)				7928**			
	LSD (Genotype)				ns					CV (Error Treat) (%)				18.41			
	LSD (Location x Genotype)				2677**					CV (Residual) (%)				34.3			

Table 6.6.9 Influence of Low-light stress on Spikelet number/m2 in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	35554	0	38082	34552	65367	1200	60271	39171	30129	0	29403	16499	26250	1950	38120	23725
2	IET 27543	34886	0	54549	45623	44333	1430	48477	38216	26763	0	44924	18738	48817	1667	77797	36451
3	IET 27586	30362	0	51095	30146	42333	1477	47550	33827	23741	0	46706	20938	27267	4140	16862	23276
4	IET 27550	29337	0	57552	42570	70617	1210	43568	40809	29181	0	47102	24793	25300	4400	7729	23084
5	IET 27559	43800	0	56243	70010	52033	915	87402	51734	36946	0	40326	24916	23950	3807	37905	27975
6	IET 27563	32572	0	50226	52092	56000	1295	43488	39279	16705	0	36718	20389	34617	4453	18491	21896
7	IET 27607	40220	0	50226	29842	69067	1393	69967	43453	36091	0	38115	22640	35767	3400	57806	32303
8	IET 27577	28640	0	34925	30982	48800	1493	24031	28145	28935	0	33275	20803	45100	3640	25838	26265
9	IET 26671	41632	0	57112	39861	27167	1434	38600	34301	27016	0	42317	16551	31417	4527	31425	25542
10	IET 27629	31172	0	55814	41836	30917	1033	58775	36591	28148	0	39534	23674	24833	4444	79411	33341
11	IET 26926	47772	0	50963	36751	50533	1173	42675	38311	27353	0	39248	28571	22950	5113	35806	26507
12	IET 27638	37644	0	53471	42712	47800	1404	61122	40692	26084	0	45991	23394	46017	3857	78984	37388
13	IET 27612	36571	0	49005	45394	46567	1522	74138	42199	32325	0	37950	28435	33950	3117	76396	35362
14	IET 27540	37843	0	58124	39466	74333	1433	49044	43374	23231	0	46926	17757	44200	4360	74555	35172
15	IET 27616	37144	0	54758	75727	50733	1320	27242	41154	30913	0	42922	28513	53750	4940	19191	30038
	Mean	**36343**	**0**	**51476**	**43838**	**51773**	**1316**	**51757**	**39417**	**28237**	**0**	**40764**	**22441**	**34946**	**3854**	**45088**	**29222**
	LSD (Treatment)			1148*						LSD (Treatment x Genotype)			ns				
	LSD (Location x Treatment)			4210**						LSD (Location x Treatment x Genotype)			14897**				
	LSD (Genotype)			ns						CV (Error Treat) (%)			22.3				
	LSD (Location x Genotype)			10351**						CV (Residual) (%)			23.9				

Table 6.6.10 Influence of Low-light stress on 1000 grain weight (g) in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	21.7	21.7	21.8	24.5	22.6	21.6	27.7	23.1	20.8	21.1	17.5	21.1	17.2	21.3	26.9	20.9
2	IET 27543	17.4	21.1	20.5	20.5	16.4	22.5	24.5	20.4	16.6	17.2	14.7	17.3	0.0	24.5	24.0	19.0
3	IET 27586	23.7	23.1	22.3	23.6	0.0	17.9	15.5	21.0	21.1	21.7	17.0	22.7	0.0	23.3	14.7	17.2
4	IET 27550	17.5	18.7	21.5	19.9	20.1	20.3	26.3	20.6	17.2	16.7	15.3	18.5	12.6	22.9	22.3	17.2
5	IET 27559	18.9	17.7	22.6	22.9	20.5	23.6	27.7	22.0	21.2	17.2	18.0	23.3	0.0	20.1	24.8	20.8
6	IET 27563	18.2	16.1	21.4	21.3	0.0	24.0	19.4	20.1	16.6	16.6	16.1	18.9	0.0	20.4	14.1	17.1
7	IET 27607	19.6	19.4	20.2	19.3	0.0	20.8	20.9	20.0	18.0	17.5	17.2	18.3	0.0	20.7	17.0	18.1
8	IET 27577	20.1	20.1	22.2	23.6	0.0	22.2	17.8	21.0	19.2	17.6	18.7	20.4	0.0	21.3	14.1	18.5
9	IET 26671	20.1	21.5	22.3	20.0	22.4	20.0	18.7	20.7	19.1	20.1	19.1	19.9	22.6	21.8	17.6	20.0
10	IET 27629	16.3	19.3	20.1	17.3	0.0	20.4	22.5	19.3	15.8	14.5	17.3	15.9	0.0	22.2	19.7	17.6
11	IET 26926	16.4	15.5	22.9	19.3	0.0	24.3	27.1	20.9	16.5	16.6	19.4	18.0	0.0	21.5	23.1	19.2
12	IET 27638	21.6	22.2	20.5	21.6	0.0	22.2	26.9	22.5	19.5	19.6	18.2	19.1	0.0	22.7	22.0	20.2
13	IET 27612	15.3	14.4	21.1	17.7	17.0	22.7	25.5	19.1	15.4	15.5	17.7	16.1	14.9	23.8	20.7	17.7
14	IET 27540	22.3	20.7	19.9	22.1	25.2	19.6	20.2	21.4	21.3	20.4	18.5	19.6	22.5	23.0	18.7	20.6
15	IET 27616	18.3	16.6	20.5	19.1	0.0	22.3	16.7	18.9	17.4	16.5	17.1	18.0	0.0	22.1	13.8	17.5
	Mean	**19.2**	**19.2**	**21.3**	**20.8**	**9.6**	**21.6**	**22.5**	**19.2**	**18.4**	**17.9**	**17.5**	**19.1**	**6.0**	**22.1**	**19.6**	**17.2**
	LSD (Treatment)				0.223*					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				0.593**					LSD (Location x Treatment x Genotype)				3.1			
	LSD (Genotype)				ns					CV (Error Treat) (%)				5.165			
	LSD (Location x Genotype)				2.19**					CV (Residual) (%)				8.077			

Table 6.6.11 Influence of Low-light stress on Shoot weight (g/m^2) in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	982	1510	347	701	1204	410	769	846	888	1593	295	433	1040	459	632	763
2	IET 27543	1097	1469	402	690	1368	502	808	905	967	1572	371	443	2124	347	711	933
3	IET 27586	1182	2024	325	542	1389	537	716	959	918	2223	289	450	1570	333	389	882
4	IET 27550	939	1876	418	521	1103	636	774	895	768	1798	395	297	1323	316	222	731
5	IET 27559	1190	1392	377	952	1653	476	866	986	1271	1383	332	436	1691	365	354	833
6	IET 27563	1275	1558	394	813	1409	447	560	922	912	2070	356	438	1758	322	266	875
7	IET 27607	1224	1835	540	700	2148	443	614	1072	954	1649	472	487	2104	242	426	905
8	IET 27577	1437	2182	508	841	1776	639	701	1155	1071	2502	494	459	1620	236	371	965
9	IET 26671	895	1821	378	663	1414	514	861	935	715	1275	367	354	1454	339	405	701
10	IET 27629	831	1796	455	644	2211	471	1006	1059	654	1794	459	337	2036	354	520	879
11	IET 26926	1312	1661	303	750	1729	388	1046	1027	973	1952	292	497	1558	382	628	897
12	IET 27638	1111	1711	562	619	1478	380	817	954	852	1503	527	330	1871	416	469	852
13	IET 27612	780	1700	462	599	1181	526	1182	918	854	1518	369	370	1527	306	425	767
14	IET 27540	1052	1965	476	562	1596	705	738	1014	845	1476	436	380	1500	255	819	816
15	IET 27616	1013	1446	396	939	2144	540	650	1018	973	1497	341	397	1870	383	469	847
	Mean	**1088**	**1730**	**423**	**702**	**1587**	**508**	**807**	**978**	**908**	**1720**	**386**	**407**	**1670**	**337**	**474**	**843**
	LSD (Treatment)				ns					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				117**					LSD (Location x Treatment x Genotype)				235**			
	LSD (Genotype)				ns					CV (Error Treat) (%)				20.49			
	LSD (Location x Genotype)				166**					CV (Residual) (%)				12.34			

Table 6.6.12 Influence of Low-light stress on Grain yield (g/m2) in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	547	352	391	482	171	545	417	415	474	228	310	142	117	292	318	269
2	IET 27543	463	334	440	512	150	3386	415	814	309	250	354	99	0	359	262	272
3	IET 27586	470	446	433	413	0	612	344	453	358	272	351	173	0	399	128	280
4	IET 27550	368	435	470	475	335	614	442	448	345	250	378	122	108	239	170	230
5	IET 27559	706	383	462	851	185	632	535	448	544	262	363	271	0	293	205	323
6	IET 27563	436	410	426	561	0	663	450	491	111	235	361	143	0	200	188	207
7	IET 27607	749	427	533	445	0	456	457	511	616	260	409	270	0	225	292	345
8	IET 27577	430	323	522	436	0	683	388	464	405	266	422	190	0	258	192	289
9	IET 26671	537	447	512	472	375	510	397	464	416	244	443	100	251	234	205	270
10	IET 27629	347	377	475	536	0	536	521	465	287	243	404	212	0	306	222	279
11	IET 26926	615	386	376	460	0	505	423	461	349	260	327	219	0	248	277	280
12	IET 27638	750	373	531	526	0	562	455	533	391	233	433	258	0	288	318	320
13	IET 27612	402	351	527	515	255	580	534	452	325	272	332	177	116	206	312	248
14	IET 27540	665	334	490	478	349	620	499	491	427	249	405	234	266	255	231	295
15	IET 27616	575	446	477	843	0	433	335	518	400	260	354	231	0	244	195	281
	Mean	**537**	**388**	**471**	**534**	**121**	**756**	**441**	**464**	**384**	**252**	**376**	**189**	**57**	**270**	**234**	**252**
	LSD (Treatment)			43.0*						LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)			159.8**						LSD (Location x Treatment x Genotype)				ns			
	LSD (Genotype)			ns						CV (Error Treat) (%)				26.3			
	LSD (Location x Genotype)			379*						CV (Residual) (%)				29.7			

Table 6.6.13 Influence of Low-light stress on Harvest Index (%) in different rice varieties during Kharif 2018

S.No.	Entries	Control							Grand Mean	Treated (Low light)							Grand Mean
		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB		IIRR	KJT	MTU	NRRI	PNR	RPR	TTB	
1	IET 27561	45.3	28.8	47.0	37.1	12.4	0.0	33.2	29.1	44.1	49.8	46.6	21.2	10.1	0.0	32.4	29.2
2	IET 27543	38.4	28.4	50.8	39.8	9.9	0.0	32.3	28.5	32.7	40.1	45.0	14.8	0.0	0.0	26.0	22.7
3	IET 27586	37.1	33.2	50.4	40.4	0.0	0.0	31.2	27.5	37.1	51.0	48.1	24.3	0.0	0.0	22.8	26.2
4	IET 27550	37.4	33.8	52.1	43.6	23.3	0.0	35.5	32.2	38.9	49.1	49.2	25.9	7.5	0.0	40.4	30.1
5	IET 27559	46.4	29.2	50.8	43.8	10.0	0.0	36.4	30.9	38.5	45.6	48.4	33.4	0.0	0.0	33.1	28.4
6	IET 27563	33.5	34.0	51.3	37.5	0.0	0.0	42.1	28.3	15.6	40.7	50.2	22.1	0.0	0.0	38.9	23.9
7	IET 27607	49.7	35.7	52.2	36.6	0.0	0.0	40.7	30.7	50.1	42.4	50.2	34.1	0.0	0.0	37.7	30.6
8	IET 27577	31.3	25.7	51.8	32.7	0.0	0.0	34.1	25.1	36.1	41.2	45.2	25.6	0.0	0.0	30.5	25.5
9	IET 26671	45.6	32.8	51.9	37.2	21.0	0.0	30.0	31.2	47.0	41.7	48.3	19.9	14.7	0.0	30.7	28.9
10	IET 27629	38.4	23.8	51.9	42.1	0.0	0.0	32.5	27.0	38.8	40.3	49.1	36.3	0.0	0.0	27.3	27.4
11	IET 26926	41.3	26.1	50.3	35.1	0.0	0.0	27.4	25.7	34.9	41.8	49.2	29.3	0.0	0.0	28.9	26.3
12	IET 27638	51.6	28.7	51.6	43.8	0.0	0.0	33.5	29.9	41.8	41.9	45.3	42.2	0.0	0.0	39.4	30.1
13	IET 27612	43.4	23.7	54.3	42.7	17.8	0.0	29.4	30.2	36.8	44.2	43.4	27.8	7.2	0.0	35.2	27.8
14	IET 27540	49.2	28.0	53.7	43.5	17.9	0.0	38.3	32.9	44.2	43.2	49.4	36.0	15.1	0.0	19.8	29.7
15	IET 27616	46.7	33.8	50.0	45.7	0.0	0.0	33.0	29.9	38.5	42.4	46.2	33.0	0.0	0.0	28.4	26.9
	Mean	**42.3**	**29.7**	**51.3**	**40.1**	**7.5**	**0.0**	**34.0**	**29.3**	**38.3**	**43.7**	**47.6**	**28.4**	**3.6**	**0.0**	**31.4**	**27.6**
	LSD (Treatment)				ns					LSD (Treatment x Genotype)				ns			
	LSD (Location x Treatment)				2.51**					LSD (Location x Treatment x Genotype)				5.59**			
	LSD (Genotype)				ns					CV (Error Treat) (%)				14.09			
	LSD (Location x Genotype)				3.97**					CV (Residual) (%)				9.31			

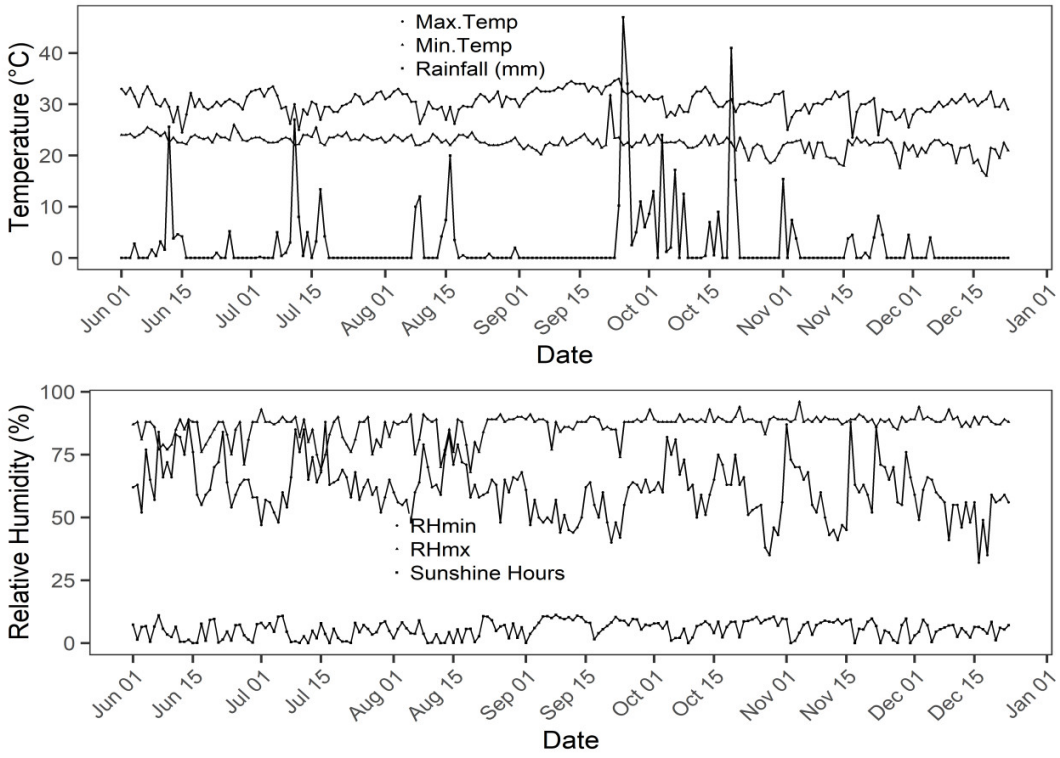


Fig. 1 Important weather parameters recorded at Coimbatore (CBT) centre during Kharif 2018 season

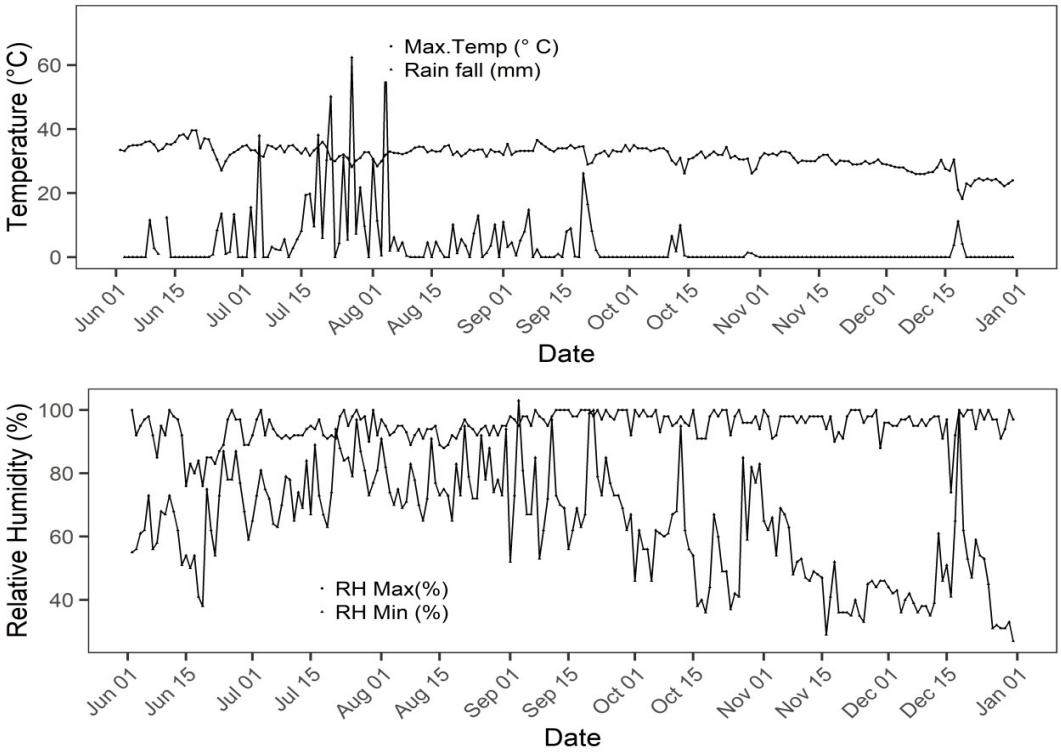


Fig.2: Important weather parameters recorded at Chinsurah (CHN) centre during Kharif -2018

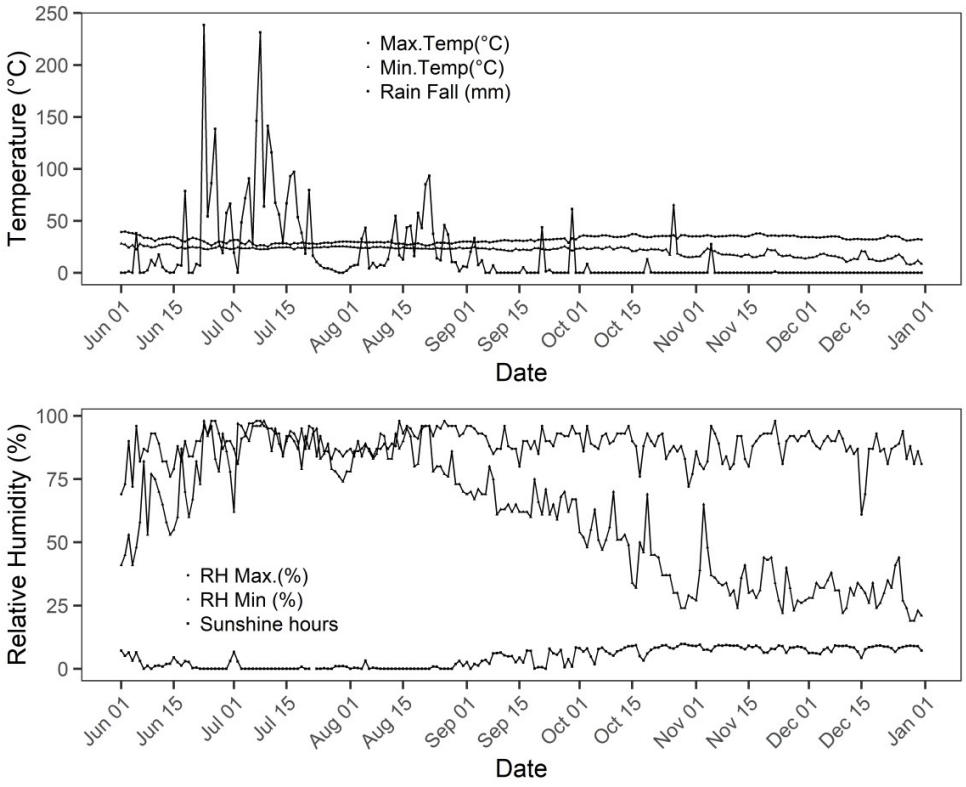


Fig. 3: Important weather parameters recorded at Karjat centre (KJT) during kharif-2018

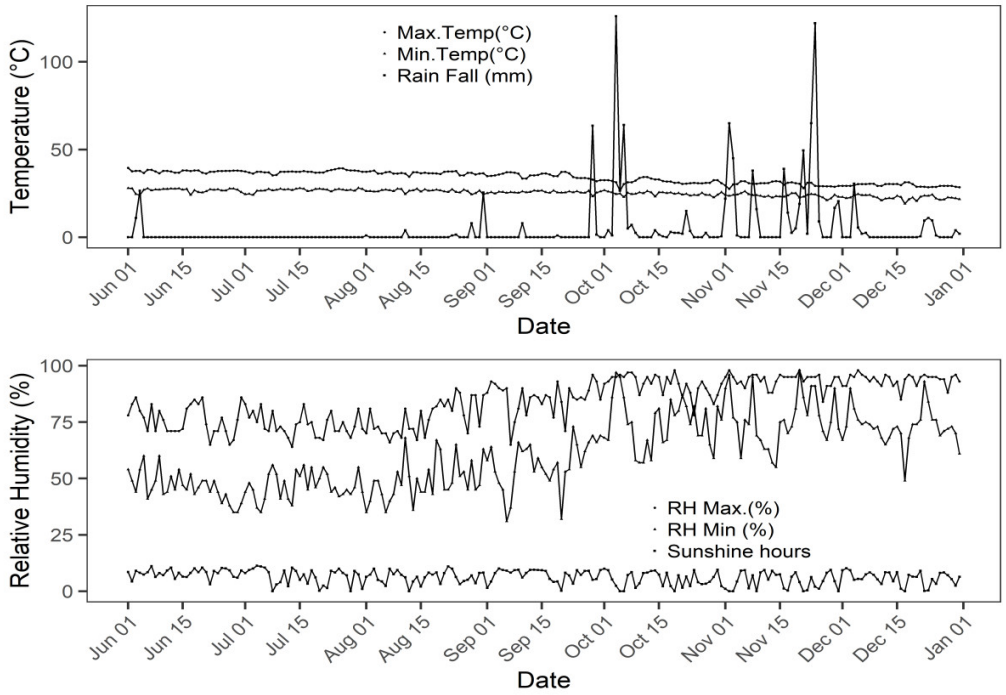


Fig. 4: Important weather parameters recorded at Karaikal centre (KRK) during kharif 2018

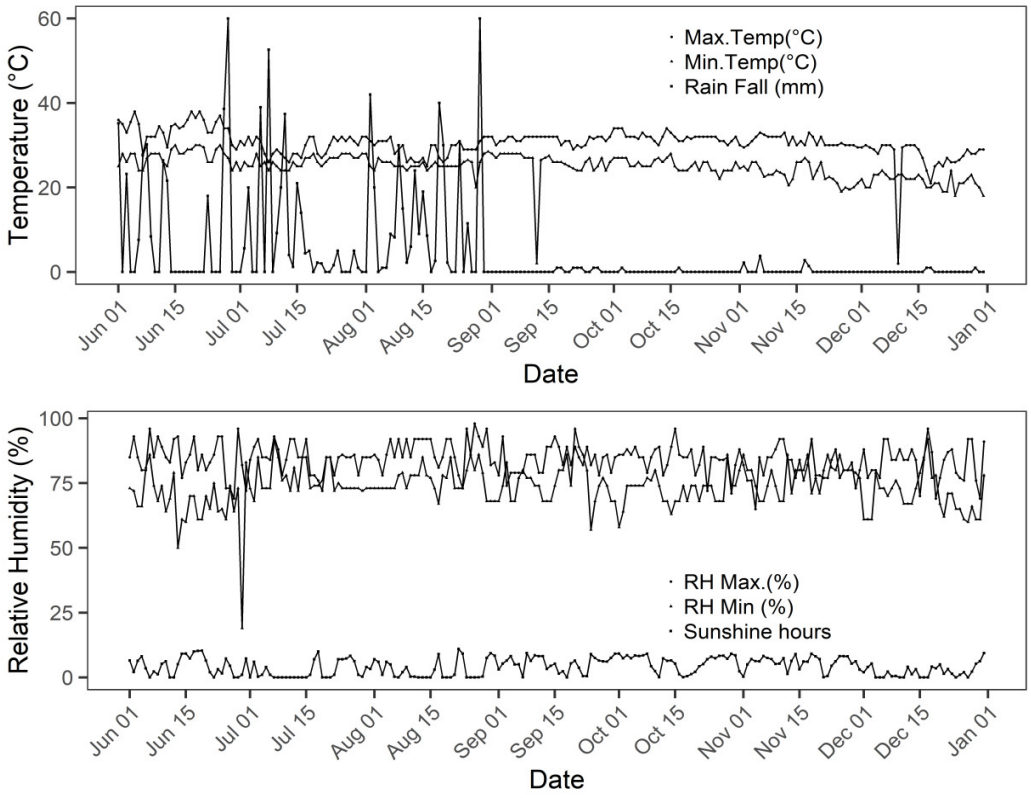


Fig.5 : Important weather parameters recorded at Maruteru (MTU) centre during kharif-2018

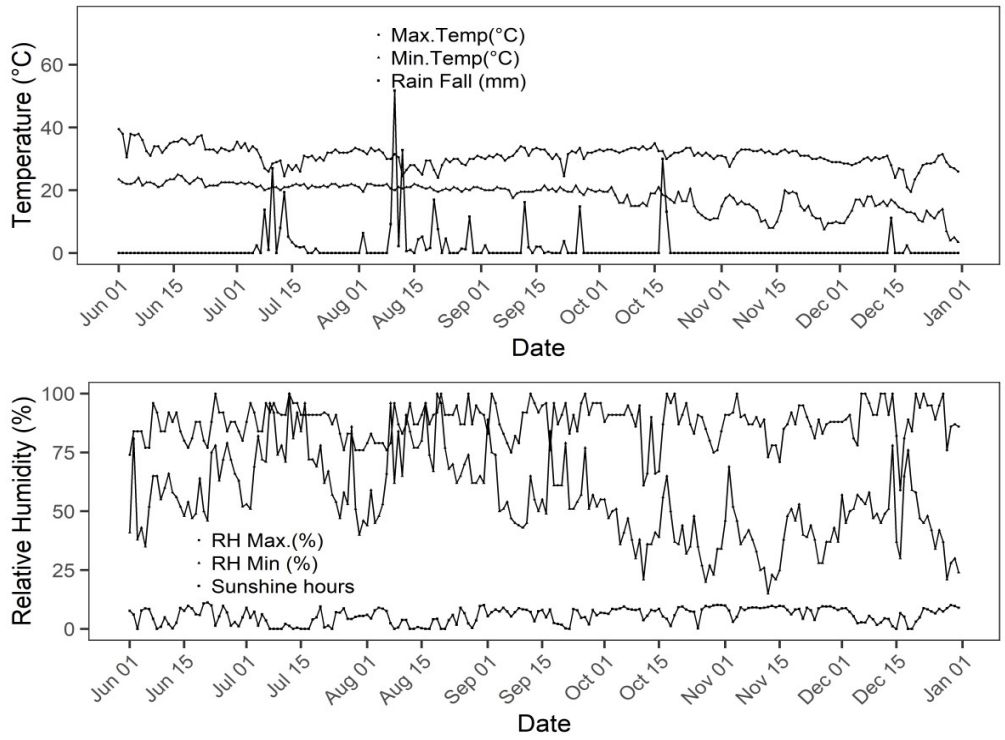


Fig 6 : Important weather parameters recorded at IIRR centre during kharif-2018

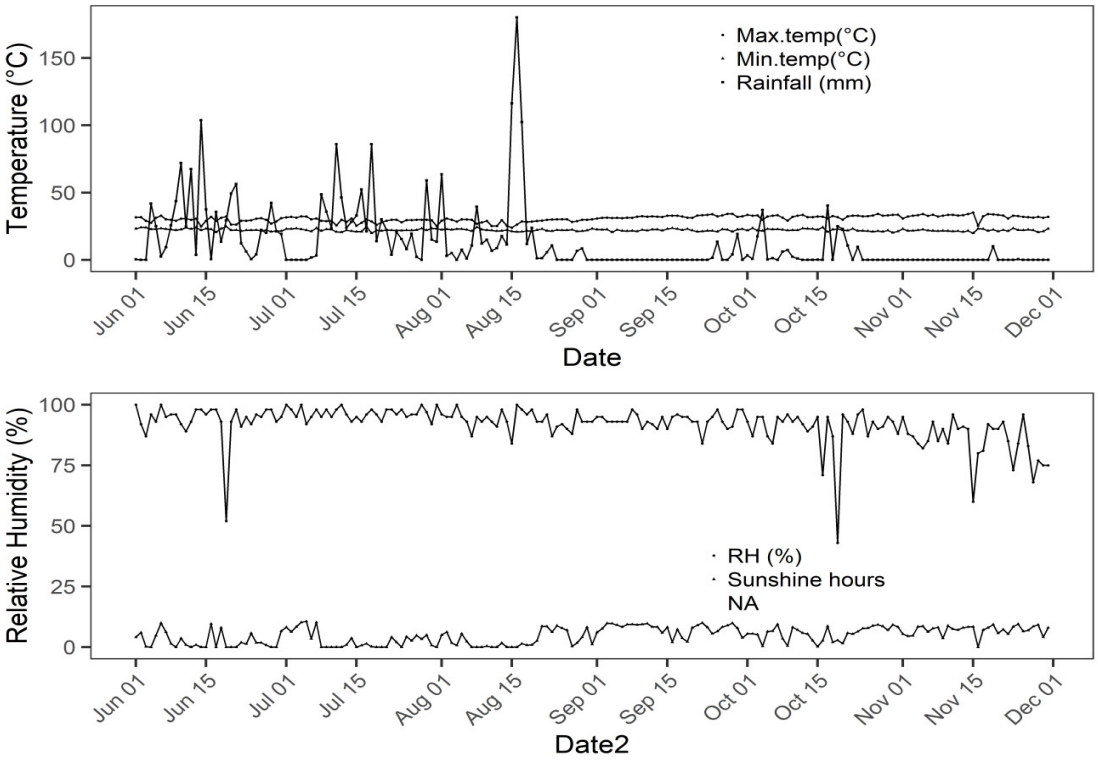


Fig.7 : Important weather parameters recorded at Pantnagar (PNR) centre during Kharif-2018

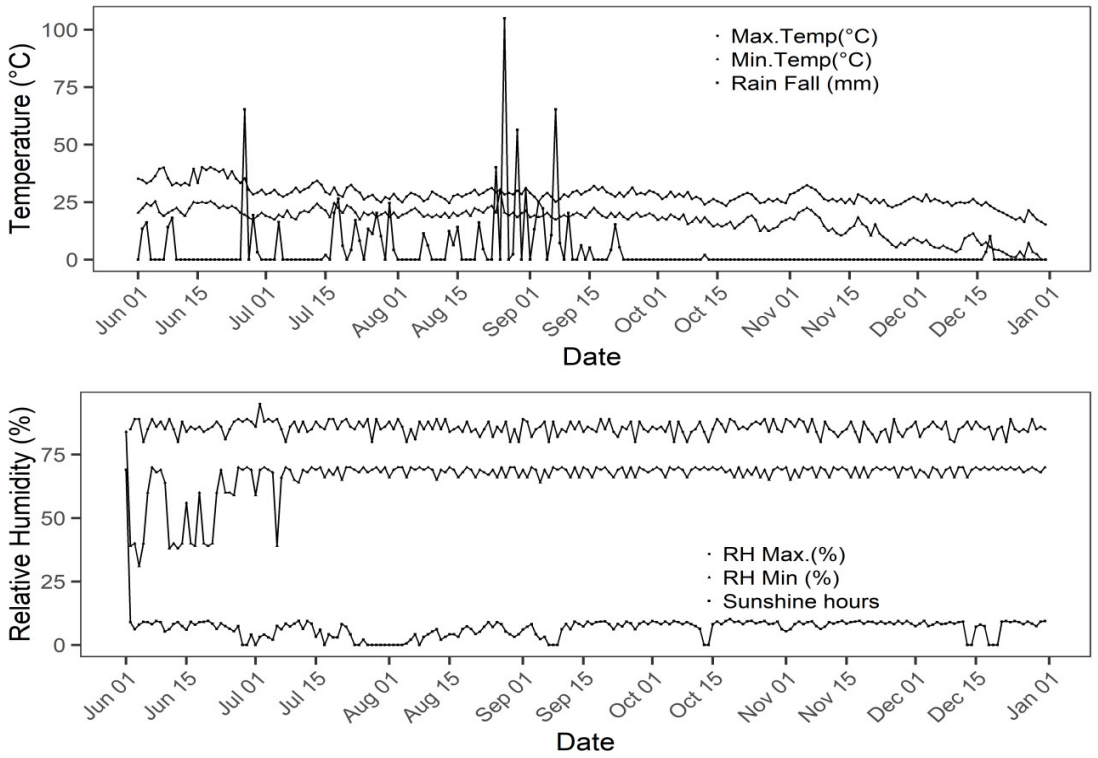


Fig.8 : Important weather parameters recorded at Ranchi centre during Kharif-2018

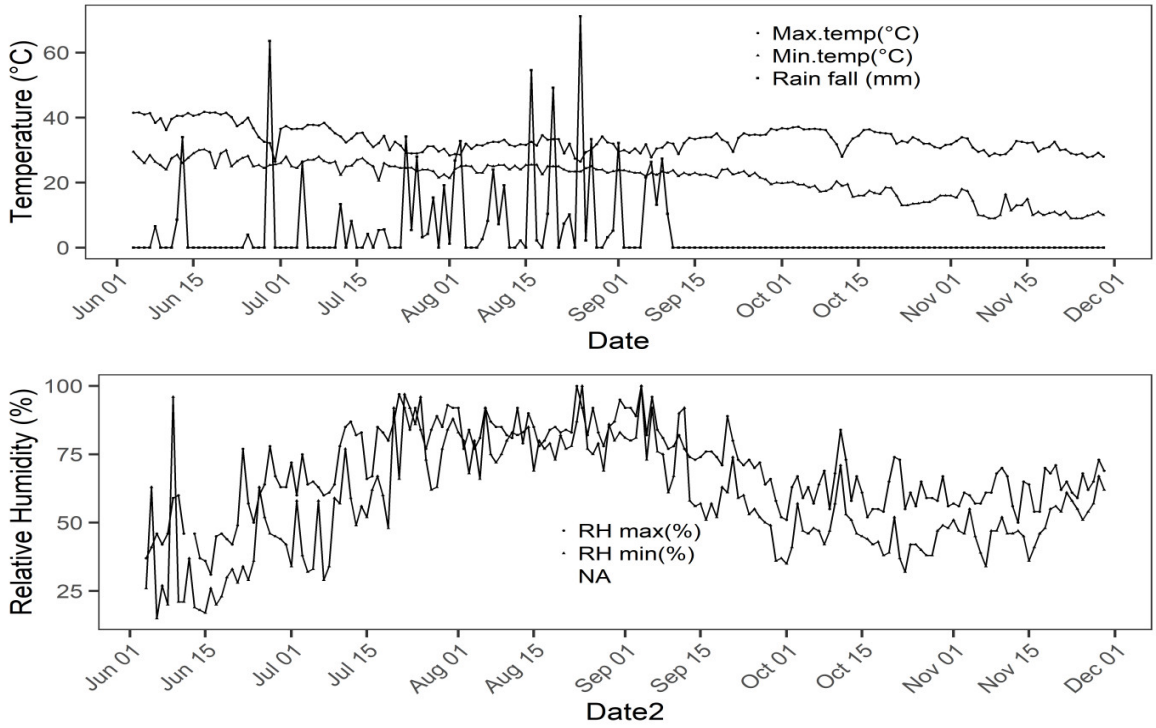


Fig.9 : Important weather parameters recorded at REWA centre during kharif-2018

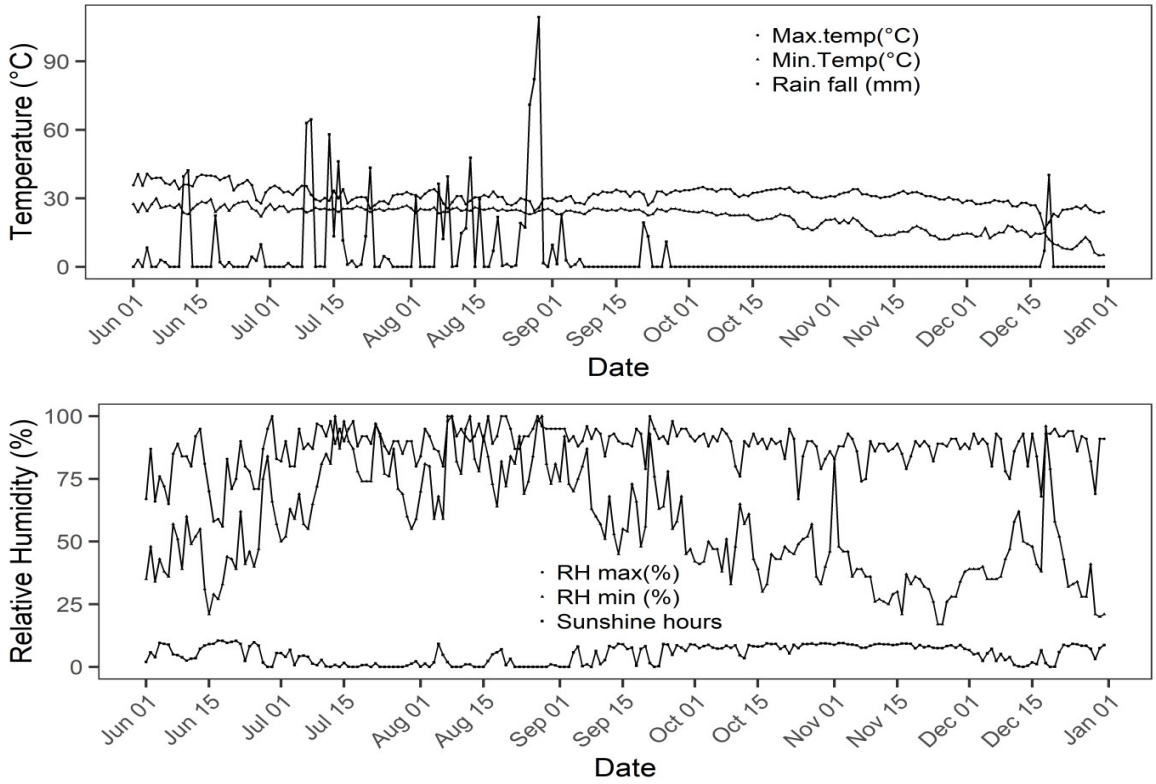


Fig.10 : Important weather parameters recorded at Raipur (RPR) centre during kharif-2018

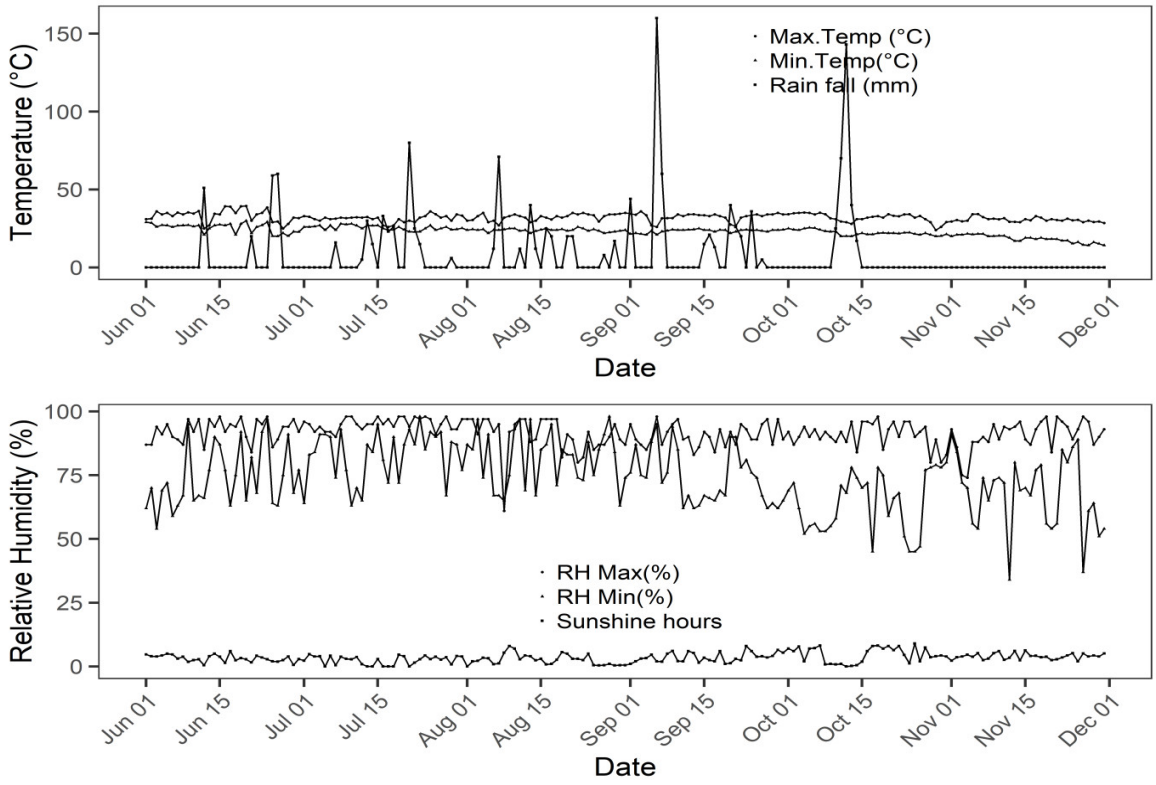


Fig.11 : Important weather parameters recorded at NRRI centre during Kharif-2018

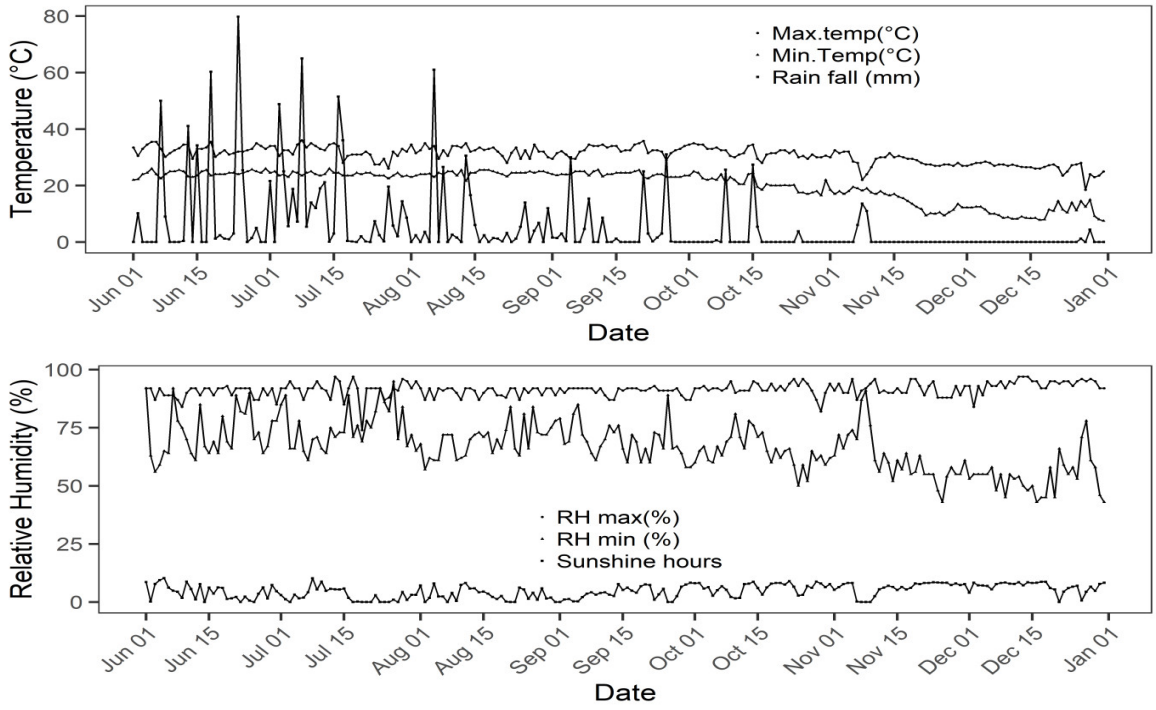


Fig.12 : Important weather parameters recorded at Titabar (TTB) centre during Kharif-2018

A P P E N D I X - II

Rice cultures of Physiology

	RNUE		HT			RFU				MAS			LLS	
S.No.	Entries	S.No.	Entries		S.No.	Entries			S.No.	Entries		S.No.	Entries	
1	BPT-5204	1	IET 24911	IVT-E-TP	1	IET 27508	IVT-E		1	IET 26487	AVT-1-IME	1	IET 27561	IVT-RSL
2	Jaya	2	IET 24914	IVT-E-TP	2	IET 27509	IVT-E		2	IET 26493	AVT-1-IME	2	IET 27543	IVT-RSL
3	MTU-1010	3	IET 25713	IVT-E-TP	3	IET 27510	IVT-E		3	IET 26498	AVT-1-IME	3	IET 27586	IVT-SDW
4	Rasi	4	IET 26464	IVT-E-TP	4	IET 27511	IVT-E		4	IET 26866	AVT-1-IME	4	IET 27550	IVT-RSL
5	Rasi x Jaya/2	5	IET 26465	IVT-E-TP	5	IET 27512	IVT-E		5	IET 26871	AVT-1-IME	5	IET 27559	IVT-RSL
6	Sampada	6	IET 26468	IVT-E-TP	6	IET 27513	IVT-E		6	IET 26908	AVT-1-IME	6	IET 27563	IVT-RSL
7	Sampada x Jaya/2	7	IET 26474	IVT-E-TP	7	IET 27514	IVT-E		7	IET 26910	AVT-1-IME	7	IET 27607	IVT-L
8	Sampada x Jaya/3	8	IET 26477	IVT-E-TP	8	IET 27515	IVT-E		8	IET 26913	AVT-1-IME	8	IET 27577	IVT-SDW
9	Varadhan	9	IET 26478	IVT-E-TP	9	IET 27516	IVT-E		9	IET 26917	AVT-1-IME	9	IET 26671	IVT-SDW
10	Varadhan x BPT 5204/10	10	IET 26480	IVT-E-TP	10	IET 27517	IVT-E		10	GONTRABIDHAN-3	AVT-1-IME	10	IET 27629	IVT-L
11	Varadhan x BPT 5204/6	11	IET 26756	IVT-E-TP	11	Sahabhagidhan	IVT-E		11	KARJAT-7	AVT-1-IME	11	IET 26926	IVT-RSL
12	Varadhan x MTU 1010/2	12	IET 26763	IVT-E-TP	12	IET 27518	IVT-E		12	LALAT	AVT-1-IME	12	IET 27638	IVT-L
		13	IET 26767	IVT-E-TP	13	IET 27519	IVT-E		13	MTU-1010	AVT-1-IME	13	IET 27612	IVT-L
	SILICON	14	IET 26771	IVT-E-TP	14	IET 27520	IVT-E		14	PR-113	AVT-1-IME	14	IET 27540	IVT-RSL
1	HRI-174	15	IET 26780	IVT-E-TP	15	IET 27521	IVT-E		15	US-312	AVT-1-IME	15	IET 27616	IVT-L
2	KRH-4	16	IET 26789	IVT-E-TP	16	IET 27522	IVT-E		16	BPT-2411	AVT-1-IME			
3	PA-6129	17	IET 26790	IVT-E-TP	17	IET 27523	IVT-E		17	BPT-2593	AVT-1-IME			
4	PA-6444	18	IET 26794	IVT-E-TP	18	IET 27524	IVT-E		18	BPT-2595	AVT-1-IME			
5	SAHABHAGIDHAN	19	IET 26799	IVT-E-TP	19	IET 27525	IVT-E		19	BPT-2766	AVT-1-IME			
6	US-312	20	IET 26803	IVT-E-TP	20	Vandana	IVT-E		20	BPT-2776	AVT-1-IME			
		21	IET 26804	IVT-E-TP	21	IET 27526	IVT-E		21	BPT-2782	AVT-1-IME			
		22	IET 26806	IVT-E-TP	22	IET 27527	IVT-E							
		23	IET 26807	IVT-E-TP	23	IET 27528	IVT-E							
		24	PR-124	IVT-E-TP	24	IET 27529	IVT-E							
		25	LUIT	IVT-E-TP	25	IET 27530	IVT-E							
		26	NARENDRA-97	IVT-E-TP	26	Tulasi	IVT-E							
		27	US-314	IVT-E-TP	27	NDR-97	IVT-E							
		28	SAHABHAGIDHAN	IVT-E-TP	28	Govind	IVT-E							
		29	MTU-1153	IVT-E-TP	29	Samaleshwari	IVT-E							
		30	CO-51	IVT-E-TP	30	Varalu	IVT-E							

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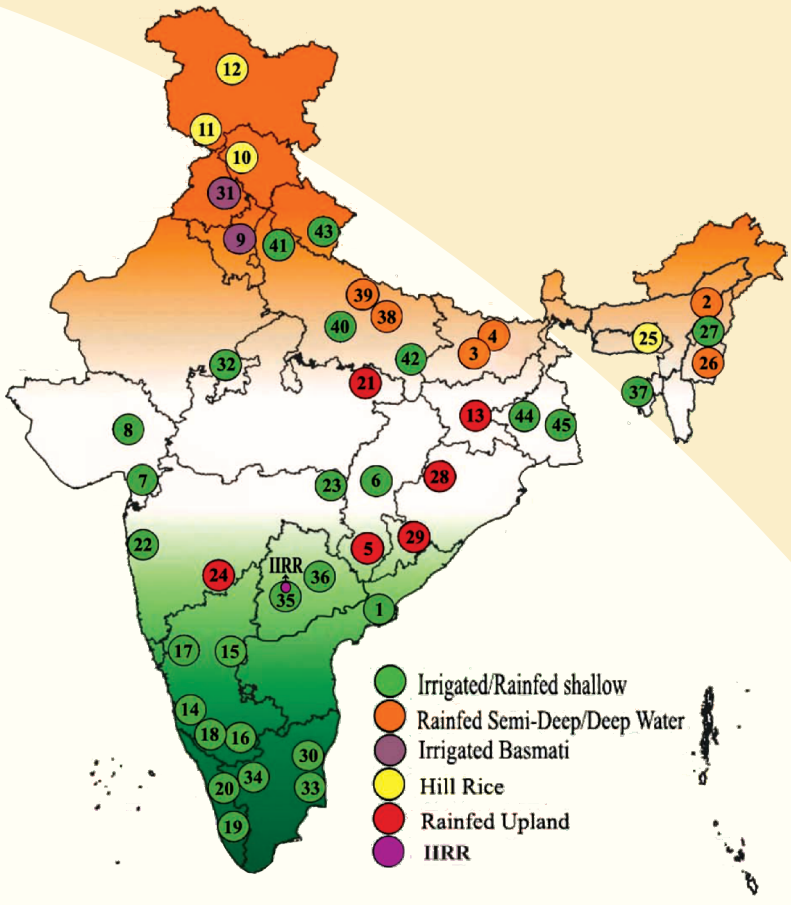
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Jaya Rice Variety
Developed by *Padma Shri Dr SVS Shastri*
which is still popular with Farmers.



भाकृअनुप ICAR

भाचाअनुसं IIRR

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