TECHNICAL PROGRAMME

ALL INDIA COORDINATED SOIL SCIENCE TRIALS

2018 – 19

ICAR - Indian Institute of Rice Research (IIRR)
Rajendranagar, Hyderabad - 500 030, Telangana.

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

Additional objectives:

1. To study potential of carbon sequestration in the soils in all the treatments, besides analysing soil for biological parameters like soil respiration, microbial biomass carbon, important enzyme activities and available sulphur and zinc status and contribution of irrigation water / silt to S nutrition. The methodology for C sequestration and enzyme studies will be provided later.
2. To evaluate the influence of liming (in acids soils only) on rice productivity and nutrient dynamics (treatment no. 7) and additional dose of vermicompost and oil cakes (treatment no. 13)

Trt. No.	Treatment details
1	Control –1, No fertilizer or manure
2	100% PK
3A	100% NK in place of 100% N
3B	STCR recommended dose for target yield
4	100% NP
5A	100 % NPK + Zn + S
5B	100% NPK+ Zn + S + FYM / PM @ 5 t/ha (to be applied in *kharif* and *rabi* seasons)
6	100% NPK –Zn
7A	100% NPK – S
7B	100% NPK – S + liming @1.0 t/ha (only in acid soils - Titabar)
8	100% N + 50% P + 50%K
9A	50% NPK
9B	50% NPK+ *Azospirillum* (both seasons in rice-rice and in *kharif* in rice-CP system)
10	50% NPK + 50% GM – N (GM – N to be applied in both seasons)
11	50% NPK + 50% FYM – N (FYM – N to be applied in both seasons)
12	50% NPK + 25% GM-N + 25% FYM–N (GM and FYM–N applied in both seasons)
13A	FYM @ 10 t/ha (In both *kharif* and *rabi* season)
13B	FYM@10t/ha + 3.0 t/ha Vermicompost + 200 kg/ha oil cakes as top dressing (In both *kharif* and *rabi* season)

At all locations Azospirillum is included additionally in INM and FYM treatments (T9, T11, T12, and T13)

Design: RBD; Replications: 4; Gross plot size: 100 m^2 surrounded by 1-2 m wide buffer zone. Spacing: 20 x 10 cm (for rice) and for other crops as per recommendation.
Water management: Continuous submergence up to 5-8 cm depth for rice, and for other crops irrigation to be provided as per recommendations.

Experimental details:

1. NPK levels: The recommended levels of NPK for the respective zone, crop and season have to be applied. The levels of NPK applied should be reported for each crop/season.

2. Apply $ZnSO_4$ @ 40 kg/ha once either in *kharif or rabi* season depending on the local recommendations, uniformly to all the plots except in treatments 6 and 7.
3. In treatment No.6 Zn should not be applied while in treatment No.7, Zn is applied by dipping seedlings in 2.0% ZnO_2 suspension before transplanting rice.
4. In treatment No.7 phosphorus is applied through triple super phosphate (TSP) or Diammonium Phosphate (DAP) instead of Single Super Phosphate (SSP) to avoid application of S. In all other treatments P is supplied through SSP. This has to be followed for both the seasons continuously. In acid soils (Titabar only), liming treatment may be imposed in 50% of the plot area by applying lime @ 1 t/ha in *kharif* season to assess the impact of lime on soil nutrient dynamics and rice productivity.
5. Treatment No. 3: One half of treatment 3 should be imposed with 100%NK treatment in place of 100% N treatment, and in the second half impose soil test based fertilizer recommendation for a yield target of *kharif* and *rabi* crops obtained at each location. Analyse the soil in treatment No. 3 for available N, P, and K and apply STCR fertilizer recommendation as per the equation developed for the district by STCR scheme. The yield target yield should be the one that is realisable at the location recorded in the STCR experiments or in progressive farmers' fields. Report the STCR recommended dose and the target yield fixed.
6. Treatment No.5: One half of the plot should be continued as per the old treatment. In the second half impose additionally FYM/poultry manure @ 5 t/ha. The nutrient composition (NPK) of the FYM/poultry manure applied should be furnished.
7. Treatment No 9: One half of the treatment area should be continued as per the old treatment i.e., 50% NPK. In the second half impose bio fertilizer treatment of applying *Azospirillum* mixed in suitable quantity of cow dung /FYM slurry at the rate recommended for the location for both *kharif* and *rabi* crops in rice – rice system, and for *kharif* crop in rice –cowpea system. The quantity and the rate of bio fertilizer application and the procedure followed should be reported.
8. N and K, wherever necessary are applied through urea and muriate of potash (MOP). However, in treatment No.7, where DAP is the source of P, the N applied through DAP should be accounted for the total N dose.
9. For treatments 10 and 12, 8 week old Dhaincha (*Sesbania aculeata*) or leaves of *Glyricidia* sp. plants or any other green manure crop suitable to the location should be used in both the seasons (*kharif and rabi*) to supply the required amount of N. The quantity of green manure (fresh) incorporated and N content on ODB per hectare basis should be reported.
10. For the treatments 5, 11, 12 and 13, locally available, well-decomposed farmyard manure (FYM) should be applied. Analyse for C, N, P, K contents in the manure used and report the data on moisture and nutrient contents. Further, in treatment no. 13 as suggested during the annual workshop additional treatment of 3.0 t/ha of vermicompost plus 200kg/ha of oil cakes over and above 10 t/ha of FYM should be applied as top dressing in 50% of the plot area (50 sq. m) in both the seasons to study its effect on the overall soil and crop productivity in view of reduced crop yields recorded in the treatment.
11. Before applying GM or FYM in both seasons (*kharif and rabi*), calculate quantity to be applied based on the N content and moisture percentage of the manures. Report the quantity of FYM applied. Raise the green manure *in situ* wherever possible.
12. All plant protection measures and other management practices must be followed as per recommendations.

13. Promising treatments should be validated in about five (5) farmers' fields of 0.5-1.0 acre (2000-4000 sq. meters) under FLDs around the location in comparison with current nutrient practices to demonstrate and transfer the technology. The results of the demonstration on yield, nutrient accumulation and basic soil data have to be reported.

Soil and Plant Sampling and Analysis:

- At the end of each cropping season (at the harvest) about 1 kg of composite soil sample (0 – 15 and 15 – 30 cm depth) should be drawn from each replicate and treatment, processed and preserved for analysis.
- Report grain and straw yields after harvest in **kg/ha** or **tonnes/ha.**
- Grain and straw samples at maturity should be collected, oven dried and processed for analysis to estimate crop removal of nutrients.

Observations (after each crop):

1. Moisture and nutrient (N, P, and K) content of organic manures on ODB.
2. Grain and straw yields for *Kharif* and *Rabi* crops.
3. Replicate-wise content of nutrients in grain and straw at harvest *viz*., N, P, K, S and Zn.
4. Replicate-wise soil analysis for available N, P, K, S, Zn and org. C.
5. Bulk density of the soil to be measured for evaluating changes in soil physical conditions.
6. S content in irrigation water and silt in water.
7. Microbial biomass carbon and dehydrogenase enzyme activity after harvest of *kharif* rice (Procedure enclosed)*
8. Incidence of pest/disease and other observations on crop performance treatment wise.

Estimation of microbial biomass:

i) Fumigation and extraction method for measuring soil microbial biomass: Chloroform is used as fumigant for measuring biomass as it is an effective biocide, and does not solubilising or predispose non-microbial soil organic matter. The increase in extractable organic C following soil fumigation is used to estimate C held in the soil microbial biomass.

Procedure:

- Weigh 20 g (dry weight) of moist sieved soil in duplicate into glass beakers.
- Fumigate one set with ethanol free $CHCl_3^*$ leaving the other set non-fumigated by placing the beakers in a large vacuum desiccator that is lined with moist filter paper.
- A beaker containing 50 ml of alcohol-free $CHCl_3$, and anti-bumping granules is placed in the desiccator.
- The desiccator is then evacuated with the help of vacuum pump till the $CHCl_3$ starts boiling. Allow the $CHCl_3$ to boil for 1 – 2 min, seal the desiccators and incubate the samples under $CHCl_3$ vapour for 18 to 24 h at 25^oC.
- Then break the vacuum in the desiccators slowly, open it, and remove the moist paper and $CHCl_3$ vapors by repeated evacuations.
- Non-fumigated control soil samples are also kept in a desiccators lined with moist paper for 18 to 24 h at 25^oC.
- After fumigation, extract the soil with 0.5*M* K_2SO_4 (1:4 soil : solution ratio) for 1 h.

- Filter the extracts through Whatman no. 1 filter paper and store the extracts at 4 -5^{o}C till further assay.
- An aliquot of the K_2SO_4 soil extract is used for measuring organic C in the extracts.

Microbial biomass C (mg C/kg dew of soil) = (C content in extracts of fumigated soil - C content in extracts of non fumigated soil) / 0.411 (K_c)

ii) Spectrophotometric method:

Pipette out 5 ml portions of the extract into digestion tubes, add 5 ml of 0.07 N $K_2Cr_2O_7$, add 10 ml of 98% K_2SO_4, add 5 ml of 88% H_3PO_4 and mix well. Use 0.5 M K_2SO_4 as blank. Boil samples in a digestion block for 30 minutes at 150^{0}C. Cool samples before reading absorbance at 440 nm. **Standard:** 1000 mg/l carbon in sucrose (0.2377g sucrose in 100 ml of 0.5 M K_2SO_4. **Working standards:** 0, 20, 40 60, 80, 100 and 150 mg/l carbon (dilute 0, 2, 4, 6, 8 10 and 15 ml of stock to 100 ml with 0.5 M K_2SO_4) Purify by shaking (3x) 5 ml chloroform with 5 ml of 5% H_2SO_4 and then wash 3x with distilled water and dry over K_2CO_3.

II. Estimation of dehydrogenase enzyme activity in soil (Casida *et al.,* 1964**)**

Reagents:
1) Calcium carbonate ($CaCo_3$), reagents grade.
2) 2, 3, 5-Triphenyl-tetrazolium chlorides (TTC), 3%: Dissolve 3g of TTC in about 80 ml of water and adjust the volume to 100 ml with water.
3) Methanol, analytical reagent grade.
4) Triphenyl formazan (TPF) standard solution: Dissolve 100 mg of TPF in about 80 ml of Methanol, and adjust the volume to 100 ml with methanol. Mix thoroughly.

Procedure:

Thoroughly mix 20 g of air-dried soil (<2mm) and 0.2 g of $CaCO_3$, and place 6 g of this mixture in each of this mixture in each of three test tubes. To each tube add 1 ml of 3% aqueous solution of TTC and 2.5 ml of distilled water. This amount of liquid should be sufficient that a small amount of free liquid appears at the surface of the soil after mixing. Mix the contents of each tube with a glass rod, and stopper the tube and incubate it a 37^{0}C. After 24 h, remove the stopper, add 10 ml of methanol, and stopper the tube and shake it for 1 min. Un-stopper the tube, and filter the suspension through a glass funnel plugged with absorbent cotton, into a 100 ml volumetric flask. Wash the tube with methanol and quantitatively transfer the soil to the funnel, then add additional, methanol (in 10-ml portions) to the funnel, until the reddish colour has disappeared from the cotton plug. Dilute the filtrate to a 100 ml volume with methanol. Measure the intensity of the reddish colour by using a spectrophotometer at a wavelength of 485 nm and a 1-cm cuvette with methanol as a blank. Calculate the amount of TPF produced by reference to a calibration graph prepared from TPF standards. To prepare this graph, dilute 10 ml of TPF standard solution to 100 ml with methanol (100 mg of TPF ml^{-1}), make up the volumes with methanol, and mix thoroughly. Measure the intensity of the red colour of TPF as described for the samples. Plot the absorbance readings against the amount of TPF in the 100 ml standard solutions.

Important decisions in the group meeting: (All centres are requested to follow the below instructions)

- It was decided to select the most popular and high yielding variety for this trial.
- It was decided to leave a buffer zone of at least 1 metre on all sides.
- Any additional observations Viz., Pest and disease occurrence may be collected.
- It was decided to study the microbial properties in selected treatments at IIRR.
- Any other important soil parameters can be studied in detail in the following treatments

Trt. No.	Treatment details
1	Control –1, No fertilizer or manure
5A	100 % NPK + Zn + S
5B	100% NPK+ Zn + S + FYM / PM @ 5 t/ha (to be applied in *kharif* and *rabi* seasons)
9A	50% NPK
12	50% NPK + 25% GM-N + 25% FYM–N (GM and FYM–N applied in both seasons)
13A	FYM @ 10 t/ha (In both *kharif* and *rabi* seasons)

Locations (3): Mandya, Maruteru, Titabar

Trial No 2 : ***Soil quality and productivity assessment for bridging the yield gaps in farmers' Fields (kharif)***

Rice production must increase to meet future food requirements amid strong competition for limited resources. Large variations in yield are a major impending problem for rice sustainability in India. Yield gap analysis is an useful method to examine how large the ranges are between potential, desirable rice yields and those actually realized in farmers' fields. Balanced nutrient application is must to meet the growth requirements of a genotype for realizing the yield potential of several contemporary genotypes. Current fertilizer management practices, in general, are not tailored to site specific soil nutrient supply capacities and crop demand. 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. In view of this, an existing old trial is modified and reported here.

Objectives:

1. To identify the soil related and management constraints limiting the productivity in farmers Fields
2. To give site specific recommendations to the farmers for higher productivity

Type of data collection : By Survey in the first year

Methodology:

A Survey will be conducted in nearby villages during *kharif* 2018 and *rabi* 2018-19 involving data collection from around 50 farmers regarding Variety, sowing time, manures and fertilizer application, management practices, Yield, weather parameters, soil conditions as per their knowledge and other details. The farmers will be grouped into Low and high categories based on their yields. Soil and plant samples will be collected from field after harvest and analyzed for their nutrient contents. The data will be analyzed critically and the reasons for low yield will be identified in comparison with high yielders. For next season crop, site specific recommendations to the farmers will be given for higher productivity and soil health improvement.

Observations:

1.Soil type. 2. Variety and seed rate 3. sowing time 4. Manures and fertilizer application 5. Management practices followed 6. Harvesting time 7. Yield 8. Rainfall 9. Relative Humidity 10. Pests 11. Diseases 12. Initial soil analysis data 13. Post harvest soil analysis 14. Nutrient uptake at harvest

Locations- Soil Science (3): Chinsurah, Medziphema and Raipur.

Note: Interested cooperators **from Agronomy** discipline can take up this trial.

Soil Science coordinated trial No. 2 (Questionnaire)

Yield gap assessment and bridging the gap through site specific integrated nutrient management in rice in farmers' fields

Details of crop management practices followed by the farmers (Season- *kharif* ----------):

Name of the farmer :

Village **:** **Mandal / Tehsil** **:**

District **:** **State** **:**

Land holding / cultivated area (ha):

GPS coordinates (Longitude/ latitude) of the site:

Soil type : Soil fertility status (kg/ha) : N:_____ P_2O_5 :_____ K_2O :_____

Rice ecosystem: Irrigated / Rain fed low land

Variety: _____ Duration (days):_____Date of sowing: _____

Date of Planting: _____ No. of hills/m^2 _____ Spacing _____

Land preparation: No. of Ploughings: _____ No. of puddlings : _____

Water source: Canal / Tank / Bore well / Water quality: _____

Crop management:

Organic manures applied (t/ha) _____ (FYM / Compost / Poultry manure / Green manure / crop residue)

Fertilizer recommendations for the site (kg ha); N____, P_2O_5_____K_2O ____ Any other nutrients: _____

Farmer's fertilizer practice: N: _____, P_2O_5: _____, K_2O _____ Any other nutrients: _____

Fertilizer sources used: _____

Basal dose quantity (kg/ha) and source :

Top dressing (Qty. kg / ha) and source including stage of crop (days after planting) :

1._____ at stage (DAT); 2 _____ at stage (DAT); 3, _____at stage (DAT)

Pest management: Major pests : _____

Control strategies : _____

Soil related problems: Salinity / alkalinity / acidity _____

Any other problems: _____

Observations:
Crop data at harvest:

Yield (3 replication): Gross plot (m^2) _____ Net plot (m^2):_____ **of each farm**

Soil data (pre sowing or post harvesting)

Soil Texture : _____

pH (1:2 ratio; soil/water) : _____

EC (1:2 ratio; soil/water) : _____ (dSm^{-1})

OC (%) : _____ (Walkley and Black method)

Available N (kg/ha) :_____ (Subbiah and Asija method - Alkaline permanganate method)

Available P_2O_5 (kg/ha) : _____ (Olsen's 0.5 N $NaHCO_3$ method)

Available K_2O (kg/ha) :_____ (Hanway–Hiedel: Neutral Normal Ammonium acetate method)

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

Objective: 1) To study the direct, residual and cumulative effects of gypsum on nutrition and productivity of rice based cropping system and to evaluate germplasm in sodic soils.

2) To study the influence of gypsum on soil properties at the end of the season

Lay out: Fixed plot (undisturbed) layout; Varieties: Rice – varieties will be sent by IIRR (IIRR) and wheat – recommended variety for sodic soils Design**:** Split plot (for sodic soils)

Treatments:

Main plots: Amendments (3) (To be applied only once during the study period)
1) No amendment (control); 2) 50% Gypsum requirement (GR); 3) 100% Gypsum requirement (GR)

Sub plots : ***kharif*** **-** Génotypes (10-15) – Include the recently released cultures which have been reported promising for sodic soils and advanced breeding lines.

Rabi - wheat - recommended variety (PBW-43) for sodic soils (Residual effect of previous *kharif* season to be studied)

Gypsum requirement (t/ha) based on soil pH (1: 2) and texture.

Soil pH (1:2 soil & water)	Soil Texture (0-15 cm)		
	Fine	Medium	Light
9.0	5.0	3.0	1.5
9.2	8.0	5.0	3.0
9.4	10.0	7.0	4.5
9.6	12.0	9.0	5.8
9.8	14.0	11.0	7.0
10.0	15.0	13.0	8.8
10.2	16.0	14.5	10.3
10.5	18.0	16.0	11.5

Cropping system: Rice in *kharif* followed by wheat in *rabi* season to be grown with standard package of practices and recommended fertilizer dose.
Plot size: At least 25 m^2 (Undisturbed layout); Replications**:** 4
Spacing: Rice – 20 cm x 10 cm. For *rabi* crop as per recommendations.
Water management: Frequent irrigation to shallow submergence for wetland rice and for *rabi* crop irrigation to be provided as per recommendation. Drainage facility should be provided for the experimental plots

Experimental details:

- Bulk soil sample (0-15 cm depth) representing the experimental area should be collected before the imposition of treatments and analysed for pH, OC, EC, ESP, exch. Ca and Mg, SAR, available N, P, K, S, Zn, Fe, Mn
- Plough the land dry without disturbing the layout, apply recommended quantity of gypsum (as per soil pH) only once in the beginning of the experiment during *kharif* season as per the treatments, mix with the top 15cm soil, irrigate, allow the gypsum to react. Irrigate frequently to leach sodium. Puddle the soil block wise and layout the plots. Report the dose of gypsum applied.
- Apply N at 25% more than the recommended dose for the location and crop through urea in 3 split doses (1/3: 1/3: 1/3). Report the fertilizer dose.
- All Basal application of N, P, K, Zn, and S should be incorporated into the soil up to 15 cm depth before transplanting rice.
- *Rabi* crop has to be grown following standard package of practices. Report the nutrient doses applied, yield of grain, straw/shoot weight.
- Send 1 kg processed soil from 0 – 15 cm depth collected from the experimental area (bulk) before applying any amendments or fertilizer to PI, Soil Science, IIRR, Hyderabad.

Observations:

- Damage due to pest/disease incidence and nutritional disorders. The crop has to be raised under protected conditions.
- Grain and straw yield, yield parameters of *kharif* rice and *rabi* crops. Report grain and straw yields after harvest in kg/ha or tonnes/ha.
- Initial soil analysis for soil pH, OC, texture, CEC, ESP, EC, SAR, Soluble Na, Ca, Mg, K, exchangeable Ca, Mg, Available N, P, K, Zn, Fe, Mn and S before amendments are applied.
- Post harvest analysis of soil samples drawn plot wise/replicate wise for pH, OC, ESP, EC, soluble Na, K, Ca, Mg and available nutrients (N, P, K, S, Zn, Mn, Fe, Cu) at the end of each season (*kharif* and *Rabi*) must be done.
- Analyse plant samples (grain and straw) for N, P, K, Zn, Fe, and Mn drawn from each plot. A duplicate set of processed (contamination free) samples (both grain and straw) may be sent to PI, Soil Science, IIRR, Hyderabad 500 030. Report all data replicate wise.
- Care should be taken to avoid contamination of grain/straw samples from dust/metals, etc. Before sending the grain samples, the material should be washed with tap water followed by 2% HCl, tap water, distilled water (in sequence) for few minutes, dried with filter paper i mmediately and oven dried in containers at 50-60^{o}C to uniform weight.

Note 1**:** The evaluation of varieties will be done for sodic and saline soils with a minimum of 6 – 10 centres. Management aspects also can be included. Wherever sodic and saline soils exist and that centre does not have Soil Scientist, Agronomists can take up this trial.

Note : The trail will be conducted with same genotypes tested in previous year and without gypsum application.

Locations (3) : Chinsurah , Mandya, Medziphema and Raipur

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

Objective: To evaluate location specific germplasm/genotypes for tolerance to Fe and /Al toxicity and other soil acidity related nutrient constraints in typical locations.

Ecosystems: The experiment should be laid out either in **Rainfed** lowlands in a soil of pH less than 5.5 (Soil: water 1: 2).

Treatments: Main plots (3) – Nutrient and lime application; Sub plots (15-20): Varieties (Include all the cultures which have been reported to promising in the previous years

Treatment Number	Treatment details
Main plots	Nutrient and lime application
1	Recommended NPK
2	Recommended NPK + liming material
3	Recommended NPK + 50% lime + locally available materials (biochar / basic slag / pressmud etc.)
Sub plots	Varieties (15-20). Please also include cultures found promising in the previous years and some important local cultures which have not been evaluated earlier for the test environment.

Note : Shift the experimental site to a new plot every year.

Replications: 3; Design: Split plot; Plot size: 20.sq. m.

Observations:

1. Soil available N, P, K, OC, Texture, CEC, soil pH, Exch. Al, Fe, Reducible Fe
2. Recording of visual symptoms of Fe toxicity during crop growth. Follow standard procedures for scoring
3. Mortality % during crop growth
4. Days to 50% flowering
5. Chaffiness in grains
6. Grain and straw yield and N, P, K, Al, Fe uptake in grain and straw. Report grain and straw yields after harvest.

Locations (5) : Hazaribagh, Medziphema, Moncompu, Raipur, Titabar

Trial No 5: ***Yield maximization in farmers' fields using Nutrient Expert software (kharif)***

Objectives:

1. To assess indigenous nutrient supplying capacity of soils in various rice growing ecologies and geographies
2. To compare yield and economic performance of field specific fertilizer recommendation using nutrient expert with the existing blanket recommendation for rice

Design : Randomized Block Design

Replications : 3

Season : *Kharif*

Variety (Rice) **:** High yielding variety

Treatments : Nutrient management practices:

T1: Farmers practice

T2: RDF

T3: Nutrient expert

Sources of Nutrients: Nitrogen - Urea; Phosphorus - SSP (Single Super Phosphate); Potassium- Muriate of potash; Zinc - $ZnSO_4$ (Zinc Sulphate)

Observations:

1. Total tillers/$m^{2;}$ 2. Total panicles/m^{2}; 3. Filled grains/panicle; 4. Unfilled grains/panicle; 5. 1000 grain weight; 6. Grain yield/15 m^{2}; 7. Straw yield/15 m^{2}; 8. Initial and Final Soil nutrient status; 9. Plant nutrient (NPK) uptake at Harvest (Straw + Grain)
2. Report grain and straw yields after harvest in **kg/ha** or **tonnes/ha.**

Note: All the cooperators should take up the analysis of soil and plant samples for NPK and send the data for report preparation.

Locations (10): Chinsurah, Faizabad, Ghagharaghat, Khudwani, Mandya, Maruteru, Medziphema, Pantnagar, Puducherry, and Pusa.

Trial No 6 ***: Bio-intensive pest management (BIPM) in rice Under Organic farming (kharif and rabi)*** (Collaborative trial of Soil Science and Entomology of IIRR) Experiment will be conducted by Entomologists

Objectives:

- To study the influence of organic farming on productivity, soil health and pest dynamics in rice.
- To develop a package of Bio-intensive pest management (BIPM) practices in organic farming.

Details of treatments	Bio-intensive pest management (BIPM) block	Farmers' practice (FP) block
Seed	Seed treatment with *Psuedomonas flourescnes* Dry seed treatment - Dress the seeds with the talc based formulation of *P. fluorescens* (@ 10 g/kg seed at the time of sowing or Wet seed treatment – Soak the seeds for 12 to 16 hours in a solution of *P. fluorescens* prepared @ 10 g/L of water or per kg seed. Seed treatment with *Azospirillum* and/or phosphorus solubilizing bacteria (PSB) or phosphorus solubilizing microorganisms (PSM) @10 g/kg seed (or) seedling root dipping in *Azospirillum* and/or PSB PSM suspension @ 600g culture for one ha land.	General POP with RFD and need based application of insecticides
Nursery	Apply vermicompost @ 500g/m^2 and rice husk ash @ 100 g/m^2 of the nursery bed and mix well with the soil at the time of preparation of the field. If vermicompost is not available, apply FYM @ 1 kg/m^2 and 100g of rice husk ash/m^2 of the nursery bed and mix well with the soil at the time of preparation of the field	
Preparation of land	Plough the field thoroughly to incorporate the weeds and straw into the soil. Ensure a smooth, level field for transplanting the seedlings. It would be better to transplant 10-15 days after incorporating organic manure.	
Fertilization	Apply 5 tonnes of FYM/ compost/ green leaf manure or 2.5 tonnes of vermicompost as basal + 300-500 kg oil cakes (ground nut cake, neem cake etc.)/ha (half as basal and half as top dressing at active tillering stage)	

Pest Management	1. Clipping of rice seedlings before transplating to remove stem borer egg mass. Avoid clipping of leaf tips at the time of transplanting in bacterial blight endemic areas 2. Mass trapping of stem borer by installing pheromone traps @ 20 numbers/ha can effectively reduce the stem borer damage. The pheromone trap is retained throughout the crop stage by replacing 3-4 times the 5 mg lure at 20 day intervals. Pheromone traps can be installed in the nursery also. 3. Growing flower borders to conserve natural enemies 4. *Trichogramma japonicum* 5 cc egg cards/ha, six times weekly from first week after transplanting 5. *T. chilonis* for leaf folder management at weekly intervals from 20 days after transplanting or when the moths of these pests are observed in large numbers in the field 6. Need based application of neem formulations/ biopesticides for other defoliating pests 7. Foliar spray of *P. fluorescens* on the foliage @ 20 g/L of water. Spraying can be repeated depending on the disease severity. The application of *P. fluorescens* for a minimum of three times like seed treatment, seedling root dip and one foliar spray for protection from disease incidence.	

Average nutrient composition (%) of major nutrients of some organic manures

Source	N	P	K_2O
FYM	0.5-0.8	0.4-0.8	0.5-0.9
Compost	0.5-1.5	0.5-1.4	1.4-1.6
Vermicompost	1.00-2.05	0.70-1.90	1.5-2.5
Poultry litter, fresh	1.0-1.8	1.4-1.8	0.8-0.9
Poultry litter, very dry	3.0-4.5	4.0-5.0	2.0-2.5
Groundnut cake	7.3	1.5	1.3
Castor cake	4.3	1.8	1.3
Neem cake	5.2	1.0	1.4
Green manure (on dry weight basis) Moisture % will be 80-85	2.0-2.5	0.4-0.8	0.5-1.0

Note: Based on the average nutrient composition of the organic source used, the Soil Scientists can calculate the quantity of organic manures based on the N equivalent basis.

Observations to be recorded:

- Divide each Treatment block into 6 smaller blocks for observation purpose. Observations on pest incidence should be recorded on 10 randomly selected hills in each replication (60 hills/each treatment) at fortnightly interval.
- At each observation, record total tillers, dead hearts, silver shoots, total leaves, damaged leaves, number of plant hoppers/hill.
- At harvest record yield/m^2 randomly at 20 points in each treatment

Observations to be recorded by Soil Scientists:

Soil analysis:

- Initial soil analysis of two blocks separately for all Soil Characteristics like pH, EC, OC, available NPK status, micronutrient status and important physical properties.
- Final analysis of soils after harvest for all important properties in smaller blocks of each block.

Plant analysis:

- Grain and straw yields at harvest. Report grain and straw yields after harvest in kg/ha or tonnes/ha.
- Grain analysis for quality parameters (in brown rice and polished rice) along with hulling, milling and head rice recovery.
  Note: If quality analysis is not available at the centres, send grain samples to the PI, (Soil Science), IIRR immediately after harvesting.
- **Cooperators should analyse grain and straw samples for nutrient concentration of major nutrients and Zn and Fe** and submit the data for report preparation.

Number of samples: 2 samples in each small block of 6 in two big blocks (2x6x2=24)

Total number of samples= 24 (soil and plant samples).

Locations (5): Chinsurah, Faizabad, Pantnagar , Puducherry and Titabar

Trail 7: ***Residue management in organic rice based cropping systems (kharif and rabi)***

Introduction

Organic farming, which is responsible for farm material utilization and recycling of residues especially rice and wheat straw addition in agricultural field with respect to increase in crop productivity and enhance the soil quality has played a crucial role in ecological protection and sustainable agricultural production. And also, burning of straw/residues, mainly caused by the need of a short turnover period between *kharif* rice and *rabi* rice/non-rice crops and this has become one of the main sources to greenhouse gas emission and air pollution.. There are various options for incorporating the straw into the field as alternatives for burning viz., incorporation, mulching, composting etc. Keeping in view the growing importance of organic farming and to avoid burning this trial is being proposed.

Objective:

1. 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

2. To develop efficient residue management practices with a view to avoid adverse environmental effects of residue burning

Treatments:

T1	Absolute Control
T2	Recommended Dose of Fertiliser (100%)
T3	Rice/Wheat residue (100% N)
T4	Rice/Wheat residue (150% N)
T5	Rice/Wheat residue 50% N + GM/GLM 50%N
T6	Rice//Wheat 75%N + GM/GLM 75% N
T7	Rice/Wheat residue 50% N + Vermicompost (VC) 50%N
T8	Rice/Wheat residue 75%N+ Vermicompost (VC) 75%N

*Based on availability of microbial culture, two optional treatments can be taken up as below.

T9: Residue 100% N + Efficient microbial culture
T10: Residue 150% N + Efficient microbial culture

**** The organics (residue/GM/GLM/VC) should be analysed for their N content and then quantity of organics to be applied should be decided based on N equivalent basis.**

Design : Randomized Block Design
Replications : 3

Plot size : 30 – 50 m^2 plot/treatment
Variety : Local popular variety (Zone specific)

Observations to be recorded:

Soil analysis:

- Initial soil analysis of fields separately for all Soil Characteristics like pH, EC, OC, available NPK status, micronutrient status and important physical properties.
- Final analysis of soils after harvest for all important properties
- Analysis of straw for its NPK content
- Microbial properties such as microbial count, microbial biomass carbon, enzyme activities (dehydrogenase, FDA, urease, phosphatase etc).

  (**Note**: If facilities are not available, collected fresh samples may be sent to IIRR in advance)

Plant analysis:

- Grain and straw yields at harvest. Report grain and straw yields after harvest in tonnes/ha.
- Grain and straw analysis for its nutrient content especially N, P, K, Zn, Fe, Mn and Cu.
- Grain analysis for quality parameters (in brown rice and polished rice) along with hulling, milling and head rice recovery.

  Note: If quality analysis is not available at the centres, send grain samples to the IIRR immediately after harvesting.

Locations (7): Ghagharaghat, Khudwani, Maruteru, Pantnagar, Pusa, Raipur, Titabar

List of cooperating centres of Soil Science and allotment of trials: 2018-19

S. No	Locations	Funded/Voluntary	Trial 1		Trial 2	Trial 3		Trial 4	Trial 5	Trial 6		Trial 7		Total	
			K	R	K	K	R	K	K	K	R	K	R	K	R
1	Kanpur	Funded				x	x							1	1
2	Karaikal	Funded													
3	Mandya	Funded	x	x		x	x		x					3	2
4	Maruteru	Funded	x	x					x			x	x	3	2
5	Moncompu	Funded						x						1	
6	Pantnagar	Funded							x	x	x	x	x	3	2
7	Pusa	Funded										x	x	1	1
8	Titabar	Funded	x	x				x		x	x	x	x	4	3
9	Chinsurah	Voluntary			x				x	x	x			3	1
10	Dumka (Ranchi)	Voluntary						x						1	
11	Faizabad	Voluntary				x	x		x	x	x			3	2
12	Ghaghraghat	Voluntary							x			x	x	2	1
13	Hazaribagh	Voluntary						x						1	
14	Khudwani	Voluntary							x			x	x	2	1
15	Medziphema	Voluntary			x			x	x					3	
16	Puducherry	Voluntary							x	x	x			2	1
17	Raipur	Voluntary			x			x	x			x	x	4	1
Total trials allotted			**3**	**3**	**3**	**3**	**3**	**6**	**10**	**5**	**5**	**7**	**7**	**37**	**18**

K – Kharif; R- Rabi; X - indented by Soil Scientists;

Trial No.1: Long-term soil fertility management in rice based cropping systems (RBCS)
Locations(3): Mandya, Maruteru, Titabar

Trial No.2: **Soil quality and productivity assessment for bridging the yield gaps in farmers' fields**
Locations (3): Chinsurah, Medziphema and Raipur

Trial No.3: **Screening of germplasm for sodicity and Management of sodic soils in RBCS**
Locations (3): Faizabad, Kanpur and Mandya

Trial No.4: **Screening of genotypes for tolerance to soil acidity and related nutritional constraints**
Locations (6): Dumka (Ranchi), Hazaribagh, Medziphema, Moncompu, Raipur and Titabar

Trial No.5: **Yield maximization in farmers' fields using Nutrient Expert software**
Locations (10): Chinsurah, Faizabad, Ghagharaghat, Khudwani, Mandya, Maruteru, Medziphema, Pantnagar, Puducherry and Pusa.

Trial No.6: **Bio-intensive pest management (BIPM) in rice Under Organic farming**
Locations (5): Chinsurah, Faizabad, Pantnagar , Puducherry and Titabar

Trial No.7 : **Residue management in organic rice based cropping systems**
Locations (7): Ghagharaghat, Khudwani, Maruteru, Pantnagar, Pusa, Raipur and Titabar

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