AICRIP

PLANT PATHOLOGY

2019-2020

AICRIP Progress Report- Plant Pathology 2019

SUMMARY

The All India Coordinated Rice Pathology Program of the ICAR-Indian Rice Research Institute (formerly as Directorate of Rice Research) is an example of effective linkage and testing mechanism to assess the advanced breeding lines over a wide range of climatic and disease epidemic conditions and also to identify broad spectrum of resistance to major rice diseases. This helps in developing need based management options for controlling major diseases of rice. During 2019, a total of 13 trials were conducted at 49 locations on host plant resistance, field monitoring of virulence of major pathogens and disease management methods. The details on screening nurseries and disease management trials proposed and conducted at various test locations are given in Table 1. The summary of observations is given below. Detailed data on extensive screening of diverse genotypes are furnished in a separate report entitled 'National Screening Nurseries, 2019'.

1. HOST PLANT RESISTANCE (NSN-1, NSN-2, NSN-H, NHSN and DSN)

❖ LEAF BLAST

The entries for leaf blast resistance were evaluated under NSN-1, NSN-2, NSN-Hills, NHSN and DSN at 28, 19, 12, 24 and 24 centres respectively. In majority of the centres the disease pressure was moderate; at few centres it was high (LSI 6- 7). Umium centre exhibited a very high disease pressure (8.2) under hill nursery. The entries that exhibited low over all disease score and high promising index were IET# 27528, 27722, 27773, 27927, 24967, 26464, 27748, 27903, 27736, 27743, 27343, 27894, 26351, 27980, 27390, 28811, 27357, 27369, 27781, 26767 and 27887 under NSN-1; IET #28818, 28298, 28505, 28074, 28071, 28359, 284486, 28279, 28088, 28647, 28362, 28521, 28828 and 28833 under NSN-2. None of the entries recorded resistant reaction across the locations under NSN-H; however a few entries *viz*., IET # 28193, 28222, 27491, 28211, 27498, 26580, 27506 and 28208 showed moderate resistance. The promising entries under NHSN included IET #28113, 28111, 28115, 28163, 28130, 28162 and 28141. The donors *viz*., HL18WS-20-5 and HL18WS-20-4 were reported promising under DSN.

❖ NECK BLAST

The entries were evaluated under NSN-1, NSN-2, NSN-Hills, NHSN and DSN at 9, 4, 5, 11 and 8 centers respectively. In most of the centres the screening was carried out under natural infection condition except at few locations, where artificial method of inoculation was followed. In majority of the locations the disease pressure was moderate to high, which was good enough for selection of the best entries. The entries that exhibited low over all disease score and high promising index were IET# 27538, 27547, 27747, 27723, 25212, 27686, 27574, 26684, 26819, 27438, 27346, 26948, 26847, 27743, 27077, 25945, 27285, 27118, 26118 and 27632 under NSN-1; IET# 28732, 28514, 28306, 28462, 28500, 28505, 28521, 28397, 28686, 28723, 28502, 28510, 28532, 28545, 28301, 28302, 28304, 28317, 28290, 28702, 28703, 27730, 28088 and

28828 under NSN-2. The entries with IET No. 28222, 28237, 27466, 26565, 25819, 26588, 26579, 28188, 28223, 28230, 28231, 28238, 28239 and 27463 under NSN-H; IET # 28117, 28187, 28184, 28129, 28128, 28154, 28142 and 28130 under NHSN were found to be promising against neck blast disease with low diseases score across the locations. Under DSN, entries RP-Bio Patho-11, RP-Bio Patho-7, RP-Patho-2, RP-Patho-3, RP-Patho-9, RP-Bio Patho-10, RP-Bio Patho-12, KNM 7787, HL18WS-22-2, HL18WS20-4, RMS-R-6, RMS-R-13 and RP-Bio Patho-8 were found to be highly promising for neck blast disease.

❖ **SHEATH BLIGHT**

The entries were evaluated under NSN-1, NSN-2, NSN-Hills, NHSN, and DSN at 19, 15, 3, 20 and 18 locations, respectively. In majority of the locations, the disease pressure was moderate to very high. None of the entries were found resistant (SI≤3) against sheath blight in all the nurseries during *Kharif*-2019. The promising entries to sheath blight (SI≤ 5.0) were IET Nos. 26684, 27836, 27118, 25912, 27781, 27637, 26692, 27851, 27646, 26927, 27438 and 26118 in NSN-1; 28517, 28293, 28301, 28482, 28471, 28478, 28346, 28732 and 28310 in NSN-2; 28217, 28198, 28212 and 27498 in NSN-H; IET Nos. 28148, 28166, 28141, 28160, 28173, 28152, 28151, 28155 and 28154 in NHSN and entries *viz.*, IET 25692, Phoghak, RP-Patho-9, Gonalasha, CR 4209-2, RMS-R-11, Pankaj, RMS-R-6, KNM 7786, MSM-BB-61, Whazhuopek, GSY-4-9, NWGR 11048, CR 4053-24-40-1, SM-801and MSM-SB-87 in DSN.

❖ **BROWN SPOT**

The entries were evaluated under NSN-1, NSN-2, NSN-Hills, NHSN and DSN at 19, 15, 6, 15 and 15 centers respectively against brown spot disease across India. In most of the centres the screening was carried out under natural infection condition except at few locations screening was carried out artificially by spraying spore suspension. In majority of the centres the brown spot pressure was moderate to high; and at few centres it was very high with LSI >7. None of entries found resistant (SI <4) under any of the screening nurseries. However, the promising entries with moderate resistance (SI 4-5) were IET # 27077, 28007, 27531, 26861, 27517, 27530, 27386, 26118, 27280, 26635, 27369, 28033, 27438, 27728 and 27732 under NSN-1; IET # 28329, 28763, 28471, 28648, 28649, 28354, 28331, 28344, 28491, 28467, 28827, 28454 and 28671 under NSN-2. The entries with IET No. 28193, 26594, 27468, 28195, 26596, 28223, 28226, 28189, 27504, 27498, 26580 and 28235 under NSN-H; IET#28148, 28144, 28159, 28134, 28181, 28135, 28152, 28121, 28138, 28145, 28161 and 28146 under NHSN and CR 4209-2, CR 4055-11-40-3, CR 4053-24-40-1, CR 4054-26-2-1, CR 4054-26-2-1, CR 4055-11-28-5, KNM 7787and KNM 7785 under DSN.

❖ **SHEATH ROT**

The entries under NSN-1(353), NSN-2(672), NSN-H(120), NHSN(108) and DSN(151) were screened against sheath rot at 13, 4, 2, 12 and 11 locations, respectively. Some of the highly promising entries that scored less than 3 were IET # 28447, 27900, 28306, 28344, 28346, 28348, 28369, 28454, 28471, 28482, 28416, 28428, 28435, 28654, 28689, 28723, 28751, 28495, 28505,

28517, 28524, 28527, 28532, 28538, 28542, 28543, 28294, 28301, 28303, 28309, 28319, 28289, 28611, 28626 and 28824 in NSN-2; 27472, 26594, 28212 and 28199 in NSN-H and none found resistant in NSN1,NHSN and DSN.

❖ **GLUME DISCOLOURATION**

Glume discolouration (GD) was observed in National Screening Nurseries at Chatha, Lonavala, Navasari and Nawagam. Some of the promising entries were: IET 27541, Tetep, Pusa 44, IET 26767, IET 27518, IET 27528, IET 28834, IET 27703, IET 27950, IET 27621 and IET 27438 in NSN-1; IET 27530, IET 27518, IET 27395, IET 27460, FL 478, IET 26767, IET 27732 in NHSN; NWGR 11048, ISM-3G-4, HL18WS-23-30, RP-Bio Patho-4, NWGR 12016, KNM 7631, KNM 7632 and RMS-R-2 in DSN.

❖ **BACTERIAL LEAF BLIGHT**

The test entries and various checks in different bacterial blight screening nurseries viz., NSN-1, NSN-2, NSN-Hills, NHSN and DSN were evaluated at 25, 15, 4, 21 and 22 locations. The number of entries including checks in different nurseries was 353 in NSN1, 672 in NSN-2, 120 in NSN-Hills, 108 in NHSN and 151 in DSN. Some of the promising entries against bacterial blight in different nurseries were IET # 27378, 28811, 28807, 28014, 27077, 28806, 27294, 28789, 28805, 27823, 28810 and 27637 in NSN 1; IET# 28503, 28751, 28635, 28585, 28654, 28528, 28391, 28467, 28493, 28491, 28311, 28521, 28396, 28432, 28461, 28478, 28063, 28726, 28502, 28299, 28732 and 28543 in NSN 2; IET # 28211, 27466, 27468, 27506 and 28197 in NSN-Hills; IET #28148, 28160, 28143, 28162, 28114, 28136, 28181, 28131, 28163, 28159, 28120 and 28164 in NHSN and KNM 7787, RP-Bio Patho-9, RP-Bio Patho-10, RP-Bio Patho-7, MSM-SB-52, ISM-2G-5412, KNM 7786, RP-Bio Patho-6, RMS-R-16, RMS-R-7, GSY-4-6, CR 4054-26-6-5, RP-Bio Patho-2, CR 4055-11-28-1, GSY-4-7, IET 25692 and RP-Bio Patho-3 in DSN.

❖ **RICE TUNGRO DISEASE**

The entries in NSN-1, NSN-2, NHSN and DSN were evaluated at 2 locations for rice tungro virus disease. The promising entries identified in different nurseries are: IET 28836, IET 26420, IET 27384, and FBR 1-15 in NSN 1; IET 28326, IET 28369, IET 28443, IET 27908, IET 28656, IET 28678, IET 28688, IET 28316, IET 28274, IET 28629, IET 28702, IET 28708, IET 28712 in NSN 2; IET 27461 and IET 26579 in NSNH; IET 28158, IET 28112, IET 28115 and IET 28115 in NHSN and RP-Patho-12, RMS-R-8, RMS-R-12, RMS-R-13, RMS-R-15, RMS-R-16 and CB 15569 in DSN.

❖ **MULTIPLE DISEASE RESISTANT LINES**

In NSN-1, the IET # 27438 entry showed resistant reaction against neck blast and sheath rot while moderate resistant reaction against sheath blight and brown spot. Entries *viz.*, IET# 25212 (resistant against NB, moderate for ShB, ShR), 27077 (moderate raection against NB, BS,

BLB) and 26118 (moderate reaction against NB, ShB, BS) showed resistant/moderate reaction against three diseases. In NSN-2, IET # 28306 had shown high resistance to two diseases *viz*., NB and ShR. In addition, IET # 28521 had shown high resistance to NB and moderate resistance to BLB. IET # 28732, 28301, 28304 shown resistance to NB and tolerance to ShB. Under NSN-H, the entries IET # 26594 (moderately resistant to ShB, ShR and BS), 27466 (moderately resistant to NB, ShB and BLB) showed moderately resistant to three diseases. In NHSN, Out of 14 entries, 13 entries showed moderate/ resistant reaction to two diseases; except IET# 28148 expressed moderate resistance against three diseases (ShB, BS and BLB). Entries expressed moderate resistance or tolerance against two diseases are IET#28130 (LB, NB), 28115 (LB, RTD), 28117 (NB, ShR), 28129 (NB, ShR), 28154 (NB, ShB), 28160 (ShB, BLB), 28152 (ShB, BS), 28134 (BS, ShR) expressed moderate resistant reaction against two different diseases. In DSN, CR 4209-2(moderate resistant to ShB, BS and ShR) and Phoghak (moderate resistant to NB, ShB and ShR) showed resistant reaction to three diseases.

II. FIELD MONITORING OF VIRULENCE
1. *Pyricularia oryzae*

The nursery included twenty five cultures consisting of international differentials, near isogenic lines, donors and commercial cultivars. It was evaluated at twenty four locations with different dates of sowing during the crop season to monitor the blast reaction on different host genotypes. Raminad str-3, Tetep and Tadukan were resistant across the locations. Tetep and Raminad str-3 were highly resistant at most of the locations (17) that showed its potentiality as the best donors for resistance against blast disease. Tetep was susceptible at Coimbatore, Gudalur and Upper Shillong and moderately susceptible at Cuttack, Ghaghraghat and Gangavati. Raminad str-3 was susceptible at Coimbatore and Cuttack and also moderately susceptible at Impal, Gudalur, Ghaghraghat and Karjat. Tadukan was showing resistant all the locations except Gangavati, Ghaghraghat, Coimbatore, Upper Shillong, Cuttack and Karjat. Zenith was highly susceptible at Gudalur and Upper Shillong; similarly NP-125 also highly susceptible at Coimbatore and Gudalur. The susceptible checks like HR-12 and Co-39 are showing susceptible reaction at most of the locations but HR-12 recorded moderately resistant reaction at Khudhwani and Co-39 also recorded low disease score at Ranchi, Karjat and Ghaghraghat. The resistant check Rasi was highly susceptible at Gudalur, Upper Shillong, Impal, Almora, Nawagam, Cuttack, Gangavati, Mandy and Rajendranagar. IR 64 was sowing susceptible reaction at Coimbatore, Lonovala, Impal, Gudalur and Cuttack. The reaction pattern of genotypes at all the locations was grouped into six major groups. The reaction pattern at Almora, Gudalur, Cuttack, Ghaghraghat, Karjat, Imphal, Ponnampet, Navasari, Coimbatore, Upper Shillong, Nawagam, Gangavati, Jagityala, Hazaribagh, Jagdalpur, Lonovala, New Delhi, IIRR, Mandya and Ranchi were in group one; Pattambi, Mugad, Malan, Khudhwani and Rajendranagar were in group two, three, four, five and six respectively.

2. *Xanthomonas oryzae* **pv.** *oryzae*

The trial consisted of twenty eight near isogenic lines (IRBB lines) possessing different bacterial blight resistant genes (singly) or various combination 5 BB resistance genes viz., *Xa4*, *xa5*, *Xa7*, *xa13* and *Xa21* in the background of rice cultivar IR 24 and different checks like Improved Samba Mahsuri, TN1 and DV85. The trial was conducted at 26 locations across India. Most of the differentials possessing single bacterial blight resistance genes like *Xa1*, *Xa3*, *Xa4*, *xa5*, *Xa7*, *xa8*, *Xa10*, *Xa11* and *Xa14* were susceptible at most of the locations. BB resistance gene *xa13* was susceptible in 14 locations while *Xa21* was susceptible in 21 locations. The differential, IRBB 55 possessing two BB resistance genes *xa13* and *Xa21* showed susceptibility at 10 hot spot locations. Based on their virulence, the isolates were grouped into high, moderate and low virulence groups. The isolate from Maruteru showed exceptional virulence and all the differentials showed susceptible reaction to this isolate.

III. DISEASE OBSERVATION NURSERY

The trial was proposed at 10 locations and data was received from 9 locations *viz.*, Chinsurah, Kaul, Malan, Mandya, Maruteru, Moncompu, Nawagam, Pusa and Raipur. The incidence of leaf blast was more severe in the late sown crop in Malan and Mandya. The incidence of neck blast was in the early sown crop in Mandya and in the normal sown crop in Moncompu. The severity of sheath blight was more severe in early sown crop in Chinsurah, Mandya, and Moncompu. In the case of BLB, the disease severity was high in the normal sown crop in Moncompu. The severity of brown spot disease was high in the late sown crop in Pusa and Mandya centres. However, in Chinsurah, the disease severity of Brown spot was more in the crop sown in normal conditions when compared to the late or normal sown crop. The severity of the sheath rot disease was found to be high in the late sown crop at Chinsurah and Nawagam. In an attempt to find out the spread of the disease and its correlation with the weather parameters like temperature, rainfall and humidity, the AUDPC was calculated from the centres which had sent their weather data. Accordingly, it was observed that in general, the rainfall had a greater impact on the impact of diseases like sheath rot and sheath blight in the spread among the populations. However, in the case of disease like leaf blast and brown spot the humidity played a major role and is directly correlated with the increase in the spread of the disease among the populations. Further it is possible that heavy rainfall might have washed away the pathogen inocula from the leaves. In contrast, the AUDPC of another disease primarily infecting the leaf, the BLB, was found to increase directly with the total rainfall. This might be due to the ability of the bacterial pathogen to survive in water and spread among the plants.

IV. DISEASE MANAGEMENT TRIALS

1. EVALUATION OF FUNGICIDES AGAINST LOCATION SPECIFIC DISEASES

Trial was conducted with an objective to evaluate new fungicidal molecules *viz.*, Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) and Prochloraz 45% EC (2.0 ml/l) against different disease of rice caused by fungi. Test molecules were compared with other standard fungicides *viz.*, tricyclazole 75% WP (0.6 g/l), azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC (1 ml/l), difenoconazole 25 EC (1.0 ml/l), hexaconazole 5% EC (2.0 ml/l) and propiconazole 25% EC (1.0 ml/l). The fungicides were evaluated against leaf blast (10 locations), neck blast (eight locations), sheath blight (15 locations), sheath rot (five locations), brown spot (six locations) false smut (two locations) and grain discoloration (two locations).

Test product prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) was found effective in reducing the leaf blast and neck blast and increasing the yield. In case of neck blast, tricycazole 75% WP (0.6g) found effective in reducing the severity. The combination fungicide azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0ml/L) found effective in minimizing the disease severity and incidence of sheath blight and sheath rot. Hexaconazole 5%EC (2.0 ml/l) was found effective in managing the brown spot of rice compare to other treatments.

2. INTEGRATED DISEASE MANAGEMENT

The IDM trials were conducted at 14 locations. The bioagent, *Trichoderma viride* was supplied by ICAR-NRRI, Cuttack. The results indicated that in all the cases, the treatment with fungicide alone was giving maximum percentage of reduction in disease severity over other treatments. In the case of leaf and neck blast, the treatment T3 and T4 (bioagent as seed treatment alone + propiconazole and bioagent as seed treatment + field application + propiconazole) were on par and was near to the standard check T5 (chemical alone). With respect to grain yield it was observed that yield was onpar and there was no direct correlation between the ratio of disease suppression and increase in grain yield in case of bioagent treated plots. In the case of sheath blight management, it was observed that the treatment T4 (bioagent + propiconazole) was more effective in managing the disease when compared to even the standard check, T5 (chemical alone) in the centres like Chiplima, Faizabad and Pantnagar while they were on par in centres like Maruteru and Pattambi. Again the treatments T3 and T4 were found to increase the grain yield percentage on par with the treatment T5. In the case of BLB, it was observed that none of the treatments had any effective control and the percentage disease control ranged between 5.75 to 8.89% and the percentage grain yield increase ranged between 14.78 to 23.37%. The treatments T3 and T4 were found to be effective and the treatment T5 was found to be the most effective among all the treatments against brown spot and sheath rot diseases. In the case of sheath rot disease, the percentage increase in grain yield was directly proportional to the decrease in the disease severity and the bioagents were able to improve the yield of the crop.

However, in the case of brown spot disease the increase in the grain yield was on par for the treatments T3 to T5 and were not correlated with the decrease in disease severity.

3. SPECIAL TRIAL ON ESSENTIAL OILS

In *Kharif* 2019, eight essential oils were tested for their performance against leaf blast, neck blast, sheath blight, brown spot and false smut diseases, at 15 locations. Two sprays of Neem oil @ 2 ml/l (T7) and Clove oil @ 2 ml/l (T6) are performing better in reducing the leaf blast severity, whereas Neem oil @ 2 ml/l (T7) alone effective in reducing both leaf and neck blast disease severity. In case of sheath blight disease, spraying of Citronella oil @ 2 ml/l (T1), Cedar wood oil @ 2.0ml/l (T3), Nirgundi oil @2.0ml/l (T4), Lemon grass oil @ 2.0 ml/l (T5), Clove oil @ 2 ml/l (T6) and Neem oil @ 2 ml/l (T7) reported as effective. With respect to brown spot, application of Citronella @ 2.0 ml/l (T1) reduced the disease development. Citronella @ 2.0 ml/l (T1) and Neem oil @ 2.0 ml/l are effective against false smut.

INTRODUCTION

The All India Co-ordinated Rice Pathology Programme of Indian Institute of Rice Research (ICAR-IIRR) provides an effective linkage for collaboration among state agricultural universities, National institutes and Department of Agriculture, Agrochemical Industry and others. The objectives of the Programme are:

- To accelerate genetic improvement of rice for resistance against major diseases occurring in different ecosystems of the country.
- To provide a testing mechanism to assess the advanced breeding lines over a wide range of climatic, cultural, soil and disease epidemic conditions.
- To identify broad spectrum of resistance to major rice diseases.
- To monitor and evaluate the genetic variation of rice pathogens.
- To monitor the prevalence of diseases in the country.
- To develop need based disease management practice.
- To identify production constraints in different ecosystems through production oriented survey.

To achieve these objectives during 2019, a total of 13 trials were conducted at 49 locations on host plant resistance, field monitoring of virulence in major pathogens and disease management. Five national screening nurseries comprising of 1404 entries of advanced breeding lines and new rice hybrids were evaluated for their reactions to major rice diseases at 49 locations.

The composition of the nurseries is as follows:

- ❖ National Screening Nursery 1 (NSN-1) - 353 entries drawn from Advanced Variety Trials.
- ❖ National Screening Nursery 2 (NSN-2) - 672 entries from Initial Variety Trials.
- ❖ National Screening Nursery-Hills (NSN-H) - 120 entries from Advanced and Initial Varietal Trials.
- ❖ National Hybrid Screening Nursery (NHSN) - 108 entries from Initial National Hybrid Rice Trials (HRT'S).
- ❖ Donor Screening Nursery (DSN) - 151 entries from different centres.

The virulence patterns of blast and bacterial leaf blight pathogens in the field were monitored, using differentials for respective diseases at disease endemic areas. The prevalence of the diseases was monitored in three sequentially sown disease observation nurseries laid-out in the endemic locations.

The disease management trials were conducted at hot-spot locations to evaluate the efficacy of new fungicides and commercially available combination fungicide formulations against major rice diseases. Production Oriented Survey (POS) was undertaken in 17 centres (16 states) to identify the production constraints in different rice growing ecosystems.

The weather parameters at locations are given in Annexure I to Annexure III. Out of 639 experiments proposed, data were received from 612 experiments of 13 trials indicating the good response with 95.7 % data receipt from the centres.

Table 1: Scientists involved in Pathology Coordinated Programme, *Kharif* 2019. Dr. M. Srinivas Prasad, PI; Associates: Drs. G.S. Laha, D. Krishnaveni, C. Kannan, D. Ladhalakshmi, V. Prakasam, K. Basavaraj and G. S. Jasudasu, ICAR-IIRR, Headquarters, Hyderabad

S.No	Location	Co-operators	Funded/ Voluntary	Experiments Proposed	Experiments Conducted
1	Aduthurai	Dr.A. Ramanathan	Funded	14	14
2	Almora	Dr. H. Rajashekara	ICAR	11	11
3	Arundhatinagar	Dr. Abijit Saha	Funded	2	2
4	Bankura	Dr. Partha Pratim Ghosh	Funded	17	24
5	Chatha	Dr. Anil Gupta	Funded	12	18
6	Chinsurah	Drs. Dr.C.K.Bhunia, Dilip Kumar Patra &P. Bandyopadhyay	Funded	13	13
7	Chiplima	Dr. Rini Pal	Funded	9	9
8	Coimbatore	Dr. C. Gopalakrishnan	Funded	17	17
9	Cuttack	Drs. Arup K Mukherjee, Sri Kanta Lenka & Manas Kumar Bag	ICAR	27	23
10	Gangavati	Dr. Pramesh Devana	Funded	23	21
11	Gerua	Dr. Rupankar Bhagawati	ICAR	9	2
12	Ghaghraghat	Dr. Amritlal Upadhayay	Funded	11	11
13	Gudalur	Dr. C. Gopalakrishnan	Voluntary	3	3
14	Hazaribagh	Drs. Amrita Banerjee & Dipankar Maiti	ICAR	14	13
15	ICAR-IIRR	Drs. M. S. Prasad, G. S. Laha, D. Krishnaveni, C. Kannan, D. Ladhalakshmi, V. Prakasam, K.Basavaraj and GS Jasudasu	HQ	32	32
16	Imphal	Dr. Susheel Kumar Sharma	ICAR	8	7
17	Jagdalpur	Dr. R. S. Netam	Funded	15	16
18	Jagtial	Dr. N. Balram	Voluntary	13	13
19	Karjat	Dr. Pushpa D Patil	Funded	16	15
20	Kaul	Dr. Mahaveer Singh	Funded	7	5
21	Khudwani	Dr. Nazir Ahmad Bhat	Funded	10	8
22	Lonavala	Dr. K. S. Raghuwanshi	Voluntary	20	23
23	Ludhiana	Drs. Jagjeet Singh Lore	Funded	17	17
24	Malan	Dr. SachinUpmanyu	Funded	15	12
25	Mandya	Dr. B. S. Chethana	Funded	18	18
26	Maruteru	Dr. V. Bhuvaneswari	Funded	22	18
27	Masodha (Faizabad)	Dr. Vindeshwari Prasad	Funded	13	13
28	Moncompu	Dr. M. Surendran	Funded	14	16
29	Mugad	Dr. B. C. Kamanna	Voluntary	15	9
30	Navsari	Dr. V. A. Patil	Funded	10	13
31	Nawagam	Dr. Rakeshkumar Gangwar	Funded	17	20
32	Nellore	Dr. P. Madhusudhan	Voluntary	10	5
33	New Delhi	Drs. K.K. Mondal, B. Bishnu Maya & G. Prakash	ICAR	10	10
34	Pantnagar	Drs. Vishwanath , Dr. Bijendrakumar	Funded	15	15
35	Patna	Dr. Md. Reyaz Ahmad	Funded	10	14
36	Pattambi	Dr. Puzhakkalraji	Funded	16	16
37	Ponnampet	Dr. G. N. Hosagoudar	Funded	14	14
38	Portblair	Mr. K. Sakthivel	ICAR	3	3
39	Pusa	Dr. Bimla Rai	Funded	12	12
40	Raipur	Dr. Pradeep Kumar Tiwari	Funded	17	16
41	Rajendranagar	Dr.Talluri Kiran Babu	Funded	14	14
42	Ranchi	Dr. M. K. Barnwal		8	8
43	Rewa	Dr. S. P. Mishra	Funded	11	11
44	Sabour	Dr. Amarendra Kumar	Voluntary	7	7
45	Titabar	Dr. Bubul Chandra Das	Funded	13	13
46	Umiam (Barapani)	Dr Akoijam Ratankumar Singh, Dr. Pankaj Baiswar	ICAR	11	7
47	Upper Shillong	Smt. Kheinkorlin Lyngdoh	Funded	9	5
48	Varanasi	Dr. R. K. Singh	Funded	9	5
49	Wangbal	Dr. Sanaton Sharma	Funded	6	-
	Total Experiments (%) 95.7 %			**639**	**612**

(All ICAR centres are Voluntary)

1. HOST PLANT RESISTANCE

Screening Nursery (NSN-1, NSN-2, NSN-H, NHSN and DSN)

❖ LEAF BLAST

➤ National Screening Nursery-1 (NSN-1)

The National Screening Nursery (NSN-1) comprised of 353 entries that included national regional and pathology checks. The nursery was evaluated at 28 locations across India under different-agro ecological Zones. The frequency distribution of disease scores and the representative location severity index (LSI) are presented in the Table 2. The screening against leaf blast was carried out under artificial inoculation condition at most the locations. None of the locations showed a very high (LSI =>7.0) disease pressure under NSN-1. The highest disease pressures was recorded at Mandya (LSI 6.3) and lowest (LSI-1.2) at Rewa. The disease pressure was moderate (LSI 4-6) at most of the locations evaluated and that included Pattambi (4.1), Chiplima (4.1), Gangavathi (4.1), Khudwani (4.2), Upper Shilling (4.2), Jagadalpur (4.4), IIRR (4.7), Jagtial (4.7), Ranchi (4.8), New Delhi (4.8), Almora (4.9), Navasari (5.0), Karjat (5.0), Hazaribagh (5.0), Umium (5.0), Rajendranagar (5.1), Cuttack (5.5), Coimbatore (5.7), Gudulur (5.7), Gagharghat (5.9) and Lonavala (5.9). The data from locations (Bankura, Mugad, Malan and Rewa) where disease pressure was low (<4.0) was not considered for the selection of promising entries.

The entries that scored SI<4 were considered as promising and presented in Table 3. The entries included IET Nos. 27528, 27722, 27773, 27927, 24967, 26464, 27748, 27903, 27736, 27743, 27343, 27894, 26351, 27980, 27390, 28811, 27357, 27369, 27781, 26767 and 27887 (Table 3).

➤ National Screening Nursery-2 (NSN-2)

The nursery consists of 672 lines drawn from initial variety trials (IVTs). These were evaluated at 19 centres under various ecological zones. The highest disease pressure was recorded at Mandya (LSI 7.4) and the lowest at Bankura (LSI 3.2). None of the locations showed a very high disease (LSI .7.0) and hight (LSI 6.0-7.0) disease pressure. The disease pressure was moderate (LSI 4.0-6.0) at most of the locations *viz.*, Ranchi (4.0), Pattambi (4.0), Mugad (4.0), Malan (4.2), Umium (4.5), Gangavathi (4.5), IIRR (4.7), Rajendranagar (4.8), Almora (4.9), Coimbatore (5.3), Hazaribagh (5.6), Gagharghat (5.6), Ponnampet (5.6), Cuttack (5.7) and Jagtial (5.7). The Performance of entries at locations *viz.*, Bankura (3.2), Jagdalpur (3.6) and Rewa (3.5) was not considered for the selection of best entries, where disease pressure was low (<4.0) (Table 4).

None of the entries were recorded SI less than 3.0, but a few promising entries with low susceptibility index was presented in Table 5 and that included IET # 28818, 28298, 28505, 28074, 28071, 28359, 284486, 28279, 28088, 28647, 28362, 28521, 28828 and 28833.

Table 2: Location severity index (LSI) and frequency distribution of leaf blast scores of NSN-1, *Kharif* 2019

Score	Location/Frequency of disease score (0-9)																											
	ALM	BNK	CBT	CHP	CTK	GDL	GGT	GNV	HZB	IIRR	JDP	JGT	KHD	KJT	LNV	MGD	MLN	MND	NDL	NVS	NWG	PNP	PTB	RNC	REW	RNR	UMM	USG
0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	2	17	0	0	3
1	4	0	0	6	0	0	0	31	6	7	11	9	4	0	0	1	101	3	33	3	0	1	1	8	68	10	1	6
2	32	0	0	47	0	0	0	124	28	26	42	36	6	0	1	1	33	14	0	7	0	17	8	8	76	0	0	122
3	58	328	25	70	20	25	0	69	74	47	54	24	93	65	4	246	23	25	111	35	63	61	95	12	96	102	22	62
4	43	0	0	102	2	0	0	4	59	112	69	66	101	79	29	41	42	49	4	68	43	36	160	131	76	0	2	11
5	88	23	214	73	234	214	197	24	59	64	61	140	87	67	114	62	44	42	102	115	127	98	50	82	10	135	2	46
6	63	0	3	20	0	3	0	1	31	18	57	19	25	54	102	2	32	39	0	97	43	56	11	60	8	0	6	27
7	34	2	72	35	79	72	155	20	40	52	39	44	13	63	63	0	26	56	67	18	58	56	17	45	1	72	3	33
8	18	0	0	0	0	0	0	5	29	13	10	0	2	7	23	0	5	22	0	9	8	19	9	5	0	0	6	19
9	11	0	38	0	10	38	1	68	25	13	2	12	0	0	16	0	9	102	35	1	10	7	0	0	0	32	5	23
Total	351	353	352	353	345	352	353	346	351	352	351	350	331	335	352	353	315	352	352	353	352	351	351	353	352	351	47	352
LSI	4.9	3.2	5.7	4.1	5.5	5.7	5.9	4.1	5.0	4.7	4.4	4.7	4.2	5.0	5.9	3.5	3.6	6.3	4.8	5.0	5.2	5.1	4.1	4.8	2.6	5.1	5.0	4.2
Screening method	N	A	A	N	A	N	-	A	N	A	N	-	N/A	A	A	N	A	A	A	N	A	N	N	A	A	A	N	N

(N-Natural; A-Artificial)

Table 3: Promising entries with low susceptibility index (<=4) and high PI in NSN-1 to leaf blast, *Kharif* 2019

P. No.	IET No.	ALM	CBT	CHP	CTK	GDL	GGT	GNV	HZB	IIRR	JDP	JGT	KHD	KJT	LNV	MND	NDL	NVS	NWG	PNP	PTB	RNC	RNR	UMM	USG	SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
353	Tetep (R)	2	6	3	5	6	7	2	1	1	2	-	5	3	2	4	3	1	3	3	2	6	3	4	5	3.4	23	14	61	19	83
85	27528	1	5	3	7	5	5	9	3	4	2	6	3	5	5	1	1	3	3	1	3	4	3	-	2	3.7	23	13	57	20	87
327	27722 (R)	3	3	2	3	3	7	3	3	1	4	4	5	5	7	2	3	3	7	3	2	7	3	-	2	3.7	23	15	65	19	83
106	27773	3	5	2	5	5	5	2	5	5	1	3	5	3	6	2	3	4	3	7	3	4	3	-	2	3.7	23	12	52	21	91
201	27927	2	5	4	7	5	7	2	4	4	2	2	4	4	4	3	1	8	5	3	3	4	3	-	2	3.8	23	10	43	20	87
132	24967	4	5	5		5	5	3	2	3	1	4	4	3	6	4	1	6	5	5	4	4	3	-	3	3.9	22	8	36	20	91
281	26464 (R)	4	5	3	3	5	7	3	2	3	2	5	3	6	7	4	5	3	4	5	3	2	3	-	2	3.9	23	12	52	20	87
138	27748	3	5	2	5	5	5	2	4	4	2	5	5	3	4	4	3	5	4	5	3	5	3	-	3	3.9	23	9	39	23	100
290	27903	3	3	2	5	3	5	2	2	4	5	5	4	5	5	3	4	5	5	3	4	5	5	-	2	3.9	23	9	39	23	100
99	27736	2	5	4	7	5	5	1	5	4	3	6	3	3	6	2	1	4	3	5	4	4	5	-	2	3.9	23	9	39	20	87
111	27743	1	5	4	5	5	5	2	3	4	1	2	4	3	6	2	1	6	5	6	3	6	5	-	5	3.9	23	9	39	19	83
276	27343	3	3	2	7	3	7	2	2	4	0	7	3	7	5	4	3	5	5	3	3	6	3	-	3	3.9	23	13	57	18	78
280	27894	2	3	4	5	3	7	3	3	5	2	3	3	5	6	7	3	4	5	3	5	4	3	-	2	3.9	23	12	52	20	87
89	26351 (R)	3	5	4	5	5	5	2	3	4	1	3	5	3	7	3	5	5	2	3	5	7	7	-	2	3.9	23	11	48	21	91
219	27980	2	5	4	5	5	5	3	3	3	3	4	5	4	5	2	1	3	5	5	4	7	5	-	2	3.9	23	9	39	22	96
167	27390	2	5	1	5	5	7	2	3	4	3	5	4	3	5	4	1	6	3	4	4	7	5	-	3	4.0	23	9	39	20	87
326	28811	3	3	2	5	3	7	3	3	1	6	5	5	5	6	2	3	4	5	4	3	8	3	6	2	4.0	24	12	50	19	79
121	27357	2	7	2	7	7	5	7	2	2	2	1	3	3	6	4	3	6	5	6	3	4	5	3	2	4.0	24	12	50	17	71
122	27369	2	5	5	5	5	7	-	1	2	4	3	4	3	6	2	1	5	7	7	3	5	5	3	3	4.0	23	10	43	19	83
134	27781	3	5	3	5	5	5	2	8	2	3	3	5	4	5	4	1	2	5	6	4	4	7	-	2	4.0	23	9	39	20	87
51	26767	1	5	5	7	5	5	1	4	6	3	2	3	5	5	6	1	4	4	2	4	4	7	-	4	4.0	23	7	30	19	83
264	27887	4	5	3	5	5	5	2	3	3	3	5	-	5	5	6	3	5	5	3	4	4	3	-	3	4.0	22	9	41	21	95
340	HR-12	7	9	7	9	9	5	9	9	9	8	9	3	5	9	9	9	7	9	7	7	4	9	9	9	7.8	24	1	4	4	17
353	LSI	4.9	5.7	4.1	5.5	5.7	5.9	4.1	5.0	4.7	4.4	4.7	4.2	5.0	5.9	6.3	4.8	5.0	5.2	5.1	4.1	4.8	5.1	5.0	4.2						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no.of locations where the entry had scored ≤3 and ≤5)

3. 12

Table 4: Location severity index (LSI) and frequency distribution of leaf blast scores of NSN-2, *Kharif* 2019

Score	Location/Frequency of score(0-9)																		
	ALM	BNK	CBT	CTK	GGT	GNV	HZB	IIRR	JDP	JGT	MGD	MLN	MND	PNP	PTB	RNC	REW	RNR	UMM
0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	1	24	0	1
1	7	0	0	0	0	52	1	3	31	4	1	168	3	1	2	0	79	32	25
2	28	0	0	0	0	182	32	6	149	20	1	40	0	2	31	8	83	0	246
3	136	602	45	10	0	167	90	83	173	17	380	44	6	43	138	106	116	264	92
4	65	0	186	0	25	6	92	244	140	61	33	111	53	89	317	462	175	0	11
5	203	67	212	467	439	50	125	167	81	262	158	69	82	207	139	78	95	192	28
6	129	0	86	0	1	10	83	74	54	74	53	79	56	121	25	16	90	0	6
7	71	3	97	141	204	22	118	85	24	183	46	48	84	145	14	1	10	115	21
8	25	0	17	0	0	18	88	2	7	7	0	7	69	45	1	0	0	0	24
9	4	0	29	54	3	160	42	5	2	43	0	73	311	12	0	0	0	68	152
Total	668	672	672	672	672	667	671	669	670	671	672	639	664	665	667	672	672	671	606
LSI	4.9	3.2	5.3	5.7	5.6	4.5	5.6	4.7	3.6	5.7	4.0	4.2	7.4	5.6	4.0	4.0	3.5	4.8	4.5
Screening method	N	A	A	A	-	A	N	A	N	-	N	A	A	N	N	A	A	A	N

(N-Natural; A-Artificial)

3. 13

Table 5: Promising entries with low susceptibility index (<=4) and high PI in NSN-2 to leaf blast, *Kharif* 2019

P. No.	IET No.	ALM	CBT	CTK	GGT	GNV	HZB	IIRR	JGT	MGD	MLN	MND	PNP	PTB	RNC	RNR	UMM	SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
672	Tetep	3	6	5	5	2	1	1	5	1	1	4	2	2	4	3	2	**2.9**	16	8	50	12	75
610	28818	1	4	5	5	3	2	4	1	3	1	4	1	4	4	5	2	**3.1**	16	6	38	13	81
404	28298	3	4	7	5	1	2	3	5	3	1	4	4	2	4	1	-	**3.3**	15	5	33	12	80
344	28505	4	3	5	5	2	3	4	5	3	1	6	3	3	4	1	2	**3.4**	16	4	25	12	75
624	28074	3	3	5	5	5	4	4	5	3	1	-	-	3	3	1	-	**3.5**	13	2	15	9	69
604	28071	1	9	5	5	2	2	3	2	3	-	5	5	3	3	3	2	**3.5**	15	5	33	10	67
39	28359	2	4	7	5	2	3	4	2	3	1	6	5	3	4	5	1	**3.6**	16	5	31	11	69
139	28486	3	4	5	7	2	4	3	6	3	1	1	5	4	4	3	2	**3.6**	16	4	25	12	75
448	28279	3	4	5	5	3	2	4	5	4	1	4	5	3	4	3	2	**3.6**	16	3	19	12	75
642	28088	3	4	7	5	2	3	4	5	3	1	5	6	3	2	3	2	**3.6**	16	4	25	11	69
227	28647	3	4	5	5	2	5	4	5	3	-	-	-	-	3	1	-	**3.6**	11	2	18	7	64
42	28362	2	6	7	5	3	2	3	4	3	-	3	6	4	3	1	3	**3.7**	15	3	20	11	73
361	28521	2	5	7	5	2	2	5	4	3	3	4	4	4	4	3	2	**3.7**	16	4	25	12	75
649	28828	3	4	5	5	2	2	5	5	5	1	4	7	3	3	3	2	**3.7**	16	4	25	10	63
655	28833	1	5	5	5	2	3	4	5	5	1	4	6	2	3	5	-	**3.7**	15	4	27	8	53
659	HR-12	7	9	9	5	9	6	9	9	6	9	9	7	7	6	9	9	**7.8**	16	0	0	0	0
LSI		4.9	5.3	5.7	5.6	4.5	5.6	4.7	5.7	4.0	4.2	7.4	5.6	4.0	4.0	4.8	4.5						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no.of locations where the entry had scored ≤3 and ≤5)

> **National Screening Nursery-Hills (NSN-Hills)**

The NSN-H included a total of 120 entries screened at 12 locations under hill ecological zones of India. The highest disease pressure was recorded at Umium (8.2); while it was lowest at Upper Shillong (2.3) (Table 6). The disease pressure was high (LSI 6-7) at Cuttack (6.5) and Lonavala (6.1). Moderate disease pressure (LSI 4-6) was observed at IIRR (4.3), Ponnampet (4.8), Karjat (5.1), Almora (5.2), Imphal (5.5) and Coimbatore (5.6). The data from centres *viz.*, Khudwani (3.4), Malan (2.5), and Upper Shillong (2.3) were not considered for the selection of resistance entries, where disease pressure was low (<4.0) (Table 6).

None of the entries recorded resistant reaction across the locations under hill ecosystem. However a few showed moderate resistance that included IET # 28193, 28222, 27491, 28211, 27498, 26580, 27506 and 28208 (Table 7).

> **National Hybrid Screening Nursery (NHSN)**

One hundred and eight hybrids that included checks were evaluated at 24 centres against leaf blast disease under NHSN. The highest disease pressure was observed at Mandya (6.6), while lowest (LSI 2.6) at Nawagam and Upper Shillong. None of the locations showed a very high disease pressure (LSI >7.0). The disease pressure was high (LSI 6-7) at Lonavala (6.1) and Jagtial (6.3). Most of the centres exhibited moderate disease pressure *viz.,*Pattambi (4.1), Karjat (4.1), Gangavathi (4.1), Ranchi (4.2), Khudwani (4.3), Rajendranagar (4.4), IIRR (4.7), Hazaribagh (4.9), Imphal (5.0), Gagharghat (5.3), Nawagam (5.4), Coimbatore (5.4) and Almora (5.4) (Table 8). The Performance of entries at Bankura, Jagdalpur, Mugad, Malan, Ponnampet, Rewa, Umiam and Upper Shillong was not considered for identifying promising entries.

The promising entries with low susceptibility index which showed resistance reaction consistently across the locations was presented in the Table 9 and that included IET# 28113, 28111, 28115, 28163, 28130, 28162 and 28141.

> **Donor Screening Nursery (DSN)**

The donor screening nursery comprised of 151entries including checks were evaluated at 24locations. None of the locations exhibited a very higher disease pressure with LSI >7.0. The disease pressure was high (LSI 6-7) at Lonavala (6.0), Almora (6.4) and Mandya (6.4). The disease pressure was moderate (LSI 4-6) at centres Ponnampet (4.0), Rajendranagar (4.4), Upper Shillong (4.6), Malan (4.8), Umium (4.9), IIRR (5.0), Nawagami (5.1), Gagharghat (5.3), Karjat (5.4), Gangavathi (5.4), Hazaribagh (5.4), Jagtial (5.5), Cuttack (5.6) and Coimbatore (5.8) (Table 10). The locations *viz.*, Bankura, Imphal, Jagdalpur, Mugad, Pattambi, Ranchi and Rewa where disease pressure was low (<4.0) were not considered for the selection of promising entries.

None of the entries were found superior over resistant check (3.0); however some of the moderate resistant donors were listed in the Table 11 that included HL18WS-20-5 and HL18WS-20-4.

Table 6: Location severity index (LSI) and frequency distribution of leaf blast scores of NSN-H, *Kharif* 2019

Score	Location/Frequency of score (0-9)											
	ALM	CBT	CTK	IIRR	IMP	KHD	KJT	LNV	MLN	PNP	UMM	USG
0	0	0	0	0	0	3	0	0	0	0	0	3
1	1	0	0	1	0	2	0	0	49	0	0	6
2	1	0	0	0	0	7	0	1	23	3	1	63
3	39	6	2	31	11	58	19	1	7	27	1	46
4	0	26	0	61	12	40	29	3	22	28	0	2
5	31	31	35	6	43	7	27	46	11	26	5	0
6	16	27	1	2	21	2	11	28	3	10	7	0
7	14	18	70	16	30	1	23	20	2	25	7	0
8	13	2	0	0	2	0	6	9	0	1	23	0
9	5	10	12	3	1	0	0	12	0	0	76	0
Total	120	120	120	120	120	120	115	120	117	120	120	120
LSI	5.2	5.6	6.5	4.3	5.5	3.4	5.1	6.1	2.5	4.8	8.2	2.3
Screening method	N	A	A	A	N	N/A	A	A	A	N	N	N

(N-Natural; A-Artificial)

Table 7: Promising entries with low susceptibility index (<5) and high PI in NSN-H to leaf blast, *Kharif* 2019

P. No.	IET No.	Location/Frequency of score (0-9)									SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ALM	CBT	CTK	IIRR	IMP	KJT	LNV	PNP	UMM						
120	Tetep	5	6	5	1	3	3	2	3	2	3.3	9	6	67	8	89
45	28193	3	6	5	3	5	3	5	3	8	4.6	9	4	44	7	78
78	28222	3	4	3	3	3	6	5	7	9	4.8	9	4	44	6	67
2	27491	3	4	7	4	5	3	5	3	9	4.8	9	3	33	7	78
65	28211	3	6	3	4	3	7	6	6	5	4.8	9	3	33	5	56
105	27498	5	7	5	3	5	3	5	3	8	4.9	9	3	33	7	78
31	26580	3	3	5	4	7	5	6	2	9	4.9	9	3	33	6	67
100	27506	5	6	5	3	6	3	5	3	8	4.9	9	3	33	6	67
62	28208	3	5	7	3	6	5	6	3	6	4.9	9	3	33	5	56
107	HR-12	9	9	9	9	7	4	9	7	9	8.0	9	0	0	1	11
LSI		5.2	5.6	6.5	4.3	5.5	5.1	6.1	4.8	8.2						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

Table 8: Location severity index (LSI) and frequency distribution of leaf blast scores of NHSN, *Kharif* 2019

Score	Location/Frequency of score (0-9)																							
	ALM	BNK	CBT	GGT	GNV	HZB	IIRR	IMP	JDP	JGT	KHD	KJT	LNV	MGD	MLN	MND	NWG	PNP	PTB	RNC	REW	RNR	UMM	USG
0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	13	0	23	0
1	8	0	0	0	9	1	1	0	11	0	0	0	0	0	31	0	0	1	0	11	9	8	23	0
2	2	0	0	0	26	13	0	0	17	2	7	0	1	1	10	0	2	14	0	13	29	0	2	55
3	6	98	1	0	30	24	17	16	33	2	18	42	1	72	3	3	9	36	14	6	22	43	13	40
4	20	0	41	12	6	13	46	26	17	12	35	33	3	7	13	14	14	19	79	33	28	0	8	7
5	18	10	19	73	11	12	18	32	15	19	34	10	40	23	12	21	36	19	8	23	6	36	18	1
6	21	0	27	1	1	10	1	17	7	21	9	6	28	2	11	10	22	7	2	10	0	0	10	0
7	16	0	8	22	5	24	23	15	2	31	4	9	19	3	5	21	19	6	4	9	0	9	6	0
8	12	0	2	0	1	7	0	2	1	6	0	0	2	0	0	13	5	2	0	3	0	0	3	0
9	5	0	10	0	18	4	2	0	2	14	0	0	14	0	2	24	1	0	0	0	0	10	1	0
Total	108	108	108	108	107	108	108	108	108	107	108	100	108	108	87	106	108	104	107	108	107	106	107	103
LSI	5.4	3.2	5.4	5.3	4.1	4.9	4.7	5.0	3.4	6.3	4.3	4.1	6.1	3.6	3.3	6.6	5.4	3.9	4.1	4.2	2.6	4.4	3.0	2.6
Screening method	N	A	A	-	A	N	A	N	N	-	N/A	A	A	N	A	A	A	N	N	A	A	A	N	N

(N-Natural; A-Artificial)

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Table 9: Promising entries with low susceptibility index (<=4) and high PI in NHSN to leaf blast, *Kharif* 2019

P. No.	IET No.	ALM	CBT	GGT	GNV	HZB	IIRR	IMP	JGT	KHD	KJT	LNV	MND	NWG	PTB	RNC	RNR	SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
108	Tetep	5	6	5	2	2	1	3	4	3	4	2	5	2	3	4	3	**3.4**	16	9	56	15	94
4	28113	1	4	5	2	2	4	4	5	4	3	6	4	6	3	2	3	**3.6**	16	7	44	14	88
1	28111	1	4	5	1	1	3	5	5	4	7	5	4	5	4	1	3	**3.6**	16	6	38	15	94
6	28115	3	4	5	2	3	3	3	4	4	3	7	3	5	3	2	5	**3.7**	16	9	56	15	94
63	28163	3	5	5	4	3	3	6	5	3	3	5	3	3	4	2	5	**3.9**	16	8	50	15	94
25	28130	4	6	5	2	3	5	6	2	2	3	5	7	6	4	1	1	**3.9**	16	7	44	12	75
61	28162	4	4	5	2	3	3	5	6	3	3	6	4	4	4	2	5	**3.9**	16	6	38	14	88
38	28141	1	4	5	1	3	4	5	7	5	4	5	3	6	4	1	5	**3.9**	16	5	31	14	88
95	HR-12	8	9	5	9	9	9	5	7	7	6	9	9	7	5	5	9	**7.4**	16	0	0	4	25
LSI		5.4	5.4	5.3	4.1	4.9	4.7	5.0	6.3	4.3	4.1	6.1	6.6	5.4	4.1	4.2	4.4						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

3. 19

Table 10: Location severity index (LSI) and frequency distribution of leaf blast scores of DSN, *Kharif* 2019

Score	ALM	BNK	CBT	CTK	GGT	GNV	HZB	IIRR	IMP	JDP	JGT	KJT	LNV	MGD	MLN	MND	NWG	PNP	PTB	RNC	REW	RNR	UMM	USG
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0	1
1	0	0	0	0	0	4	1	1	2	6	2	0	0	0	25	1	0	2	0	5	64	15	3	10
2	2	0	0	0	0	27	2	1	4	36	12	0	2	2	12	9	15	15	15	33	50	0	17	25
3	25	145	0	6	1	38	39	35	76	48	6	10	1	94	4	12	17	57	62	20	2	62	21	18
4	0	0	28	0	1	2	12	33	20	39	25	38	5	6	9	16	16	19	47	54	1	0	7	35
5	20	6	54	101	126	14	27	28	45	13	33	30	44	31	13	22	50	33	15	22	0	33	19	11
6	18	0	22	0	2	4	21	6	1	2	21	20	56	9	16	12	9	11	4	11	0	0	4	18
7	30	0	29	37	21	3	18	44	3	1	34	30	29	8	15	15	34	13	4	5	0	27	11	4
8	30	0	5	0	0	5	13	0	0	3	6	13	2	0	9	16	7	0	1	0	0	0	7	6
9	25	0	12	7	0	52	17	3	0	2	11	0	12	0	14	48	3	0	2	0	0	10	13	22
Total	150	151	150	151	151	149	150	151	151	150	150	141	151	150	117	151	151	150	150	150	150	147	102	150
LSI	6.4	3.1	5.8	5.6	5.3	5.4	5.4	5.0	3.8	3.4	5.5	5.4	6.0	3.8	4.8	6.4	5.1	4.0	3.7	3.7	1.2	4.4	4.9	4.6
Screening method	N	A	A	A	-	A	N	A	N	N	-	A	A	N	A	A	A	N	N	A	A	A	N	N

(N-Natural; A-Artificial)

Table 11: Promising entries with low susceptibility index (<=4) and high PI in DSN to leaf blast, *Kharif* 2019

P. NO	Designations	Location/Frequency of score (0-9)																SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ALM	CBT	CTK	GGT	GNV	HZB	IIRR	JGT	KJT	LNV	MLN	MND	NWG	PNP	RNR	UMM	USG						
150	**Tetep**	3	6	5	5	3	1	1	8	4	2	1	5	3	3	3	2	5	3.5	17	10	59	15	88
94	**HL18WS-20-5**	5	6	5	5	2	3	4	2	5	4	1	2	4	6	3	7	2	3.9	17	7	41	14	82
92	**HL18WS-20-4**	3	5	5	5	2	3	4	2	4	6	1	4	3	5	5	5	6	4.0	17	6	35	15	88
84	**HR-12**	9	9	9	5	9	9	7	6	8	9	9	9	9	3	7	-	9	7.9	16	1	6	2	13
	LSI	**6.4**	**5.8**	**5.6**	**5.3**	**5.4**	**5.4**	**5.0**	**5.5**	**5.4**	**6.0**	**4.8**	**6.4**	**5.1**	**4.0**	**4.4**	**4.9**	**4.6**						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

3. 21

❖ **NECK BLAST**

➢ **NSN-1**

The National Screening Nursery-1 (NSN-1) for neck blast disease was evaluated at nine locations across India with 353 entries during *Kharif* 2019. The entries were screened under natural conditions in all the centres except at Nawagami and Rajendranagar, where artificial method of screening was followed with spray of spore suspension. The frequency distribution of disease scores and location severity indices are presented in Table 12. The highest and lowest disease pressure was observed at Lonavala (6.8) and Bankura (1.9) respectively. The disease pressure was high (LSI 6-7) at Nellore (6.3) and Lonavala (6.8); while it was moderate (LSI 4-6) at Nawagami (4.0), Jagadalpur (4.4), Ponnampet (4.7), Rajendranagar (4.7), Mandya (5.2) and Jagtial (5.3). The data from Bankura was not considered for selection of best entries.

The data presented in the Table 12 depicts the frequency distribution of disease scores along with location severity indices. Some of the promising entries which performed better across all locations include IET # 27538, 27547, 27747, 27723, 25212, 27686, 27574, 26684, 26819, 27438, 27346, 26948, 26847, 27743, 27077, 25945, 27285, 27118, 26118 and 27632 (Table 13).

Table 12: Location severity index (LSI) and frequency distribution of Neck blast scores of NSN-1, *Kharif* 2019

Score	Location/Frequency of score(0-9)								
	BNK	JDP	JGT	LNV	MND	NWG	PNP	RNR	NLR
0	39	15	0	0	0	0	2	10	0
1	170	22	0	7	40	12	43	60	14
2	0	0	0	0	0	0	0	0	0
3	104	81	47	16	101	188	115	61	26
4	1	0	0	0	0	0	1	0	0
5	36	171	224	100	76	111	76	104	116
6	0	0	0	0	0	0	0	0	0
7	3	61	60	104	57	35	70	85	100
8	0	0	0	0	0	0	0	0	0
9	0	2	19	113	78	6	45	33	93
Total	353	352	350	340	352	352	352	353	349
LSI	1.9	4.4	5.3	6.8	5.2	4.1	4.7	4.7	6.3
Screening method	N	N	N	N	N	A	N	A	N

(N-Natural; A-Artificial)

Table 13: Promising entries with low susceptibility index (<=4) and high PI in NSN-1 to Neck blast, *Kharif* , 2019

P. No.	IET No.	Location/Frequency of score (0-9)								SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		JDP	JGT	LNV	MND	NWG	PNP	RNR	NLR						
353	Tetep	0		1	3	3	3	5	3	2.6	7	6	86	7	100
150	27538	0	5	5	1	3	3	1	3	2.6	8	6	75	8	100
154	27547	3	5	3	3	3	1	3	3	3.0	8	7	88	8	100
104	27747	5	5	3	1	3	1	1	5	3.0	8	5	63	8	100
59	27723	0	5	9	3	3	1	1	3	3.1	8	6	75	7	88
20	25212 (R)	0	3	7	9	5	1	0	1	3.3	8	5	63	6	75
169	27686	1	5	5	3	5	1	1	5	3.3	8	4	50	8	100
14	27574	5	5	-	3	3	1	1	5	3.3	7	4	57	7	100
18	26684	3	3	5	5	3	1	0	7	3.4	8	5	63	7	88
175	26819 (R)	1	5	7	5	3	1	0	5	3.4	8	4	50	7	88
7	27438	3	5	-	5	5	1	0	5	3.4	7	3	43	7	100
117	27346	7	5	5	1	3	3	1	3	3.5	8	5	63	7	88
246	26948	1	3	5	3	3	5	1	7	3.5	8	5	63	7	88
133	US 312 (HC)	5	5	5	1	3	1	7	1	3.5	8	4	50	7	88
168	26847(R)	5	3	5	3	3	3	3	5	3.8	8	5	63	8	100
111	27743	5	3	9	1	3	1	5	3	3.8	8	5	63	7	88
37	27077	1	5	7	3	7	1	3	3	3.8	8	5	63	6	75
239	25945	1	5	7	3	3	1	3	7	3.8	8	5	63	6	75
301	27285	3	3	5	1	7	3	1	7	3.8	8	5	63	6	75
5	27118	3	5	5	3	5	1	1	7	3.8	8	4	50	7	88
161	26118	1	5	5	5	3	3	1	7	3.8	8	4	50	7	88
232	27632	0	5	5	5	3	3	0	9	3.8	8	4	50	7	88
340	HR-12	7	5	9	9	7	9	9	9	8.0	8	0	0	1	13
LSI		4.5	5.3	6.8	5.2	4.1	4.7	4.7	6.3						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **NSN-2**

A total of 672 entries were evaluated under NSN-2 at four different locations during *kharif* 2019. The screening was done under natural infection condition at all the locations. The location severity index and frequency distribution of scores presented in the Table 14 indicated that, the disease pressure was moerate (LSI 4-6) at Mandya (5.4) and Ponnampet (5.7). The centres *viz*., Jagdalpur (3.6) and Bankura (2.0) showed lower disease pressure (LSI <4); and hence the data from these centres were not considered for selection of best entries.The entries that had shown low disease scores across the two locations (Mandya and Ponnampet) were listed in Table 15. Since only two centres were considered in selection of best entries, hence it may not help in understanding the resistance/susceptible nature of entries; however a few promising entries are IET# 28732, 28514, 28306, 28462, 28500, 28505, 28521, 28397, 28686, 28723, 28502, 28510, 28532, 28545, 28301, 28302, 28304, 28317, 28290, 28702, 28703, 27730, 28088 and 28828.

➢ **NSN-H**

A total of 120 entries were evaluated under NSN-hills nursery at five different locations across India under hill ecosystem. The entries were screened under natural infection condition at locations. The location severity index and frequency distribution of scores were presented in the Table 16. The disease pressure was high at Lonavala (6.5) and Ponnampet (6.9); while it was moderate (LSI 4-6) at Malan (4.0) and Imphal (4.5). The disease pressure was low at Almora (2.7) and hence not considered for selection of promising entries. The entries *viz*., IET#. 28222, 28237, 27466, 26565, 25819, 26588, 26579, 28188, 28223, 28230, 28231, 28238, 28239 and 27463 were found to be promising against neck blast disease across the locations (Table 17).

➢ **NHSN**

The entries in National Hybrid Screening Nursery (NHSN) were evaluated for neck blast reaction at 11 locations. The entries were screened under natural infection conditions in all the locations except at Nawagami and Rajendranagar; where artificial method of screening was followed. The disease pressure was high at Jagtial (6.1) and Lonavala (6.3); it was moderate (LSI 4-6) Umiam (4.2), Nawagami (4.2) and Madya (4.8). The data from centres (Almora, Bankura, Imphal, Jagdalpur, Malan and Rajendranagar) where the disease pressure was low (LSI<4) were not considered for selection of best entries (Table 18). The entries which showed low disease score across the locations were considered as promising against neck blast and are listed in Table 19. The entries included IET# 28117, 28187, 28184, 28129, 28128, 28154, 28142 and 28130.

Table 14: Location severity index (LSI) and frequency distribution of Neck blast scores of NSN-2, *Kharif* 2019

Score	Location/Frequency of score(0-9)			
	BNK	JDP	MND	PNP
0	76	75	0	7
1	315	92	16	21
2	0	1	0	0
3	203	186	182	127
4	2	0	0	1
5	71	239	225	180
6	0	0	0	1
7	5	78	119	231
8	0	0	0	0
9	0	0	122	100
Total	672	671	664	668
LSI	2.0	3.6	5.4	5.7
Screening method	N	N	N	N

(N-Natural; A-Artificial)

Table 15: Promising entries with low susceptibility index (<=2) and high PI in NSN-2 to Neck blast, *Kharif* 2019

P. No.	IET No.	Location/Frequency of score (0-9)		SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		MND	PNP						
282	28732	1	0	0.5	2	2	100	2	100
353	28514	1	1	1.0	2	2	100	2	100
412	28306	1	1	1.0	2	2	100	2	100
112	28462	3	0	1.5	2	2	100	2	100
339	28500	3	0	1.5	2	2	100	2	100
344	28505	3	0	1.5	2	2	100	2	100
361	28521	3	0	1.5	2	2	100	2	100
163	28397	3	1	2.0	2	2	100	2	100
267	28686	1	3	2.0	2	2	100	2	100
273	28723	3	1	2.0	2	2	100	2	100
341	28502	1	3	2.0	2	2	100	2	100
349	28510	1	3	2.0	2	2	100	2	100
372	28532	3	1	2.0	2	2	100	2	100
387	28545	1	3	2.0	2	2	100	2	100
407	28301	3	1	2.0	2	2	100	2	100
408	28302	3	1	2.0	2	2	100	2	100
410	28304	3	1	2.0	2	2	100	2	100
423	28317	3	1	2.0	2	2	100	2	100
459	28290	3	1	2.0	2	2	100	2	100
524	28702	1	3	2.0	2	2	100	2	100
525	28703	3	1	2.0	2	2	100	2	100
641	27730	3	1	2.0	2	2	100	2	100
642	28088	1	3	2.0	2	2	100	2	100
649	28828	1	3	2.0	2	2	100	2	100
672	Tetep	1	3	2.0	2	2	100	2	100
659	HR-12	9	9	9.0	2	0	0	0	0
LSI		5.5	5.7						

Table 16: Location severity index(LSI) and frequency distribution of Neck blast scores of NSN-H, *Kharif* 2019

Score	Location/Frequency of score(0-9)				
	ALM	IMP	LNV	MLN	PNP
0	21	0	0	0	0
1	33	1	2	28	0
2	0	0	0	0	0
3	30	44	0	17	7
4	0	0	0	0	0
5	24	60	40	26	26
6	0	0	0	0	0
7	10	15	60	15	56
8	0	0	0	0	0
9	0	0	18	6	31
Total	**118**	**120**	**120**	**92**	**120**
LSI	**2.7**	**4.5**	**6.5**	**4.0**	**6.9**
Screening method	**N**	**N**	**N**	**N**	**N**

(N-Natural; A-Artificial)

Table 17: Promising entries with low susceptibility index (<=4) and high PI in NSN-H to Neck blast, *Kharif* 2019

P. No.	IET No.	Location/Frequency of score (0-9)				SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		IMP	LNV	MLN	PNP						
120	Tetep	3	1	-	3	**2.3**	**3**	**3**	**100**	**3**	**100**
78	28222	3	5	1	5	**3.5**	**4**	**2**	**50**	**4**	**100**
95	28237	5	5	1	3	**3.5**	**4**	**2**	**50**	**4**	**100**
13	27466	3	5	-	3	**3.7**	**3**	**2**	**67**	**3**	**100**
25	26565	3	7	1	5	**4.0**	**4**	**2**	**50**	**3**	**75**
27	25819	3	5	1	7	**4.0**	**4**	**2**	**50**	**3**	**75**
36	26588	3	7	1	5	**4.0**	**4**	**2**	**50**	**3**	**75**
38	26579	3	7	1	5	**4.0**	**4**	**2**	**50**	**3**	**75**
40	28188	3	7	1	5	**4.0**	**4**	**2**	**50**	**3**	**75**
79	28223	5	7	1	3	**4.0**	**4**	**2**	**50**	**3**	**75**
86	28230	3	5	1	7	**4.0**	**4**	**2**	**50**	**3**	**75**
88	28231	3	5	1	7	**4.0**	**4**	**2**	**50**	**3**	**75**
96	28238	3	7	1	5	**4.0**	**4**	**2**	**50**	**3**	**75**
97	28239	3	5	1	7	**4.0**	**4**	**2**	**50**	**3**	**75**
14	27463	1	5	5	5	**4.0**	**4**	**1**	**25**	**4**	**100**
107	HR-12	7	9	-	9	**8.3**	**3**	**0**	**0**	**0**	**0**
LSI		**4.5**	**6.6**	**4.0**	**6.9**						

Table 18: Location severity index (LSI) and frequency distribution of Neck blast scores of NHSN, *Kharif* 2019

Score	Location/Frequency of score(0-9)										
	ALM	BNK	IMP	JDP	JGT	LNV	MLN	MND	NWG	RNR	UMM
0	10	14	0	4	0	0	0	0	0	4	2
1	20	57	0	19	2	2	17	11	3	21	2
2	0	0	0	0	0	0	0	0	0	0	16
3	7	29	65	57	3	0	10	28	46	42	27
4	0	0	0	0	0	0	0	0	0	0	14
5	13	7	43	19	41	44	20	34	47	28	20
6	0	0	0	0	0	0	0	0	0	0	14
7	2	1	0	8	57	43	3	23	10	6	4
8	0	0	0	0	0	0	0	0	0	0	1
9	3	0	0	1	5	15	1	8	2	5	7
Total	55	108	108	108	108	104	51	104	108	106	107
LSI	2.7	1.7	3.8	3.2	6.1	6.3	3.5	4.8	4.3	3.5	4.2
Screening method	N	N	N	N	-	N	N	N	A	A	N

(N-Natural; A-Artificial)

Table 19: Promising entries with low susceptibility index (<=4) and high PI in NHSN to Neck blast, *Kharif* 2019.

P. No.	IET No.	Location/Frequency of score (0-9)					SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		JGT	LNV	MND	NWG	UMM						
108	Tetep	5	1	3	1	3	2.6	5	4	80	5	100
9	28117	5	5	1	1	5	3.4	5	2	40	5	100
94	28187	5	5	3	3	2	3.6	5	3	60	5	100
89	28184	1	7	3	5	2	3.6	5	3	60	4	80
24	28129	7	-	3	1	4	3.8	4	2	50	3	75
22	28128	5	5	3	3	3	3.8	5	3	60	5	100
52	28154	7	5	1	3	3	3.8	5	3	60	4	80
39	28142	5	5	1	5	3	3.8	5	2	40	5	100
28	US-312	7	5	3	3	2	4.0	5	3	60	4	80
107	Swarnadhan	3	1	7	3	6	4.0	5	3	60	3	60
23	Gontra Bidhan-3	5	5	3	5	2	4.0	5	2	40	5	100
25	28130	1	7	5	3	4	4.0	5	2	40	4	80
95	HR-12	5	9	9	5	9	7.4	5	0	0	2	40
LSI		6.1	6.4	4.8	4.3	4.3						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➤ **DSN**

A total of 151 entries were evaluated under Donor screening nursery at eight locations during *Kharif*, 2019. The location severity index and frequency distribution of scores were presented in the Table 20. The disease pressure was high at Jagtial (LSI 6.0); while it was lowest at Jagdalpur (2.3). The disease pressure was moderate (LSI 4-6) at Mandya (5.4), Lonavala (5.7) and Umiam (5.7) while it was low at (<4) Jagadalpur (2.3), Rajendranagar (3.4), Nawagami (3.7) and Imphal (3.9) and hence data from these centres were not

considered for selection of best entries under DSN. The promising entries with low disease pressure across the locations were presented in Table 21 and that included RP-Bio Patho-11, RP-Bio Patho-7, RP-Patho-2, RP-Patho-3, RP-Patho-9, RP-Bio Patho-10, RP-Bio Patho-12, KNM 7787, HL18WS-22-2, HL18WS20-4, RMS-R-6, RMS-R-13 and RP-Bio Patho-8.

Table 20: Location severity index (LSI) and frequency distribution of Neck blast scores of DSN, *Kharif* 2019

Score	Location/Frequency of score(0-9)							
	IMP	JDP	JGT	LNV	MND	NWG	RNR	UMM
0	0	30	0	0	0	0	16	0
1	0	52	0	3	16	28	29	1
2	0	0	0	0	0	0	0	6
3	80	30	14	0	21	62	33	20
4	0	0	1	0	0	0	0	19
5	71	32	46	96	47	45	38	9
6	0	0	2	0	0	0	0	6
7	0	5	87	34	47	14	17	7
8	0	0	0	0	0	0	0	5
9	0	1	1	11	19	2	3	29
Total	151	150	151	144	150	151	136	102
LSI	3.9	2.3	6.0	5.7	5.4	3.7	3.4	5.7
Screening method	N	N	N	N	N	A	A	N

(N-Natural; A-Artificial)

Table 21: Promising entries with low susceptibility index (<=4) and high PI in DSN to Neck blast, *Kharif* 2019

P. No.	Designtions	Location/Frequency of score (0-9)				SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		JGT	LNV	MND	UMM						
83	Tetep	5	1	3	3	3.0	4	3	75	4	100
127	Whazhuopek	3	5	1	3	3.0	4	3	75	4	100
75	RP-Bio Patho-11	5	-	1	3	3.0	3	2	67	3	100
126	Phoghak	5	5	1	2	3.3	4	2	50	4	100
71	RP-Bio Patho-7	7	-	1	3	3.7	3	2	67	2	67
54	RP-Patho-2	5	5	3	2	3.8	4	2	50	4	100
55	RP-Patho-3	3	5	5	2	3.8	4	2	50	4	100
61	RP-Patho-9	7	5	1	2	3.8	4	2	50	3	75
74	RP-Bio Patho-10	3	7	1	4	3.8	4	2	50	3	75
76	RP-Bio Patho-12	6	5	1	3	3.8	4	2	50	3	75
32	KNM 7787	3	5	5	3	4.0	4	2	50	4	100
91	HL18WS-22-2	3	5	5	3	4.0	4	2	50	4	100
92	HL18WS-20-4	3	5	5	3	4.0	4	2	50	4	100
102	RMS-R-6	3	5	1	7	4.0	4	2	50	3	75
109	RMS-R-13	5	5	1	5	4.0	4	1	25	4	100
72	RP-Bio Patho-8	7	-	1	4	4.0	3	1	33	2	67
137	HR-12	7	9	9	-	8.3	3	0	0	0	0
LSI		6.0	5.7	5.4	5.7						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤5 and ≤3;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

❖ SHEATH BLIGHT

➤ NSN-1

The National Screening Nursery-1 (NSN-1) was evaluated for resistance to sheath blight at 19 locations across India. The entries were screened by artificial inoculation at most of the centres except Patna where the entries were evaluated under natural condition and disease pressure was 3.7. The highest disease pressure was recorded at Gangavati (8.0) and lowest at Titabar (3.7) through artificial inoculation. The frequency distribution of disease scores and location severity indices (LSI) were presented in Table 22. The disease pressure was very high (LSI >7) at Gangavati (8.0), Mandya (7.8), Maruteru (7.6), Pattambi (7.6), Cuttack (7.2), IIRR (7.4), New Delhi (7.1) and Ludhiana (7.0); high (LSI 6 - 7) atMasodha (6.7); and moderate (LSI 3-6) at Raipur (5.8), Chiplima (5.6), Aduthurai (5.5), Chinsurah (5.3), Pusa (5.0),Bankura (4.7), Moncompu (4.7), Pant Nagar (4.1) and Titabar (4.0). The selection of best entries in NSN-1 was done based on the reaction at those locations where LSI was ≥4. Some of the promising entries with SI ≤ 5.0 are presented in the Table 23. None of the entries were found resistant (SI≤3.0) against sheath blight disease. The promising entries were selected based on low susceptibility index than Swarnadhan (tolerant check) are IET Nos. 26684, 27836, 27118, 25912, 27781, 27637, 26692, 27851, 27646, 26927, 27438 and 26118.

➤ NSN-2

The National Screening Nursery-2 (NSN-2) was evaluated for their resistance to sheath blight at 15 locations. The entries were screened by artificial inoculation at most of the centres except Patna where the entries were evaluated under natural condition and observed a moderate level of disease severity (LSI <3.4). The frequency distribution of disease scores and location severity index (LSI) are presented in Table 24. The disease pressure was very high (LSI >7) at Gangavati (8.0), Mandya (8.0), Maruteru (7.6), Ludhiana (7.0); high (LSI 6 - 7) at Pattambi (6.9), Raipur (6.7), IIRR (6.4), Titabar (6.4) and Masodha (6.1); and moderate (LSI 3-6) at Aduthurai (5.9), Pusa (5.0), Bankura (4.9), Pantnagar (4.7), Moncompu (3.6) and Patna (3.4).The selection of promising entries in NSN-2 was done based on the reaction at those locations where LSI was ≥4.0. Some of the promising entries with SI ≤ 5.0 are presented in the Table 25. None of the entries were resistant (SI≤3.0) against sheath blight. Highly promising entries (IETNos. 28688, 28455, 28304, 28676, and 28305) were found better than tolerant check (Tetep). Besides, some of the other promising entries *viz.,* IET Nos. 28517, 28293, 28301, 28482, 28471, 28478, 28346, 28732 and 28310 were selected and they found better than Swarnadhan (tolerant check).

Table 22: Location severity index and frequency distribution of sheath blight disease score for NSN-1 entries, *Kharif*-2019

Score	Location/Frequency of score(0-9)																		
	ADT	BNK	CHN	CHP	CTK	GNV	IIRR	LDN	MNC	MND	MSD	MTU	NDL	PNT	PSA	PTB	PTN	RPR	TTB
0	14	0	0	0	0	0	0	0	8	0	0	0	0	4	1	0	36	0	0
1	12	36	0	9	11	0	0	0	38	1	0	0	0	20	11	0	5	19	31
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
3	69	100	62	60	19	1	10	0	74	3	15	0	1	147	59	11	101	35	167
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	98	0	0
5	97	120	175	140	34	16	41	5	120	21	105	28	81	151	203	28	90	119	108
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	91	81	107	92	153	144	172	334	102	161	148	195	160	28	69	153	22	134	35
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	66	16	8	48	135	191	130	12	6	166	84	127	102	2	9	158	0	43	9
Total	349	353	352	349	352	352	353	351	348	352	352	350	344	352	353	350	353	350	350
LSI	5.5	4.7	5.3	5.6	7.2	8.0	7.4	7.0	4.7	7.8	6.7	7.6	7.1	4.1	5.0	7.6	3.7	5.8	4.0
Screening method	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	N	A	A

(N- Natural; A- Artificial)

3. 30

Table 23: Promising entries with low susceptibility index (SI≤5.0) and high promising index in NSN-1 to sheath blight, *Kharif*-2019

P.No	IET No.	ADT	BNK	CHN	CHP	CTK	GNV	IIRR	LDN	MNC	MND	MSD	MTU	NDL	PNT	PSA	PTB	RPR	TTB	SI	Total	≤3	PI (<-3)*	≤5	PI (<5)**
353	Tetep (TC)	0	3	3	7	5	5	5	7	1	1	5	7	7	5	3	3	7	1	4.2	18	8	44	13	72
18	26684	0	1	3	3	9	7	5	7	3	9	3	5	9	1	5	5	1	3	4.4	18	9	50	13	72
19	Purnendu (Eastern)ZC	3	3	3	5	5	9	5	7	3	9	3	5	5	3	3	5	3	1	4.4	18	9	50	15	83
35	27836	5	3	3	5	5	7	5	7	1	9	5	5	7	3	5	5	3	1	4.7	18	6	33	14	78
5	27118	3	3	5	1	3	9	7	7	1	9	5	5	-	0	7	7	5	3	4.7	17	7	41	11	65
13	25912	0	5	5	9	7	7	5	7	1	7	3	7	7	3	3	3	5	1	4.7	18	7	39	11	61
134	27781	-	5	5	3	7	3	5	7	5	7	5	5	5	5	7	5	1	1	4.8	17	4	24	13	76
20	25212 (R)	3	5	3	3	9	7	3	9	3	9	3	5	7	3	7	3	1	3	4.8	18	10	56	12	67
231	27637	0	5	3	5	7	9	5	7	1	7	3	5	7	5	5	3	5	5	4.8	18	5	28	13	72
155	26692	1	7	5	5	7	7	5	7	0	7	5	5	7	5	3	3	5	3	4.8	18	5	28	12	67
24	27851	3	3	5	3	7	7	5	7	3	7	3	7	7	3	5	5	5	3	4.9	18	7	39	12	67
235	27646	1	5	5	5	7	7	3	7	1	9	5	7	7	3	5	7	1	3	4.9	18	6	33	11	61
244	26927	3	5	3	3	3	5	7	7	3	7	5	7	7	3	3	7	9	3	5.0	18	8	44	11	61
7	27438	5	3	3	1	9	9	7	7	-	9	3	5	7	1	1	5	5	5	5.0	17	6	35	11	65
161	26118	3	1	3	1	7	7	7	7	7	7	5	7	5	7	5	3	5	3	5.0	18	6	33	10	56
352	Swarnadhan (TC)	3	7	7	5	7	9	5	7	3	9	5	7	7	5	1	5	7	1	5.6	18	4	22	9	50
342	T(N1) (SC)	9	7	7	9	7	7	9	7	5	9	7	9	9	5	5	7	7	3	7.1	18	1	6	4	22
	LSI	5.6	4.7	5.4	5.6	7.2	8.0	7.4	7.0	4.7	7.8	6.7	7.6	7.1	4.1	5.0	7.6	5.8	4.0						

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3* and ≤5**)

Table 24: Location severity index and frequency distribution of sheath blight disease score for NSN-2 entries, *Kharif*-2019

Score	Location/Frequency of score(0-9)														
	ADT	BNK	GNV	IIRR	LDN	MNC	MND	MSD	MTU	PNT	PSA	PTB	PTN	RPR	TTB
0	5	0	0	0	0	107	0	0	0	0	2	0	110	0	0
1	35	0	0	0	0	89	1	0	0	2	27	1	0	29	29
2	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
3	87	252	0	1	0	154	0	6	1	180	179	42	276	12	61
4	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0
5	214	230	42	301	8	172	6	320	69	405	271	159	228	117	155
6	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0
7	188	148	259	255	626	127	303	316	319	75	156	265	33	375	249
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	132	42	370	109	23	6	353	24	259	2	37	198	0	135	171
Total	**661**	**672**	**671**	**669**	**657**	**655**	**663**	**666**	**648**	**664**	**672**	**665**	**672**	**668**	**665**
LSI	**5.9**	**4.9**	**8.0**	**6.4**	**7.0**	**3.6**	**8.0**	**6.1**	**7.6**	**4.7**	**5.0**	**6.9**	**3.4**	**6.7**	**6.4**
Screening method	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**N**	**A**	**A**

(N- Natural; A- Artificial)

Table 25: Promising entries with low susceptibility index (SI≤5.0) and high promising index in NSN-2 to sheath blight, *Kharif*-2019

P.No.	IET No.	Location/Frequency of score (0-9)													SI	Total	≤3	PI (<-3)*	≤5	PI (<5)**
		ADT	BNK	GNV	IIRR	LDN	MND	MSD	MTU	PNT	PSA	PTB	RPR	TTB						
269	28688	0	5	9	5	7	7	5	5	3	3	5	1	3	4.5	13	5	38	10	77
94	28445	5	3	9	5	5	7	5	5	3	7	3	1	1	4.5	13	5	38	10	77
410	28304	3	5	7	5	7	7	3	5	3	5	3	5	1	4.5	13	5	38	10	77
256	28676	5	5	7	5	7	7	5	5	3	3	5	1	1	4.5	13	4	31	10	77
411	28305	3	5	9	5	7	5	5	5	3	3	3	5	3	4.7	13	5	38	11	85
564	28255	3	7	7	7	7	7	5	-	5	1	7	1	1	4.8	12	4	33	6	50
672	Tetep (TC)	5	5	9	5	7	1	5	9	5	3	3	3	3	4.8	13	5	38	10	77
357	28517	1	3	7	5	7	9	7	5	3	5	3	5	3	4.8	13	5	38	9	69
398	28293	1	3	9	5	7	7	5	5	5	3	3	7	3	4.8	13	5	38	9	69
407	28301	1	3	5	5	7	7	5	7	3	5	5	7	3	4.8	13	4	31	9	69
135	28482	1	3	7	5	7	7	5	7	5	1	7	7	1	4.8	13	4	31	7	54
123	28471	3	5	7	5	7	9	5	7	3	3	5	3	3	5.0	13	5	38	9	69
131	28478	3	3	5	5	7	7	5	7	5	3	5	7	3	5.0	13	4	31	9	69
26	28346	5	3	9	5	–	7	5	5	5	1	3	7	5	5.0	12	3	25	9	75
282	28732	1	3	5	5	7	7	5	7	5	3	5	7	5	5.0	13	3	23	9	69
416	28310	3	5	7	5	7	7	5	5	5	3	5	7	1	5.0	13	3	23	9	69
671	Swarnadhan (TC)	5	9	7	5	7	9	5	9	5	1	3	1	3	5.3	13	4	31	8	62
661	TN1 (SC)	5	9	9	9	7	9	7	7	5	7	7	5	5	7.0	13	0	0	4	31
LSI		5.9	4.9	8.0	6.4	7.0	8.0	6.1	7.6	4.7	5.0	6.9	6.7	6.4				-		

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3* and ≤5**)

> **NSN-H**

The National Screening Nursery - Hills (NSN-H) was evaluated for their resistance to sheath blight at Cuttack, IIRR and Pantnagar. These entries were screened through artificial inoculation in all the locations. The frequency distribution of disease scores and location severity indices are presented in Table 26. The disease pressure was high (LSI 6-7) at IIRR (7.1) and Cuttack (6.9) and moderate at (LSI 3-6) Pantnagar (5.1). The selection of best entries was done based on the reaction at these three locations. None of the entries were resistant (SI≤3.0) against sheath blight. Some of the promising entries better than tolerant check (Tetep) are IET Nos.28217, 28198, 28212 and 27498 (Table 27).

> **NHSN**

The National Hybrid Screening Nursery (NHSN) was evaluated for their resistance to sheath blight at 20 varied hot spot locations. The entries were screened by artificial inoculation at most of the centres except Patna where the entries were evaluated under natural incidence with moderate disease pressure (LSI 3.5). The frequency distribution of disease score and location severity index (LSI) are presented in the Table 28. The disease pressure was very high (LSI >7) at Maruteru (8.9), Gangavathi (8.2), Mandya (7.3), Titabar (7.2) and Pattambi (7.0); high (LSI 6-7) at Cuttack (6.9), Ludhiana (6.7) and IIRR (6.1);and moderate (LSI 3-6) at Raipur (5.9),Masodha (5.9), New Delhi (5.7), Chinsurah (5.6), Aduthurai (5.5),Bankura (5.4),Pant Nagar (4.9),Kaul (4.4), Pusa (4.2)and Arundhatinagar (4.1); and low (LSI <3) at Moncompu (3.3). Therefore, the data from those centers having LSI ≤4.0 was not considered for selecting the promising entries. None of the entries were showed resistant against sheath blight. Some of the promising entries IET 28148, 28166, 28141, 28160, 28173, 28152, 28151, 28155 and 28154) showed less disease severity index when compare to tolerant check (Swarnadhan) are listed in Table 29.

> **DSN**

The Donor Screening Nursery (DSN) was evaluated for resistance to sheath blight at 18 hot spot locations in India. The entries were screened by artificial inoculation at all the centres except Patna where the entries were evaluated under natural conditions and it was recorded moderate disease pressure (4.5). The frequency distribution of disease scores and location severity index (LSI) were presented in Table 30. The disease pressure was very high (LSI >7) at Maruteru (8.1), Mandya (7.7), Gangavati (7.5) and Ludhiana (7.0);high (LSI 6-7) at IIRR (6.9),Masodha (6.8), Pattambi (6.8), Cuttack (6.8),Kaul (6.5) and Aduthurai (6.4); and moderate (LSI 3-6) at New Delhi (5.7), Chiplima (5.5),Raipur (5.3),Moncompu (4.6), Patna (4.5), Pant Nagar (4.4) andTitabar (3.6). The selection of promising entries in DSN was done based on the reaction at those locations where LSI was ≥4.0. None of the entries were showed resistant (≤3) against sheath blight. However, some of the promising entries were presented in the Table 31. The selected promising entries *viz.*, IET 25692, Phoghak, RP-Patho-9, Gonalasha, CR 4209-2, RMS-R-11, Pankaj, RMS-R-6, KNM 7786, MSM-BB-61, Whazhuopek, GSY-4-9, NWGR 11048, CR 4053-24-40-1, SM-801 and MSM-SB-87 performed better than tolerant check Tetep and lower susceptibility index than field tolerant check Swarnadhan.

Table 26: **Location severity index and frequency distribution of sheath blight disease score for NSN-H entries,** *Kharif-***2019**

Score	Location/Frequency of score(0-9)		
	CTK	**IIRR**	**PNT**
0	0	0	0
1	4	0	0
2	0	0	0
3	9	0	22
4	0	0	0
5	22	27	72
6	0	0	0
7	36	61	24
8	0	0	0
9	47	32	2
Total	**118**	**120**	**120**
LSI	**6.9**	**7.1**	**5.1**
Screening method	**A**	**A**	**A**

(N- Natural; A- Artificial)

Table 27: **Promising entries with low susceptibility index (SI≤5.0) and high promising index in NSN-H to sheath blight, Kharif-2019**

P.No.	IET No.	CTK	IIRR	PNT	SI	Total	<=3	PI (<-3)*	<=5	PI (<5)**
72	28217	1	7	3	3.7	3.0	2.0	66.7	2	67
51	28198	1	5	5	3.7	3.0	1.0	33.3	3	100
66	28212	3	5	5	4.3	3.0	1.0	33.3	3	100
105	27498	5	5	3	4.3	3.0	1.0	33.3	3	100
120	Tetep (RC)	3	5	5	4.3	3.0	1.0	33.3	3	100
108	IR-65	1	7	5	4.3	3.0	1.0	33.3	2	67
15	Vivekdhan 86 (NC)	3	5	7	5.0	3.0	1.0	33.3	2	67
20	27465	7	5	3	5.0	3.0	1.0	33.3	2	67
30	25826 (R)	5	7	3	5.0	3.0	1.0	33.3	2	67
32	26594	3	7	5	5.0	3.0	1.0	33.3	2	67
63	28209	7	5	3	5.0	3.0	1.0	33.3	2	67
84	28228	3	7	5	5.0	3.0	1.0	33.3	2	67
97	28239	3	7	5	5.0	3.0	1.0	33.3	2	67
114	Ajaya	1	7	7	5.0	3.0	1.0	33.3	1	33
10	27479	5	5	5	5.0	3.0	0.0	0.0	3	100
13	27466	5	5	5	5.0	3.0	0.0	0.0	3	100
87	Sukaradhan -1 (NC)	5	5	5	5.0	3.0	0.0	0.0	3	100
89	28232	5	5	5	5.0	3.0	0.0	0.0	3	100
119	Swarnadhan (TC)	5	5	5	5.0	3.0	0.0	0.0	3	100
109	T(N)1 (SC)	3	9	5	**5.7**	**3**	**1**	**33**	**2**	**67**
	LSI	**7.0**	**7.0**	**7.1**	**5.1**	**-**	**-**	**-**	**-**	**-**

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3* and ≤5**)

Table 28: Location severity index and frequency distribution of sheath blight disease score for NHSN entries, *Kharif*-2019

Score	Location/Frequency of score (0-9)																			
	ADT	BNK	CHN	CTK	GNV	IIRR	KUL	LDN	MNC	MND	MSD	MTU	NDL	PNT	PSA	PTB	PTN	RPR	TTB	ARD
0	2	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0	9	0	0	0
1	5	0	0	3	0	0	1	0	10	1	0	0	0	1	7	0	7	0	1	6
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	13	26	1	8	0	0	44	1	25	0	1	0	4	19	48	1	47	11	5	49
4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
5	31	45	76	17	1	55	40	23	26	12	62	1	62	67	35	26	45	40	14	29
6	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	43	25	29	41	41	43	18	71	14	62	42	3	37	15	16	51	0	54	48	16
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	5	12	2	38	65	8	0	8	0	31	3	99	2	0	2	30	0	3	40	0
Total	99	108	108	107	107	108	106	103	94	106	108	103	105	102	108	108	108	108	108	100
LSI	5.5	5.4	5.6	6.9	8.2	6.1	4.4	6.7	3.3	7.3	5.9	8.9	5.7	4.9	4.2	7.0	3.5	5.9	7.2	4.1
Screening method	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	N	A	A	-

(N-Natural; A-Artificial)

Table 29: Promising entries with low susceptibility index (SI≤5.5) and high promising index in NHSN to sheath blight, *Kharif*-2019

P.No	IET No.	ADT	BNK	CHN	CTK	GNV	IIRR	KUL	LDN	MND	MSD	MTU	NDL	PNT	PSA	PTB	RPR	TTB	ARD	SI	Total	≤3	PI (<-3)*	≤5	PI (<-5)**
108	Tetep	5	5	5	5	7	5	3	5	1	5	9	5	5	3	5	5	9	3	5.0	18	4	22	15	83
46	28148	1	5	3	5	9	5	7	7	9	5	9	7	5	5	3	3	3	3	5.2	18	6	33	12	67
66	28166	5	3	5	3	7	7	3	7	7	5	9	7	1	3	5	7	5	-	5.2	17	5	29	10	59
38	28141	1	7	5	3	7	6	5	7	9	5	7	5	5	3	9	3	5	3	5.3	18	5	28	11	61
59	28160	7	5	5	5	7	5	7	3	7	5	9	5	5	3	5	5	7	1	5.3	18	3	17	12	67
74	28173	3	3	5	5	7	5	5	5	7	7	-	7	5	5	7	7	5	3	5.4	17	3	18	11	65
50	28152	-	7	7	7	-	5	5	−	-	5	-	-	-	7	5	3	5	3	5.4	11	2	18	7	64
62	HRI-174 (NCH)	5	3	5	7	7	5	3	5	9	5	9	5	3	3	7	5	9	3	5.4	18	5	28	12	67
49	28151	9	5	5	7	9	5	3	7	7	5	9	3	3	5	7	3	5	1	5.4	18	5	28	11	61
53	28155	7	3	5	3	7	5	3	7	7	7	9	5	5	3	9	5	7	1	5.4	18	5	28	10	56
52	28154	5	5	5	9	9	5	3	7	7	5	9	5	3	5	7	7	1	1	5.4	18	4	22	11	61
41	MTU-1010 (RCV)	3	3	7	7	7	5	5	7	7	5	9		5	5	5	3	7	3	5.5	17	4	24	10	59
107	Swarnadhan (TC)	5	9	5	5	9	5	5	7	9	5	5	9	5	3	7	7	7	3	6.1	18	2	11	10	56
97	T(N1) (SC)	9	9	7	7	7	9	3	7	7	7	9	7	5	7	7	7	9	7	7.2	18	1	6	2	11
	LSI	5.5	5.4	5.6	6.9	8.2	6.1	4.5	6.7	7.4	5.9	8.9	5.7	4.9	4.2	7.1	5.9	7.2	4.1						

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3* and ≤5**)

Table 30: Location severity index and frequency distribution of sheath blight disease score for DSN entries, *Kharif*-2019

Score	Location/Frequency of score(0-9)																	
	ADT	BNK	CHP	CTK	GNV	IIRR	KUL	LDN	MNC	MND	MSD	MTU	NDL	PNT	PTB	PTN	RPR	TTB
0	1	0	0	0	0	0	0	0	12	0	0	0	0	0	0	1	0	0
1	1	20	4	6	0	0	0	0	12	1	0	0	1	7	0	1	8	15
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	8	39	27	13	2	0	6	0	33	0	3	0	16	44	9	41	38	25
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0
5	42	41	61	25	26	39	48	4	40	14	44	10	54	86	34	48	43	12
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	75	39	43	48	51	82	55	142	48	64	67	46	45	13	72	24	42	6
8	150	152	151	150	151	152	134	151	150	151	150	147	127	151	151	152	151	62
9	22	12	15	57	71	28	24	4	4	71	35	90	10	0	35	0	19	3
Total	**299**	**303**	**301**	**299**	**301**	**301**	**267**	**301**	**299**	**301**	**299**	**293**	**253**	**301**	**301**	**303**	**301**	**123**
LSI	**6.4**	**4.8**	**5.5**	**6.8**	**7.5**	**6.9**	**6.5**	**7.0**	**4.6**	**7.7**	**6.8**	**8.1**	**5.7**	**4.4**	**6.8**	**4.5**	**5.3**	**3.6**
Screening method	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**N**	**A**	**A**

(N-Natural; A-Artificial)

Table 31: Promising entries with low susceptibility index (SI≤5.5) and high promising index in DSN to sheath blight, *Kharif*-2019

P.No.	Designation	ADT	BNK	CHP	CTK	GNV	IIRR	KUL	LDN	MNC	MND	MSD	MTU	NDL	PNT	PTB	PTN	RPR	SI	Total	≤3	PI (<3)*	≤5	PI (<-5)**
151	IET 25692	3	3	-	7	-	7	-	-	0	-	-	-	-	5	-	4	-	**4.1**	7	3	43	5	71
126	Phoghak	5	1	5	5	7	5	5	7	1	5	5	9	3	1	5	7	3	**4.6**	17	5	29	13	76
61	RP-Patho-9	7	1	3	7	9	5	7	7	1	5	5	9	1	5	3	5	1	**4.8**	17	6	35	11	65
128	Gonalasha	5	3	5	9	7	5	5	7	1	7	3	7	3	5	5	4	1	**4.8**	17	5	29	12	71
13	CR 4209-2	5	5	3	3	9	5	-	7	1	7	7	5	5	3	3	5	5	**4.9**	16	5	31	12	75
107	RMS-R-11	3	9	3	1	7	5	7	7	1	7	5	-	5	5	5	5	3	**4.9**	16	5	31	11	69
124	Pankaj	0	5	5	1	5	5	5	7	1	9	5	9	9	5	7	4	3	**5.0**	17	4	24	12	71
102	RMS-R-6	5	7	5	9	5	5	7	7	1	7	5	5	5	3	3	4	3	**5.1**	17	4	24	12	71
31	KNM 7786	5	5	5	5	7	5	5	7	0	7	7	7	-	3	5	5	3	**5.1**	16	3	19	11	69
36	MSM-BB-61	7	1	3	1	7	7	5	7	3	7	9	9	3	3	7	5	3	**5.1**	17	7	41	9	53
127	Whazhuopek	3	1	7	5	9	5	5	7	3	5	7	7	5	5	5	7	5	**5.4**	17	3	18	11	65
122	GSY-4-9	5	1	5	5	5	5	5	7	3	9	7	7	7	5	7	3	5	**5.4**	17	3	18	11	65
18	NWGR 11048	3	1	5	5	9	5	7	7	3	9	7	9	-	1	7	5	3	**5.4**	16	5	31	9	56
2	CR 4053-24-40-1	7	5	3	3	9	7	5	7	7	7	7	7	3	3	7	3	3	**5.5**	17	6	35	8	47
129	SM-801	5	3	7	7	5	5	5	7	3	7	7	9	5	3	3	5	7	**5.5**	17	4	24	10	59
35	MSM-SB-87	1	3	5	9	7	5	5	7	1	9	7	7	7	5	7	5	3	**5.5**	17	4	24	9	53
83	Tetep (TC)	7	5	5	5	7	8	7	7	0	7	5	9	3	5	3	5	7	**5.6**	17	3	18	9	53
149	Swarnadhan (TC)	5	7	5	7	5	5	7	5	0	9	5	9	7	5	5	3	7	**5.6**	17	2	12	10	59
139	T(N)1 (SC)	9	7	7	7	9	9	9	7	7	9	7	7	7	5	9	7	7	**7.59**	17	0	0	1	6
	LSI	6.5	4.8	5.5	6.8	7.5	6.9	6.5	7.0	4.6	7.7	6.8	8.1	5.7	4.4	6.8	4.5	5.3	-	-	-	-	-	-

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3* and ≤5**)

❖ **BROWN SPOT**

➢ **NSN-1**

The National Screening Nursery (NSN-1) comprised of 353 entries evaluated at 19 locations across India under different-agro ecological Zones. The entries were screened under natural infection conditions at most of the centres except at Coimbatore, Chinusurah, Gangavathi, Ludhiana and Pusa; where screening was conducted under artificial inoculation with spore suspension. The frequency distribution of disease scores and the representative location severity index (LSI) are presented in the Table 32. The disease pressure was highest at Hazaribagh (7.9), while it was lowest at Upper shilling (0.4). It was very high (LSI =>7) at Lonavala (7.1), Gangavathi (7.0), Ludhiana (7.0), while Moderate disease pressure (LSI 4-6) was observed at Chinsurha (4.2), Mugad (4.5), Khudwani (4.6), Ponnampet (4.6), Coimbatore (4.9), Sabour (5.4), Gagarghat (5.7) and Cuttack (5.9). The selection of promising entries was done based on the data of those locations where LSI was more than 4. The disease pressure was low at centres *viz*., Bankura (3.0), Jagdalpur (3.5) and Rewa (3.6); hence data from these centres were not considered for the selection of best entries. None of the entry was shown a resistance reaction against brown spot disease under NSN-1; however, a few promising entries with low disease score (<5) across the centres included IET# 27077, 28007, 27531, 26861, 27517, 27530, 27386, 26118, 27280, 26635, 27369, 28033, 27438, 27728 and 27732 (Table 33).

➢ **NSN-2**

A total of 672 entries were screened under NSN- 2 at 15 locations across the India for brown spot disease. The entries were screened under artificial inoculation conditions at Coimbatore, Gangavathi, Ludhiana, Pusa and Rewa; while it was under natural infection condition at remaining locations. The disease pressure was highest and lowest at Gangavathi (7.8) and Ranchi (1.4) respectively. The disease pressure was very high (LSI =>7) at Ludhiana (7.0) while it was high (LSI 6-7) at Cuttack (6.2), Pusa (6.6) and Hazaribagh (6.9). It was moderate (4-6) at Mugad (4.4), Rewa (4.6), Ponnampet (5.1), Coimbatore (5.5), Chatha (5.7) and Gagharghat (5.7). The disease pressure was very low at Ranchi (1.4), Bankura (3.0) and Jagdalpur (3.2); hence data from this centre was not considered for selection of best entries (Table 34). The promising entries with low disease pressure across the locations presented in Table 35. Some of the promising entries included IET# 28329, 28763, 28471, 28648, 28649, 28354, 28331, 28344, 28491, 28467, 28827, 28454 and 28671.

➢ **NSN-H**

The NSN-H included a total of 120 entries screened at six locations under hill ecological zones of India. The highest disease pressure was recorded at Cuttack (7.3); while it was lowest at Khudwani (5.1) (Table 36). The disease pressure was high at Coimbatore (6.1) and Lonavala (6.1) while moderate (LSI 4-6) at Almora (5.5) and Ponnampet (5.5). None of the entries recorded resistant reaction across the locations. However, a few showed moderate resistance that included IET # 28193, 26594, 27468, 28195, 26596, 28223, 28226, 28189, 27504, 27498, 26580 and 28235 (Table 37).

Table 32: Location severity index (LSI) and frequency distribution of brown spot scores of NSN-1, *Kharif* 2019.

Score	Location/Frequency of score(0-9)																		
	BNK	CBT	CHN	CHT	CTK	GDL	GGT	GNV	HZB	JDP	KHD	LDN	LNV	MGD	PNP	PSA	REW	SBR	USH
0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	1	7	0	226
1	11	0	4	0	0	0	0	1	0	5	12	0	0	3	15	0	2	49	120
2	98	6	79	0	0	6	0	2	0	58	22	0	0	3	14	0	73	0	6
3	188	43	60	32	13	43	1	16	3	104	45	2	6	85	82	13	82	81	0
4	2	61	34	0	0	61	0	21	7	101	54	0	25	54	58	4	87	0	0
5	51	175	101	119	176	174	199	45	7	60	107	5	22	158	85	3	81	59	0
6	0	17	44	0	0	17	100	38	14	16	44	0	68	14	26	123	15	1	0
7	3	40	21	172	140	40	1	69	75	0	47	342	56	36	54	195	5	80	0
8	0	9	8	0	0	9	52	42	110	0	0	0	86	0	8	13	0	0	0
9	0	2	2	19	17	2	0	118	135	0	0	2	77	0	10	1	1	83	0
Total	353	353	353	342	346	352	353	352	351	352	331	351	340	353	352	353	353	353	352
LSI	3.0	4.9	4.2	6.0	5.9	4.9	5.7	7.0	7.9	3.5	4.6	7.0	7.1	4.5	4.6	6.5	3.6	5.4	0.4
Screening method	N	A	A	N	N	N	N	A	N	N	N/A	A	N	N	N	A	A	N	N

(N-Natural; A-Artificial)

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Table 33: Promising entries with low susceptibility index (<5) and high PI in NSN-1 to brown spot, *Kharif* 2019

P. No.	IET No.	CBT	CHN	CHT	CTK	GDL	GGT	GNV	HZB	KHD	LDN	LNV	MGD	PNP	PSA	SBR	SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
37	27077	5	2	3	3	5	6	5	4	4	3	7	5	1	7	3	4.2	15	6	40	12	80
143	28007	4	2	5	5	4	5	5	7	2	7	7	3	5	6	1	4.5	15	4	27	11	73
73	27531	3	2	3	5	3	5	5	4	7	7	4	7	4	7	3	4.6	15	5	33	11	73
101	26861	3	5	3	3	3	5	6	9	5	7	7	5	1	7	1	4.7	15	6	40	10	67
74	27517	3	2	7	5	3	5	5	7	3	7	5	5	2	6	5	4.7	15	5	33	11	73
76	27530	5	2	5	5	5	5	5	4	5	7	8	4	1	7	3	4.7	15	3	20	12	80
166	27386	3	2	7	5	3	5	3	7	5	7	7	5	3	7	3	4.8	15	6	40	10	67
161	26118	3	3	3	5	3	6	7	8	5	7	7	3	4	7	1	4.8	15	6	40	9	60
299	27280	3	5	3	5	3	6	6	8	3	7	4	3	1	7	9	4.9	15	6	40	9	60
75	26635 (R)	3	2	5	7	3	5	7	7	5	7	4	5	4	6	3	4.9	15	4	27	10	67
122	27369	3	2	7	7	3	5	-	8	2	7	6	3	6	7	3	4.9	14	6	43	7	50
147	28033	5	3	5		5	5	3	8	2	7	8	3	5	7	3	4.9	14	5	36	10	71
7	27438	5	4	5	5	5	5	6	7	4	7	-	4	3	6	3	4.9	14	2	14	10	71
57	27728	3	2	7	5	3	5	8	4	6	7	8	3	2	6	5	4.9	15	5	33	9	60
58	27732	5	2	3	5	5	5	7	4	7	7	5	5	3	6	5	4.9	15	3	20	11	73
350	IR-50	7	4	7	5	7	8	9	8	4	7	7	6	6	4	5	6.3	15	0	0	5	33
LSI		4.9	4.2	6.0	5.9	4.9	5.7	7.0	7.9	4.6	7.0	7.1	4.5	4.7	6.5	5.4						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

Table 34: Location severity index (LSI) frequency distribution of brown spot scores of NSN-2, *Kharif* 2019

Score	Location/Frequency of score(0-9)														
	BNK	CBT	CHT	CTK	GGT	GNV	HZB	JDP	LDN	MGD	PNP	PSA	RNC	REW	SBR
0	0	0	0	0	0	0	0	7	0	0	0	4	135	23	0
1	0	0	0	0	0	0	0	13	0	20	17	0	256	1	69
2	196	1	0	0	0	0	0	166	0	0	0	0	209	69	0
3	367	3	116	31	0	5	0	242	2	157	187	14	36	81	126
4	6	126	0	0	48	45	18	174	0	162	1	3	23	121	0
5	98	253	237	282	283	34	127	54	14	245	243	26	9	178	182
6	0	177	0	0	243	67	96	14	0	37	0	170	3	97	0
7	5	78	250	282	5	65	222	1	629	49	192	442	0	97	146
8	0	32	0	0	93	68	88	0	0	2	0	13	0	1	0
9	0	1	55	77	0	381	117	0	18	0	28	0	0	4	145
Total	672	671	658	672	672	665	668	671	663	672	668	672	671	672	668
LSI	3.0	5.5	5.7	6.2	5.7	7.8	6.9	3.2	7.0	4.4	5.1	6.6	1.4	4.6	5.5
Screening method	N	A	N	N	N	A	N	N	A	N	N	A		A	N

(N-Natural; A-Artificial)

Table 35: Promising entries with low susceptibility index (<5) and high PI in NSN-2 to brown spot, *Kharif* 2019

P. No.	IET No.	CBT	CHT	CTK	GGT	GNV	HZB	LDN	MGD	PNP	PSA	REW	SBR	SI	Total	≤3*	PI (<3)**	≤5*	PI (<5)**
8	28329	6	3	7	5	5	8	5	3	3	0	4	1	4.2	12	5	42	9	75
315	28763	4	5	5	4	8	4	3	5	3	5	2	5	4.4	12	3	25	11	92
123	28471	6	3	5	6	4	9	7	3	1	7	3	1	4.6	12	5	42	7	58
228	28648	4	5	5	6	9	5	7	3	3	7	0	1	4.6	12	4	33	8	67
229	28649	5	5	5	6	8	5	7	5	5	0	4	1	4.7	12	2	17	9	75
34	28354	4	-	5	6	-	-	−	3	-	7	3	-	4.7	6	2	33	4	67
10	28331	4	5	5	5	7	8	7	1	3	6	3	3	4.8	12	4	33	8	67
23	28344	4	3	7	5	8	6	7	4	3	3	4	3	4.8	12	4	33	8	67
144	28491	4	3	5	6	5	8	7	4	3	6	3	3	4.8	12	4	33	8	67
119	28467	6	3	5	5	5	8	7	5	1	7	0	5	4.8	12	3	25	8	67
648	28827	4	7	5	6	3	5	7	4	5	7	3	1	4.8	12	3	25	8	67
104	28454	6	3	5	6	6	8	7	3	3	6	2	3	4.8	12	5	42	6	50
251	28671	4	3	5	6	6	5	7	5	3	7	2	5	4.8	12	3	25	8	67
567	28257	7	3	3	6	6	5	−	5	5	6	5	3	4.9	11	3	27	7	64
31	28351	4	3	5	6	9	7	7	3	7	3	2	3	4.9	12	5	42	7	58
105	28455	5	3	5	5	8	9	7	3	3	6	4	1	4.9	12	4	33	8	67
157	27668	7	3	5	5	4	9	7	3	3	7	5	1	4.9	12	4	33	8	67
2	28323	4	3	7	5	5	7	7	6	3	0	3	9	4.9	12	4	33	7	58
52	28372	7	3	3	6	7	7	5	4	3	6	5	3	4.9	12	4	33	7	58
268	28687	7	3	5	5	7	7	7	3	5	7	2	1	4.9	12	4	33	7	58
395	28553	4	7	5	6	3	4	7	3	3	7	7	3	4.9	12	4	33	7	58
418	28312	4	3	5	6	9	6	7	3	3	7	5	1	4.9	12	4	33	7	58
669	IR-50	8	7	7	5	9	8	7	5	7	5	5	9	6.8	12	0	0	4	33
LSI		5.5	5.7	6.2	5.7	7.8	6.9	7.0	4.4	5.1	6.6	4.6	5.5						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

Table 36: Location severity index (LSI) and frequency distribution of brown spot scores of NSN-H, *Kharif*-2019

Score	Location/Frequency of score(0-9)					
	ALM	**CBT**	**CTK**	**KHD**	**LNV**	**PNP**
0	0	0	0	0	0	0
1	0	0	0	1	0	1
2	0	0	0	4	0	0
3	1	1	3	3	3	25
4	18	8	0	21	8	1
5	52	30	26	51	28	45
6	29	39	0	23	35	0
7	14	25	39	15	28	41
8	6	13	0	2	17	0
9	0	4	52	0	1	7
Total	**120**	**120**	**120**	**120**	**120**	**120**
LSI	**5.5**	**6.1**	**7.3**	**5.1**	**6.1**	**5.5**
Screening method	**N**	**A**	**N**	**N/A**	**N**	**N**

(N-Natural; A-Artificial)

Table 37: Promising entries with low susceptibility index (<=5.2) and high PI in NSN-H to brown spot, *Kharif* **2019**

P. No.	IET No.	Location/Frequency of score (0-9)						SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ALM	CBT	CTK	KHD	LNV	PNP						
120	Tetep	5	8	5	1	3	4	4.3	6	2	33	5	83
45	28193	5	6	5	5	4	3	4.7	6	1	17	5	83
32	26594	6	7	3	5	5	3	4.8	6	2	33	4	67
104	VivekDhan 154	4	5	5	4	5	7	5.0	6	0	0	5	83
18	27468	4	5	9	5	5	3	5.2	6	1	17	5	83
48	28195	5	5	9	4	5	3	5.2	6	1	17	5	83
112	CH-46	5	8	5	5	5	3	5.2	6	1	17	5	83
39	26596	4	4	9	5	6	3	5.2	6	1	17	4	67
79	28223	5	5	7	5	6	3	5.2	6	1	17	4	67
82	28226	5	5	7	6	5	3	5.2	6	1	17	4	67
41	28189	4	7	7	7	5	1	5.2	6	1	17	3	50
99	27504	4	6	7	4	3	7	5.2	6	1	17	3	50
105	27498	3	6	5	6	6	5	5.2	6	1	17	3	50
119	26580	5	5	5	5	6	5	5.2	6	0	0	5	83
31	28235	5	7	5	4	5	5	5.2	6	0	0	5	83
92	IR-50	7	7	7	5	7	7	6.7	6	0	0	1	17
LSI		5.5	6.1	7.4	5.2	6.1	5.5						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **National Hybrid Screening Nursery (NHSN)**

One hundred and eight hybrids including checks were evaluated at 15 centres against brown spot disease under NHSN. The highest and lowest disease pressure was recorded at Gangavathi (7.5) and Lonavala (2.4) respectively. The disease pressure was high (LSI 6-7) at Pusa (6.1) and Lonavala (6.5). Most of the centres exhibited moderate disease pressure *viz.,*Chinsurah (4.6), Coimbatore (5.0), Mugad (5.0), Almora (5.4), Ludhiana (5.4), Gagharghat (5.6) and Hazaribagh (5.8) (Table 38). The Performance of entries at Bankura, Chatha, Jagdalpur, and Khudwani was not considered for identifying promising entries, as the disease pressure was low at these centres (< 4.0).

None of the entries recorded resistance reaction consistently across the locations however a few promising entries that included IET # 28148, 28144, 28159, 28134, 28181, 28135, 28152, 28121, 28138, 28145, 28161 and 28146 (Table 39).

➢ **DSN**

The entries under donor screening nursery (DSN) were evaluated for their resistance to brown spot at 15 locations with 151 entries across the country. The brown spot resistance screening was done under natural infection conditions in most of the centres except at Coimbatore, Cuttack, Gangavati, Ludhiana Pusa and Rewa; where artificial method of screening was followed. The frequency distribution of disease scores and location severity index (LSI) are presented in Table 40. The highest and lowest disease pressure was recorded at Gangavathi (7.7) and Rewa (1.0) respectively. The disease Pressure was high (LSI 6-7) at Gagharghat (6.0), Cuttack (6.1), Pusa (6.2), Coimbatore (6.7), Lonavala (6.8) and Ludhiana (6.9). The moderate disease pressure (LSI 4-6) was observed at Mugad (4.4), Sabour (4.9), Almora (5.6) and Hazaribagh (5.8). The data from the locations (Bankura, Chatha, Jagdalpur and Rewa), where the disease pressure was low (LSI <4) was not considered for selection of promising entries. The promising donor lines with low disease reaction across the locations were presented in Table 41 and that includes CR 4209-2, CR 4055-11-40-3, CR 4053-24-40-1, CR 4054-26-2-1, CR 4054-26-2-1, CR 4055-11-28-5, KNM 7787 and KNM 7785.

Table 38: Location severity index (LSI) and frequency distribution of brown spot scores of NHSN, *Kharif* 2019

Score	Location/Frequency of score(0-9)														
	ALM	BNK	CBT	CHN	CHT	GGT	GNV	HZB	JDP	KHD	LDN	LNV	MGD	PSA	REW
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
1	0	0	0	0	3	0	0	0	0	0	2	0	0	0	14
2	0	40	0	5	0	0	0	1	12	11	0	0	0	0	6
3	4	52	5	0	92	0	1	9	26	32	29	2	11	7	7
4	17	0	37	49	0	17	7	11	43	37	0	6	22	6	26
5	42	14	41	34	11	47	9	27	16	20	20	17	52	12	19
6	27	0	13	15	0	27	13	18	11	8	0	23	6	33	0
7	16	2	4	4	1	0	13	29	0	0	52	31	17	46	2
8	2	0	6	1	0	17	19	7	0	0	0	20	0	4	0
9	0	0	2	0	0	0	45	5	0	0	0	5	0	0	0
Total	108	108	108	108	107	108	107	107	108	108	103	104	108	108	108
LSI	5.4	3.0	5.0	4.6	3.2	5.6	7.5	5.8	3.9	3.8	5.4	6.5	5.0	6.1	2.4
Screening method	N	N	A	A	N	N	A	N	N	N/A	A	N	N	A	A

(N-Natural; A-Artificial)

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Table 39: Promising entries with low susceptibility index (<=5) and high PI in NHSN to brown spot, *Kharif* 2019

P.No	IET No.	ALM	CBT	CHN	GGT	GNV	HZB	LDN	LNV	MGD	PSA	SI	Total	<=3*	PI (<-3)**	<=5 *	PI (<-5)**
		Location/Frequency of score (0-9)															
46	28148	5	4	2	4	5	5	3	5	4	6	**4.3**	**10**	**2**	**20**	**9**	**90**
42	28144	4	4	4	5	5	5	3	5	5	6	**4.6**	**10**	**1**	**10**	**9**	**90**
58	28159	5	3	4	5	6	4	1	8	4	7	**4.7**	**10**	**2**	**20**	**7**	**70**
30	28134	6	3	4	5	6	2	5	5	5	7	**4.8**	**10**	**2**	**20**	**7**	**70**
84	28181	6	4	4	5	8	4	5	6	3	3	**4.8**	**10**	**2**	**20**	**7**	**70**
31	28135	5	4	4	6	4	3	7	5	4	6	**4.8**	**10**	**1**	**10**	**7**	**70**
50	28152	5	4	4	4	5	6	−	−	5	6	**4.9**	**8**	**0**	**0**	**6**	**75**
13	28121	4	4	4	6	6	7	3	5	3	7	**4.9**	**10**	**2**	**20**	**6**	**60**
34	28138	7	4	5	4	7	5	3	8	4	3	**5.0**	**10**	**2**	**20**	**7**	**70**
43	28145	5	5	4	5	6	5	3	7	3	7	**5.0**	**10**	**2**	**20**	**7**	**70**
60	28161	5	6	4	5	6	5	5	8	3	3	**5.0**	**10**	**2**	**20**	**7**	**70**
44	28146	4	5	5	6	5	4	3	7	5	6	**5.0**	**10**	**1**	**10**	**7**	**70**
105	IR-50	5	7	7	6	9	7	7	7	4	3	**6.2**	**10**	**1**	**10**	**3**	**30**
LSI		**5.4**	**5.0**	**4.7**	**5.6**	**7.5**	**5.8**	**5.4**	**6.5**	**5.0**	**6.1**						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

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Table 40: Location severity index (LSI) and frequency distribution of brown spot scores of DSN, *Kharif* **2019**

Score	Location/Frequency of score (0-9)														
	ALM	BNK	CBT	CHT	CTK	GGT	GNV	HZB	JDP	LDN	LNV	MGD	PSA	REW	SBR
0	0	0	0	0	0	0	0	0	2	0	0	0	0	63	0
1	0	8	0	16	0	0	0	0	4	0	0	0	0	35	10
2	0	57	0	0	0	0	5	1	39	0	0	0	0	44	0
3	7	67	1	105	8	1	9	8	47	4	6	28	13	6	44
4	23	2	0	0	0	0	0	13	41	0	10	52	5	3	0
5	53	16	5	23	71	43	10	43	12	3	14	61	6	0	47
6	31	0	59	0	0	80	5	30	5	0	27	2	38	0	0
7	19	1	56	6	55	5	19	41	0	143	26	6	78	0	28
8	9	0	26	0	0	22	15	9	0	0	37	1	4	0	0
9	8	0	3	0	17	0	87	5	0	0	24	0	1	0	15
Total	**150**	**151**	**150**	**150**	**151**	**151**	**150**	**150**	**150**	**150**	**144**	**150**	**145**	**151**	**144**
LSI	**5.6**	**2.8**	**6.7**	**3.3**	**6.1**	**6.0**	**7.7**	**5.8**	**3.2**	**6.9**	**6.8**	**4.4**	**6.2**	**1.0**	**4.9**
Screening method	**N**	**N**	**A**	**N**	**N**	**N**	**A**	**N**	**N**	**A**	**N**	**N**	**A**	**A**	**N**

(N-Natural; A-Artificial)

Table 41: Promising entries with low susceptibility index (<=5.2) and high PI in DSN to brown spot, *Kharif* **2019**

P.No.	Designations	Location/Frequency of score (0-9)											SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ALM	CBT	GNV	HZB	CTK	PSA	SBR	LDN	LNV	GGT	MGD						
13	CR 4209-2	5	6	2	2	5	7	3	7	3	7	4	4.6	11	4	36	7	64
10	CR 4055-11-40-3	5	6	3	5	5	3	3	7	5	5	8	5.0	11	3	27	8	73
2	CR 4053-24-40-1	3	8	3	6	5	3	3	7	8	6	4	5.1	11	4	36	6	55
3	CR 4054-26-2-1	3	7	2	3	5	7	7	7	4	6	5	5.1	11	3	27	6	55
9	CR 4055-11-28-5	5	6	2	6	3	7	5	7	5	5	5	5.1	11	2	18	7	64
32	KNM 7787	4	7	9	3	5	7	3	3	6	6	4	5.2	11	3	27	6	55
30	KNM 7785	6	6	9	6	3	6	3	5	3	6	4	5.2	11	3	27	5	45
147	IR-50	5	7	6	9	7	3	9	7	7	6	4	6.4	11	1	9	3	27
	LSI	5.6	6.7	7.7	5.9	6.1	6.2	4.9	6.9	6.9	6.0	4.4						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

❖ **SHEATH ROT**

➤ **NSN -1**

The National Screening Nursery 1 consisting of 353 entries was evaluated at 13 locations across the country. The screening was done under artificial inoculation at Chinsurah, Navasari, Raipur and Titabar and under natural condition at the remaining centers. Very high disease pressure (LSI>7) was recorded at Lonavala (7.5) and high disease pressure at Raipur (6.4), Navasari (6.1); moderate disease pressure at Nawagam (5.6), Karjat (5.3), Cuttack (5.2), Chinsurah (4.3), Aduthurai (4.0), Rajendranagar (3.6), Bankura (3.4) and Nellore (3.2). The disease pressure was very low (LSI< 3) at Rajendranagar (2.8) and Maruteru (1.3) and hence, the data from these centres was not considered for selecting the resistant entries for sheath rot. The frequency distribution of sheath rot scores are presented in the Table 42 along with location severity indices.

Table 42: Location severity index (LSI) and frequency distribution of sheath rot scores of NSN 1, *Kharif* -2019

Location/Frequency of score(0-9)													
Score	**ADT**	**BNK**	**CHN**	**CTK**	**KJT**	**LNV**	**MTU**	**NVS**	**NWG**	**RNR**	**RPR**	**TTB**	**NLR**
0	111	4	24	1	0	0	133	0	0	91	0	190	0
1	24	40	57	0	5	0	118	0	0	8	0	114	52
2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	53	204	82	0	61	13	74	22	57	151	8	41	223
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	46	95	89	314	172	39	25	151	160	97	133	5	67
6	1	0	0	0	0	0	0	0	0	0	0	0	0
7	20	10	66	30	108	131	0	151	106	5	165	0	4
8	0	0	0	0	0	1	0	0	0	0	0	0	0
9	95	0	35	1	7	156	0	29	29	1	46	0	3
Total	350	353	353	346	353	340	350	353	352	353	352	350	349
LSI	4.0	3.4	4.3	5.2	5.3	7.5	1.3	6.1	5.6	2.8	6.4	0.7	3.2
Screening method	N	N	A	N	N	N	N	A	N	N	A	A	

(N-Natural; A-Artificial)

The selection of promising entries was done based on the disease data of those locations where the disease pressure was moderate to very high. The promising entries with SI≤5 are presented in the Table 43. Some of the promising entries are IET # 27438, 27541, 27555, 27736, 27280, 25212 (R), 27378 and 27387.

Table 43: Promising entries with low susceptibility index and high PI in NSN-1 to sheath rot, *Kharif* -2019

P.No.	IET No.	Location/Frequency of score (0-9)								SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ADT	CHN	CTK	KJT	LNV	NVS	NWG	RPR						
7	27438	0	0	0	5	-	7	5	5	3.1	7	3	43	6	86
151	27541	0	0	5	3	-	5	5	7	3.6	7	3	43	6	86
15	CR Dhan 506 (NC)	0	1	5	1	5	7	3	7	3.6	8	4	50	6	75
331	Tetep (DP)	0	1	5	3	-	5	5	7	3.7	7	3	43	6	86
153	27555	0	0	5	3	7	5	5	5	3.8	8	3	38	7	88
99	27736	0	0	#	5	7	7	3	5	3.9	7	3	43	5	71
299	27280	0	3	5	3	3	7	3	7	3.9	8	5	63	6	75
133	US 312 (HC)	0	5	5	3	5	3	3	7	3.9	8	4	50	7	88
19	Purnendu (Eastern)--ZC	0	1	5	3	5	5	7	5	3.9	8	3	38	7	88
20	25212 (R)	0	5	5	1	3	7	5	5	3.9	8	3	38	7	88
308	Samba Mahsuri (RP)	3	5	5	3	5	3	3	5	4.0	8	4	50	8	100
174	27378	0	0	7	3	3	7	5	7	4.0	8	4	50	5	63
182	27387	0	0	5	3	7	7	5	5	4.0	8	3	38	6	75
342	T(N1)	3	7	5	7	9	9	7	7	6.8	8	1	13	2	25
	LSI	4.1	4.3	5.2	5.3	7.5	6.1	5.6	6.4						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **NSN-2**

The entries in NSN-2 consisting of 672 entries were evaluated at 4 locations *viz.,* Aduthurai, Bankura, Maruteru and Raipur. A high disease pressure was recorded at Aduthurai (6.6) and moderate at Raipur (4.9) and Bankura (3.4). The disease pressure was very low (LSI< 3) at Maruteru (1.2) and hence, the data from this centre was not considered for selecting the resistant entries for sheath rot. At all the centres, the entries were screened under natural condition except at Raipur (artificial inoculation). The frequency distribution of disease scores along with location severity indices are presented in the Table 44. The selection of promising entries was done based on the disease data from Aduthurai and Raipur. Some of the promising entries are IET Nos. 28447, 27900, 28306, 28344, 28346 and 28348 (Table 45).

Table 44: Location severity index (LSI) and frequency distribution of sheath rot scores for NSN- 2 entries, *Kharif* **-2019**

Location/Frequency of score(0-9)				
Score	ADT	BNK	MTU	RPR
0	3	8	275	112
1	3	72	201	57
2	0	0	0	0
3	14	391	157	116
4	0	0	0	0
5	243	184	15	103
6	0	0	0	0
7	249	17	0	79
8	0	0	0	0
9	155	0	0	195
Total	667	672	648	662
LSI	6.6	3.4	1.2	4.9
Screening method	N	N	N	A

(N-Natural; A-Artificial)

Table 45: NSN-2 entries with high promising index to sheath rot¸ *Kharif,* **2019**

P.No.	IET No.	Location/Frequency of score (0-9)		SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ADT	RPR						
96	28447	3	0	**1.5**	2	2	100	2	100
125	27900	3	0	**1.5**	2	2	100	2	100
412	28306	3	0	**1.5**	2	2	100	2	100
23	28344	1	3	**2.0**	2	2	100	2	100
26	28346	0	5	**2.5**	2	1	50	2	100
28	28348	0	5	**2.5**	2	1	50	2	100
661	T(N1)	9	7	**8.0**	2	0	0	0	0
	LSI	6.6	4.9						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **NSN-H**

The nursery consisting of 121 test entries including checks was evaluated at two centers *viz.*, Lonavala and Karjat. The disease pressure was moderate at Kajrat (LSI= 5.9) and Lonavala (4.7). The disease screening was done under natural conditions at both the centres (Table 46). The selection of promising entries was done based on the disease data from those locations where the disease was moderate to very high. Some of the IET Nos. 27472, 26594, 28212 and 27491 were found to be promising against sheath rot (Table 47).

Table 46: Location severity index (LSI) and frequency distribution of sheath rot scores for NSN-H entries, *Kharif* – 2019

Location/Frequency of score(0-9)		
Score	**KJT**	**LNV**
0	0	0
1	0	0
2	0	0
3	7	58
4	0	0
5	56	35
6	0	0
7	49	16
8	0	0
9	119	121
Total	**231**	**230**
LSI	**5.9**	**4.7**
Screening method	**N**	**N**

(N-Natural; A-Artificial)

Table 47: Promising entries with low susceptibility index and high PI in NSN-H to sheath rot, *Kharif* 2019

P.No.	IET No.	Location/Frequency of score (0-9)		SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		KJT	**LNV**						
16	27472	3	3	**3.0**	2	2	100	2	100
32	26594	3	3	**3.0**	2	2	100	2	100
66	28212	3	3	**3.0**	2	2	100	2	100
2	27491	5	3	**4.0**	2	1	50	2	100
9	27496	5	3	**4.0**	2	1	50	2	100
20	27465	5	3	**4.0**	2	1	50	2	100
109	T(N) 1	7	9	**8.0**	2	0	0	0	0
	LSI	**5.9**	**4.7**						

 (SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **NHSN**

The NHSN trial consisted of 108 entries including checks was evaluated at 12 locations representing different geographical regions. The frequency distribution of disease scores and the LSI are presented in Table 48**.** The disease pressure was high at Raipur (6.6), Aduthurai (6.2) and Lonavala (6.0); Moderate disease pressure was noticed at Navsari (5.9), Nawagam (5.7), Karjat (5.4), Chatha (4.9), Rajendranagar (4.6), Chinsurah (4.2) and Bankura (3.0). Very low disease pressure was recorded at Titabar (1.1) and Maruteru (0.8). The disease screening was done under natural conditions at Aduthurai, Bankura, Chatha, Karjat, Lonavala, Maruteru, Nawagam and Rajendranagar and artificial inoculation at Chinsurah, Navasari, Titabar and Raipur (Table 48).

Table 48: Location severity index (LSI) and frequency distribution of sheath rot scores for NHSN entries, *Kharif* **– 2019**

Location/Frequency of score(0-9)												
Score	**ADT**	**BNK**	**CHN**	**CHT**	**KJT**	**LNV**	**MTU**	**NVS**	**NWG**	**RNR**	**RPR**	**TTB**
0	4	3	7	10	0	1	62	0	0	2	0	36
1	3	18	13	0	0	0	20	0	0	0	0	50
2	0	0	0	0	0	1	0	0	0	0	0	0
3	8	67	30	15	16	20	20	6	18	31	0	22
4	0	0	2	0	0	0	0	0	0	0	0	0
5	30	18	28	54	55	33	1	51	43	57	39	0
6	0	0	2	0	0	0	0	0	0	0	0	0
7	23	2	21	24	33	22	0	50	40	8	52	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	31	0	5	4	3	27	0	1	7	3	17	0
Total	**99**	**108**	**108**	**107**	**107**	**104**	**103**	**108**	**108**	**101**	**108**	**108**
LSI	**6.2**	**3.0**	**4.2**	**4.9**	**5.4**	**6.0**	**0.8**	**5.9**	**5.7**	**4.6**	**6.6**	**1.1**
Screening method	**N**	**N**	**A**	**N**	**N**	**N**	**N**	**A**	**N**	**N**	**A**	**A**

(N-Natural; A-Artificial)

The selection of promising entries was done based on the disease data of those locations where the disease pressure was moderate to very high. The promising entries with SI≤5 are presented in the Table 49. Some of the promising entries include IET # 28147, 28129, 28117, 28123, 28171 and 28134.

Table 49: Promising entries with low susceptibility index and high PI in NHSN to sheath rot, *Kharif* **2019**

P.No.	IET No.	Location/Frequencey of score (0-9)									SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ADT	CHN	CHT	KJT	LNV	NVS	NWG	RNR	RPR						
45	28147	5	0	3	5	3	5	3	5	5	3.8	9	4	44	4	44
24	28129	-	5	3	3	-	5	3	3	5	3.9	7	4	57	4	57
9	28117	5	1	0	7	3	3	7	5	5	4.0	9	4	44	4	44
16	28123	7	3	3	3	3	5	3	3	7	4.1	9	6	67	6	67
8	MTU-1153 (RCV)	7	3	0	5	3	7	3	3	7	4.2	9	5	56	5	56
72	28171	1	0	7	3	5	5	5	3	9	4.2	9	4	44	4	44
30	28134	7	1	5	5	0	5	5	3	7	4.2	9	3	33	3	33
18	Rasi (LCV)	9	7	7	7	9	7	7	5	7	7.2	9	0	0	0	0
	LSI	6.2	4.3	4.9	5.4	6.0	5.9	5.7	4.6	6.6						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **DSN**

The DSN trial consisted of 151 entries including checks were screened at 11 locations across the country. The frequency distribution of disease scores and the LSI are presented in Table 50. The nursery was screened under natural conditions at all the locations except at Rajendranagar. The high disease pressure was recorded at Lonavala (6.9) and Raipur (6.7). Moderate disease pressure was recorded at Navasari (5.8), Karjat (5.7), Aduthurai (5.6), Nawagam (5.2), Cuttack (5.1), Pusa (4.6), Bankura (3.2) and Rajendranagar (3.1) and very low disease pressure was observed at Maruteru (0.9) during the season. The selection of promising entries were done based on the data of those locations where the disease pressure was moderate to high. The promising entries with SI≤5 are presented in the Table 51. Some of the promising lines were RMS-R-2, RMS-R-11, RP-Patho-3 and IET 25692.

Table 50: Location severity index (LSI) and frequency distribution of sheath rot scores for DSN entries, *Kharif* **– 2019**

	Location/Frequency of score(0-9)										
Score	**ADT**	**KJT**	**CTK**	**NVS**	**NWG**	**RNR**	**RPR**	**MTU**	**LNV**	**BNK**	**PSA**
0	12	0	0	0	0	26	0	68	0	4	0
1	5	1	0	0	0	5	0	53	0	19	9
2	0	0	0	0	0	0	0	1	0	0	0
3	19	27	0	5	40	67	6	20	18	89	38
4	0	0	0	0	0	0	0	0	0	0	0
5	44	54	88	85	62	47	51	4	25	35	75
6	0	0	0	0	0	0	0	0	0	0	0
7	33	51	3	58	46	3	55	0	47	4	16
8	0	0	0	0	0	0	0	0	0	0	0
9	36	17	0	2	3	0	38	0	54	0	7
Total	**149**	**150**	**91**	**150**	**151**	**148**	**150**	**146**	**144**	**151**	**145**
LSI	**5.6**	**5.7**	**5.1**	**5.8**	**5.2**	**3.1**	**6.7**	**0.9**	**6.9**	**3.2**	**4.6**
Screening method	**N**		**N**	**N**	**N**	**A**	**N**	**N**		**N**	

(N-Natural; A-Artificial)

Table 51: Promising entries with low susceptibility index and high PI in DSN to sheath rot, *Kharif* **2019**

P.No.	Designation	Location/Frequencey of score (0-9)								SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		ADT	**KJT**	**CTK**	**NVS**	**NWG**	**RPR**	**LNV**	**PSA**						
98	**RMS-R-2**	0	5	-	5	5	3	3	1	**3.1**	7	4	57	7	100
107	**RMS-R-11**	1	1	-	5	5	7	3	3	**3.6**	7	4	57	6	86
55	**RP-Patho-3**	5	3	5	5	3	3	3	3	**3.8**	8	5	63	8	100
151	**IET 25692**	1	-	-	5	5	-	5	3	**3.8**	5	2	40	5	100
126	**Phoghak**	0	5	-	5	5	7	3	3	**4.0**	7	3	43	6	86
13	**CR 4209-2**	0	3	5	5	7	5	3	5	**4.1**	8	3	38	7	88
18	**NWGR 11048**	3	5	5	5	3	7	3	3	**4.3**	8	4	50	7	88
111	**RMS-R-15**	0	5	-	5	3	5	9	3	**4.3**	7	3	43	6	86
128	**Gonalasha**	0	3	-	5	3	9	5	5	**4.3**	7	3	43	6	86
124	**Pankaj**	0	3	-	5	5	7	3	7	**4.3**	7	3	43	5	71
139	**T(N)1**	9	7	-	7	7	5	9	7	**7.3**	7	0	0	1	14
	LSI	**5.7**	**5.8**	**5.1**	**5.8**	**5.2**	**6.7**	**6.9**	**4.7**						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

❖ **GLUME DISCOLOURATION**

➢ **NSN-1**

The National Screening Nursery (NSN-1) for grain discoloration was evaluated at four locations *viz.*, Chatha, Lonavala, Navasari and Nawagam which comprised of 353 entries. The frequency distribution of disease scores and the representative location severity index (LSI) are presented in the **Table 52**. The entries were screened under natural infection conditions. The disease pressure was high at Lonavala (LSI 6.5), moderate at Navasari (LSI 5.5) Nawagam (LSI 5.2) and Chatha (LSI 5.1). At Chatha only 98 entries were tested against GD. Hence, the data from Chatha was not considered for the selection of resistance entries. Some of the promising entries IET under NSN 1 for grain discoloration included IET27541, Tetep, Pusa 44, IET26767, IET27518, IET27528, IET28834, IET27703, IET27950, IET27621 and IET27438 (Table 53).

Table 52: Location severity index (LSI) and frequency distribution of Grain discoloration scores of NSN-1, *Kharif*2019

Score	Location/Frequency of GD score(0-9)			
	NWG	NVS	CHT	LNV
1	1	0	0	0
3	92	66	16	0
5	150	131	62	121
7	86	153	20	184
9	23	3	0	35
Total	**352**	**353**	**98**	**340**
LSI	**5.2**	**5.5**	**5.1**	**6.5**
Screening method	N	N	N	N

(N-Natural; A-Artificial)

Table 53: Promising entries with low susceptibility index (<=4) and high PI in NSN-1 to grain discoloration, *Kharif* 2019

P. No	IETNo	Location/Frequency of GD score (0-9)			SI	Total	<=3*	PI (<-3) **	<=5*	PI (<-5)**
		NWG	NVS	LNV						
151	27541	3	3	-	**3.0**	**2**	**2**	**100**	**2**	**100**
331	Tetep	3	3	-	**3.0**	**2**	**2**	**100**	**2**	**100**
46	Pusa 44)	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**

P. No	IETNo	Location/Frequency of GD score (0-9)			SI	Total	<=3*	PI (<-3) **	<=5*	PI (<-5)**
		NWG	NVS	LNV						
51	26767	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
77	27518	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
85	27528	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
92	28834	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
177	27703	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
223	27950	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
236	27621	3	3	5	**3.7**	**3**	**2**	**67**	**3**	**100**
7	27438	3	5	-	**4.0**	**2**	**1**	**50**	**2**	**100**
LSI		**5.2**	**5.5**	**6.5**						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **NHSN**

National Hybrid Screening Nursery (NHSN) consisting of 108 entries including checks were screened under natural conditions for glume discoloration at 4 locations. The frequency distribution of disease scores and location severity indices are presented in **Table 54.** The disease pressure was high at Lonavala (LSI 6.2), moderate at Navasari (LSI 5.5) and Nawagam (LSI 5.5); while it was low (<4) at Chatha (LSI 3.8).

Table 3: Location severity index (LSI) and frequency distribution of Grain discoloration scores of NHSN *Kharif* 2019

Score	Location/Frequency of GD score(0-9)			
	NWG	NVS	CHT	LNV
1	0	0	0	0
3	22	14	64	0
5	47	55	24	52
7	28	37	6	44
9	11	2	0	8
Total	**108**	**108**	**94**	**104**
LSI	**5.5**	**5.5**	**3.8**	**6.2**
Screening method	N	N	N	N

(N-Natural; A-Artificial)

Some of the promising entries under NHSN for grain discoloration included IET 27530, IET27518, IET27395,IET 27460, FL 478, IET26767, IET27732, Shabhagidhan, IET28835, IET26753 and IET27768 (**Table 55**).

Table 55: Promising entries with low susceptibility index and high PI in NHSN to grain discoloration, *Kharif* 2019

P. No.	IET No.	Location/Frequency of score (0-9)			SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		NWG	NVS	LNV						
76	27530	3	3	5	3.7	3	2	67	3	100
77	27518	3	3	5	3.7	3	2	67	3	100
6	27395	3	5	5	4.3	3	1	33	3	100
8	27460	3	5	5	4.3	3	1	33	3	100
45	FL 478	5	3	5	4.3	3	1	33	3	100
51	26767	3	5	5	4.3	3	1	33	3	100
58	27732	3	5	5	4.3	3	1	33	3	100
79	Shabhagidhan	3	5	5	4.3	3	1	33	3	100
93	28835	3	5	5	4.3	3	1	33	3	100
98	26753	3	5	5	4.3	3	1	33	3	100
108	27768	3	5	5	4.3	3	1	33	3	100
LSI		5.5	5.5	6.2						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➢ **DSN**

Donor screening nursery (DSN) comprising of 151 entries including checks were tested against glume discolouration at 4 locations under natural infection conditions. The frequency distribution of disease scores and LSI are presented in Table 56. The disease pressure was very high at Lonavala (LSI 6.2); moderate at Navasari (LSI 5.5), Nawagam (LSI 5.3) and moderate at Chatha (LSI 4.1)

Table: Location severity index (LSI) and frequency distribution of Grain discoloration scores of DSN *Kharif* 2019

Score	Location/Frequency of score (0-9)			
	NWG	NVS	CHT	LNV
1	0	0	0	0
3	40	20	52	0
5	59	75	38	75
7	43	52	7	52

Score	Location/Frequency of score (0-9)			
	NWG	NVS	CHT	LNV
9	9	3	0	17
Total	**151**	**150**	**97**	**144**
LSI	**5.3**	**5.5**	**4.1**	**6.2**
Screening method	N	N	N	N

(N-Natural; A-Artificial)

The selection of promising entries was based on locations where diseases pressure was more and hence the data from 4 locations were considered for selection of promising entries. The best entries for grain discolouration included NWGR 11048, ISM-3G-4, HL18WS-23-30, RP-Bio Patho-4, NWGR 12016, KNM 7631, KNM 7632 and RMS-R-2(Table 57)

Table 57: Promising entries with low susceptibility index (<=4) and high PI in DSN to grain discoloration, *Kharif* 2019

Designations	Location/Frequency of score (0-9)				SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
	NWG	NVS	CHT	LNV						
NWGR 11048	3	3	3	5	**3.5**	**4**	**3**	75	**4**	100
ISM-3G-4	3	3	3	5	**3.5**	**4**	**3**	75	**4**	100
V-MSM 143	3	3	-	5	**3.7**	**3**	**2**	67	**3**	100
HL18WS-23-30	3	5	3	-	**3.7**	**3**	**2**	67	**3**	100
RP-Bio Patho-4	3	3	3	7	**4.0**	**4**	**3**	75	**3**	75
NWGR 12016	3	3	5	5	**4.0**	**4**	**2**	50	**4**	100
KNM 7631	5	3	3	5	**4.0**	**4**	**2**	50	**4**	100
KNM 7632	3	5	3	5	**4.0**	**4**	**2**	50	**4**	100
RMS-R-2	5	3	3	5	**4.0**	**4**	**2**	50	**4**	100
LSI	**5.3**	**5.5**	**4.1**	**6.2**						

(SI-Susceptibility Index;*No. of locations where the entry has scored ≤3 and ≤5;**Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

❖ **BACTERIAL BLIGHT**

➢ **NSN-1**

The National Screening Nursery-1 (NSN-1) consisted of 353 entries including checks. The entries were evaluated at 25 locations across the country. The entries were evaluated through artificial inoculation at all the locations except Jagtiyal and Sabour. The frequency distribution of the disease scores and location severity indices are presented in Table 58. The disease pressure was exceptionally high at Maruteru (LSI-8.4); high (LSI-6-8) at Jagtiyal (7.9), IIRR (7.3), Raipur (7.2), Navsari (6.6), Pattambi (6.6), Aduthurai (6.6), Pantnagar (6.3), Cuttack (6.3), Chiplima (6.3), Ludhiana (6.2), Nawagam (6.2) and Chinsurah (6.1); moderate (LSI-3-6) at Gangavathi (5.9), New Delhi (5.7), Masodha (5.6), Karjat (5.0), Chatha (4.8), Varanasi (4.7), Nellore (4.5), Patna (4.5), Titabar (3.8), Moncompu (3.7) and Sabour (3.0) and very low (LSI < 3) at Port Blair.

For selection of best entries, data of Port Blair was not considered as the disease pressure was very low (LSI-2.8). The data of Maruteru was also not considered as the disease pressure was shown as exceptionally high (LSI>8.4) where about 97% of the entries showed highly susceptible reaction and remaining showed moderate reaction. This looks overestimation of the disease score and needs reconfirmation. The promising entries with SI less than 4.5 and which exhibited a score of 5 at or more than 60% of the locations are presented in Table 59. Some of the promising entries which were on par or better than resistant check Improved Samba Mahsuri were IET # 27378, 28811, 28807, 28014, 27077, 28806 and 27294. Some of the other promising entries with SI less than 4.5 were IET # 28789, 28805, 27823, 28810 and 27637

➢ **NSN-2**

The National Screening Nursery-2 (NSN-2) consisted of 672 entries including checks. The entries were evaluated at 15 locations across the country. The entries were evaluated through artificial inoculation at all the locations. The frequency distribution of the disease scores and location severity indices are presented in Table 60. The disease pressure was high (LSI->6) at Maruteru (8.2), Pantnagar (7.4), IIRR (7.1), Cuttack (7.0), Gangavathi (6.8), Aduthurai (6.7), Raipur (6.7), Ludhiana (6.6), Pattambi (6.5) and Masodha (6.3); moderate (LSI-3-6) at Varanasi (5.3), Titabar (5.2), Chatha (4.4) and Patna (4.1) and very low (LSI <3) at Moncompu. For selection of promising entries, data of those locations were considered where, LSI was greater than 3. Accordingly, data of Moncompu was not considered. The promising entries with SI less than 5 and which exhibited a score of 5 at or more than 60% of the locations are presented in Table 61. Only one entry viz., IET 28503 was slightly superior than resistant check Improved Samba Mahsuri. Some of the highly promising entries were IET # 28751, 28635, 28585 and 28654. Other promising entries were IET # 28528, 28391, 28467, 28493, 28491, 28311, 28521, 28396, 28432, 28461, 28478, 28063, 28726, 28502, 28299, 28732 and 28543.

Table 58: Location severity index (LSI) and frequency distribution of bacterial blight scores of NSN 1, *Kharif'* 2019

Score	Location/Frequency of scores (0-9)												
	ADT	CHN	CHP	CHT	CTK	GGV	IIRR	JGT	KJT	LDN	MNC	MSD	MTU
Inoculation	A	A	A	A	A	A	A	N	A	A	A	A	A
0	1	0	0	0	0	0	0	0	0	0	67	0	0
1	1	31	8	0	0	0	17	0	0	1	32	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	14	22	29	135	47	90	24	6	111	63	66	33	2
4	0	0	0	1	0	0	0	0	0	0	0	0	0
5	107	66	117	112	98	94	19	23	143	54	111	189	10
6	0	0	0	0	0	0	0	0	0	0	0	0	0
7	151	196	122	90	139	93	121	124	84	184	69	117	77
8	0	0	0	0	0	0	0	0	0	0	0	0	0
9	76	37	73	4	67	74	171	197	15	47	3	13	254
LSI	6.6	6.1	6.3	4.8	6.3	5.9	7.3	7.9	5	6.2	3.7	5.6	8.4
Total	350	352	349	342	351	351	352	350	353	349	348	352	343

Table contd..

Score	Location/Frequency of scores (0-9)											
	NDL	NLR	NVS	NWG	PNT	POB	PTB	PTN	RPR	SBR	TTB	VRN
Inoculation	A	A	A	A	A	A	A	A	A	N	A	A
0	0	0	0	0	10	0	0	2	0	118	0	0
1	21	34	1	0	29	143	0	0	0	39	11	0
2	0	0	0	0	0	0	0	0	0	1	0	0
3	0	116	14	21	46	97	15	89	5	70	195	136
4	0	0	0	0	0	0	0	91	0	0	0	0
5	190	114	52	142	60	59	98	115	44	55	141	140
6	0	0	0	0	0	0	0	0	0	4	0	0
7	110	66	267	151	48	25	173	56	220	35	3	63
8	0	0	0	0	0	0	0	0	0	0	0	0
9	32	19	19	38	159	3	64	0	83	31	0	12
LSI	5.7	4.5	6.6	6.2	6.3	2.8	6.6	4.5	7.2	3	3.8	4.7
Total	353	349	353	352	352	327	350	353	352	353	350	351

(N: Natural; Artificial)

Table 59: NSN 1 entries with low susceptibility index (SI ≤4.5) with score ≤ 5 to BB at or more than 60% of the locations

P. No.	Ent. No.	IET No.	ADT	CHN	CHP	CHT	CTK	GGV	IIRR	JGT	KJT	LDN	MNC	MSD	NDL	NLR	NVS	NWG	PNT	PTB	PTN	RPR	SBR	TTB	VRN	SI	*PI (≤3)	*PI (≤5)
174	1316	27378	5	1	3	3	5	5	3	7	3	5	0	5	7	5	7	7	3	3	3	5	1	3	3	4.0	52.2	82.6
326	4830	28811	5	1	7	5	5	3	1	5	5	3	3	5	5	3	5	7	1	7	0	7	3	3	5	4.1	43.5	82.6
320	4824	28807	5	1	3	5	3	5	3	7	5	3	1	5	5	3	5	5	3	9	7	7	0	3	3	4.2	47.8	82.6
304	4808	28014	3	1	5	3	3	9	1	7	3	3	0	5	5	9	3	7	0	7	7	7	3	3	3	4.2	56.5	69.6
37	3401	27077	9	5	5	3	3	3	3	5	5	3	0	5	5	1	7	7	5	5	4	7	1	3	3	4.2	43.5	82.6
319	4823	28806	5	1	3	5	5	3	1	5	5	3	1	5	5	5	7	7	0	9	7	7	0	3	5	4.2	39.1	78.3
309	4813	27294	7	1	7	3	7	3	1	5	3	3	0	7	5	5	5	7	0	9	3	7	5	3	3	4.3	47.8	69.6
193	1338	28789	0	5	3	3	7	5	7	7	3	5	0	5	5	3	7	7	7	5	3	5	3	3	3	4.4	43.5	73.9
317	4821	28805	7	1	9	7	5	7	1	7	3	3	0	7	1	7	5	7	0	7	4	5	0	3	5	4.4	39.1	60.9
38	3402	27823	7	3	5	5	3	7	3	9	5	3	5	5	1	3	3	5	3	7	4	7	1	3	5	4.4	43.5	78.3
325	4829	28810	7	1	7	5	7	3	1	7	5	3	1	7	5	1	7	7	1	7	4	7	3	3	3	4.4	43.5	60.9
231	1501	27637	5	9	1	5	5	5	7	9	5	3	0	5	7	3	7	5	5	3	4	5	0	3	3	4.5	34.8	78.3
349	RP-BIO-226		7	1	5	5	3	3	3	7	3	3	3	3	9	5	1	7	1	5	5	3	9	3	5	4.3	52.2	78.3
342	TN1		7	7	9	7	9	9	9	7	7	7	5	9	5	9	9	9	9	7	4	9	3	5	7	7.3	4.3	21.7
LSI			6.6	6.1	6.3	4.8	6.3	5.9	7.3	7.9	5	6.2	3.7	5.6	5.7	4.5	6.6	6.2	6.3	6.6	4.5	7.2	3	3.8	4.7			

(SI-Susceptibility Index;*Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

Table 60: Location severity index (LSI) and frequency distribution of bacterial blight scores of NSN 2, *Kharif'* 2019

Score	Location/Frequency of scores (0-9)														
	ADT	CHT	CTK	GGV	IIRR	LDN	MNC	MSD	MTU	PNT	PTB	PTN	RPR	TTB	VRN
Inoculation	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
0	0	0	0	0	0	0	302	0	0	4	0	26	0	0	0
1	1	1	2	1	15	0	45	0	0	20	0	0	3	0	0
2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
3	31	317	39	93	46	77	106	23	1	50	36	282	14	123	178
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	203	225	157	137	82	93	131	267	13	84	205	304	181	381	245
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	246	107	244	171	270	387	67	308	222	107	304	60	344	132	193
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	180	6	225	269	244	106	4	68	415	399	120	0	126	29	48
LSI	**6.7**	**4.4**	**7.0**	**6.8**	**7.1**	**6.6**	**2.3**	**6.3**	**8.2**	**7.4**	**6.5**	**4.1**	**6.7**	**5.2**	**5.3**
Total	**661**	**657**	**667**	**671**	**657**	**663**	**655**	**666**	**651**	**664**	**665**	**672**	**668**	**665**	**664**

(N: Natural; Artificial)

➤ **NSN-Hills**

The entries in NSNH were evaluated at 4 locations across the country. The entries were evaluated using artificial inoculation at all the four locations. The frequency distribution of the disease scores and location severity indices are presented in Table 62. At IIRR, the entries were evaluated under glass house condition. The disease pressure was very high (LSI >8) at IIRR and high (LSI-6-8) at Cuttack (7.5), Pantnagar (7.1) and Karjat (6.5). Data of all the four locations were considered for selection of promising entries. The promising entries with an SI less or equal to 6 and which showed a disease score of 5 at 50% locations or more are presented in Table 63. Only one entry (IET 28211) was highly promising and was on par with the resistant check, Improved Samba Mahsuri. Other moderately promising entries with SI ranging from 5.5-6 were IET # 27466 (TRC KS-20-114-B-B-37), 27468 (TRC BN -83-372-B-B-18), 27506 (TRC BN-188-145-B-B-18) and 28197 (VL 32463).

Table 61: NSN 2 entries with low susceptibility index (SI ≤5) with score ≤ 5 to BB at or more than 60% of the locations

P.No.	Ent. No.	IET No.	Locations/Score (0-9)														SI	*PI (≤3)	*PI (≤5)
			ADT	CHT	CTK	GGV	IIRR	LDN	MSD	MTU	PNT	PTB	PTN	RPR	TTB	VRN			
342	1609	28503	5	5	3	3	1	3	9	5	3	5	3	1	3	7	4.0	57.1	85.7
302	4231	28751	7	3	3	3	1	3	3	5	3	3	5	7	3	9	4.1	64.3	78.6
214	3905	28635	5	3	3	9	1	3	5	5	3	5	3	5	3	5	4.1	50.0	92.9
79	1917	28585	7	3	5	3	1	3	7	-	1	5	3	9	5	5	4.4	46.2	76.9
234	3925	28654	7	3	3	7	3	3	3	9	1	5	7	5	3	3	4.4	57.1	71.4
368	1635	28528	9	3	9	7	1	3	3	3	3	5	3	5	3	7	4.6	57.1	71.4
156	1209	28391	5	5	3	5	3	5	7	9	1	5	3	7	3	3	4.6	42.9	78.6
119	1434	28467	3	3	7	3	1	3	5	7	5	5	3	7	5	7	4.6	42.9	71.4
146	1462	28493	5	3	7	5	5	3	5	7	1	7	3	5	3	5	4.6	35.7	78.6
144	1460	28491	5	3	3	5	1	3	7	5	1	7	5	7	5	7	4.6	35.7	71.4
417	623	28311	5	5	5	5	3	5	5	7	5	3	5	5	3	3	4.6	28.6	92.9
361	1628	28521	9	3	7	7	3	3	3	7	3	3	3	7	3	5	4.7	57.1	64.3
162	1215	28396	5	5	3	5	3	3	5	7	3	7	3	5	7	5	4.7	35.7	78.6
201	1255	28432	-	3	5	9	3	3	5	7	3	5	5	5	5	-	4.8	33.3	83.3
111	1426	28461	7	3	3	5	3	3	5	9	7	3	3	5	5	7	4.9	42.9	71.4
131	1446	28478	9	3	7	3	3	3	7	7	3	5	5	5	3	5	4.9	42.9	71.4
601	4303	28063	3	7	3	9	5	7	5	7	3	5	3	5	3	3	4.9	42.9	71.4
276	4205	28726	5	5	3	9	1	3	7	7	3	7	5	7	3	3	4.9	42.9	64.3
341	1608	28502	5	3	7	7	3	7	7	5	3	5	3	3	3	9	5.0	42.9	64.3
405	610	28299	7	3	7	5	3	7	7	9	3	5	5	3	3	3	5.0	42.9	64.3
282	4211	28732	5	5	7	3	5	3	7	7	7	3	3	5	5	5	5.0	28.6	71.4
385	1653	28543	5	5	5	5	3	5	7	7	5	5	5	3	3	7	5.0	21.4	78.6
668	RP-BIO-226		5	-	3	3	-	3	3	7	1	7	5	3	3	5	4.0	58.3	83.3
661	TN1		7	7	9	9	7	9	9	9	9	9	3	9	7	7	7.9	7.1	7.1
LSI			6.7	4.4	7	6.8	7.1	6.6	6.3	8.2	7.4	6.5	4.1	6.7	5.2	5.3			

(SI-Susceptibility Index;*Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

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Table 62: Location severity index (LSI) and frequency distribution of bacterial blight scores of NSN Hills, *Kharif'* 2019

Score	Location/Frequency of scores (0-9)			
	CTK	IIRR	KJT	PNT
Inoculation	A	A	A	A
0	0	0	0	0
1	0	1	0	1
2	0	0	0	0
3	4	0	1	7
4	0	0	0	0
5	15	3	37	33
6	0	0	0	0
7	46	11	71	21
8	0	0	0	0
9	53	99	9	58
Total	118	114	118	120
LSI	7.5	8.6	6.5	7.1

Table 63: NSN-Hills entries with low susceptibility index (SI ≤6) with score ≤ 5 to BB at or more than 50% of the locations

P. No.	E. No.	IET No.	Designation	Locations/Score (0-9)				SI	*PI (≤3)	*PI (≤5)
				CTK	IIRR	KJT	PNT			
65	2604	28211	HPR 3111	9	1	5	3	4.5	50.0	75.0
13	2203	27466	TRC KS-20-114-B-B-37	5	9	5	3	5.5	25.0	75.0
18	2208	27468	TRC BN -83-372-B-B-18	3	9	5	7	6.0	25.0	50.0
100	2703	27506	TRC BN-188-145-B-B-18	9	7	5	3	6.0	25.0	50.0
50	2311	28197	VL 32463	5	9	5	5	6.0	0.0	75.0
116			RP-Bio-226	3	9	5	1	4.5	50.0	75.0
109			TN 1	9	9	9	9	9.0	0.0	0.0
LSI				7.5	8.6	6.5	7.1			

(SI-Susceptibility Index;*Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

➤ **NHSN**

The National Hybrid Screening Nursery (NHSN) consisted of 108 entries including different checks. The entries were evaluated at 21 locations across the country. The entries were evaluated using artificial inoculation at all the centres except at Arundhatinagar and Jagtiyal where the screening was done under natural condition. The frequency distribution of the disease scores and location severity indices are presented in Table 64. The disease pressure was high (LSI >6) at Maruteru (8.2), Jagtiyal (8.0), Pattambi (7.4), Gangavathi (7.2), Pantnagar (6.9), Karjat (6.7), Aduthurai (6.7), Nawagam (6.4), Raipur (6.4), Navsari (6.4), Ludhiana (6.3) and Chinsurah (6.2); moderate (LSI 3-6) at IIRR (6.0), Titabar (5.8), Masodha (5.8), New Delhi (5.7), Varanasi (5.0), Patna (4.1), Moncompu (3.7) and Chatha (3.3) and very low (LSI < 3) at Arundhatinagar.

For selection of best entries, data of Arundhatinagar was not considered as the disease pressure was very low (LSI-2.9). The promising entries with SI less than 5.5 and which exhibited a score of 5 at or more than 50% of the locations are presented in Table 65. None of the entries were on par or better than resistant check (Improved Samba Mahsuri). Some of the highly promising entries with an average SI less or equal to 5 were IET #28148, 28160 and 28143. Some of the promising entries which SI below 5.5 are IET # 28162, 28114, 28136, 28181, 28131, 28163, 28159, 28120 and 28164.

➤ **DSN**

The Donor Screening Nursery (DSN) consisted of 151 entries including different checks. The entries were evaluated at 22 locations across the country. The entries were evaluated using artificial inoculation at all the centres except at Jagtiyal where the screening was done under natural condition. The frequency distribution of the disease scores and location severity indices are presented in Table 66. The disease pressure was high (LSI > 6) at Jagtiyal (8.1), Maruteru (8.0), Gangavathi (7.4), Cuttack (7.1), Chiplima (7.0), Pattambi (6.8), Aduthurai (6.4), IIRR (6.4), Ludhiana (6.3), Pantnagar (6.2), Raipur (6.1) and Nawagam (6.1); moderate (LSI-3-6) at Navsari (6.0), Karjat (6.0), Masodha (5.9), Patna (5.8), New Delhi (5.8), Varanasi (5.0), Titabar (4.5), Moncompu (3.8) and Chatha (3.6) and very low (LSI <3) at Port Blair (2.8).

For selection of promising entries, the data of those locations were considered where the disease pressure was more than 3. Accordingly, the data of Port Blair was not considered for selection of promising entries. Only one entry (KNM 7787) was better than the resistant check, Improved Samba Mahsuri. Some of the other promising entries which showed an SI ranging from 4.5 to 5.5 were RP-Bio Patho-9, RP-Bio Patho-10, RP-Bio Patho-7, MSM-SB-52, ISM-2G-5412, KNM 7786, RP-Bio Patho-6, RMS-R-16, RMS-R-7, GSY-4-6, CR 4054-26-6-5, RP-Bio Patho-2, CR 4055-11-28-1, GSY-4-7, IET 25692 and RP-Bio Patho-3 (Table 67).

Table 64: Location severity index (LSI) and frequency distribution of bacterial blight scores of NHSN, *Kharif'* 2019

Score	Location/Frequency of scores (0-9)										
	ADT	ARD	CHN	CHT	GGV	IIRR	JGT	KJT	LDN	MNC	MSD
Inoculation	A	N	A	A	A	A	N	A	A	A	A
0	0	0	0	0	0	0	0	0	0	22	0
1	0	27	4	8	0	0	0	0	0	6	0
2	0	0	0	0	0	0	0	0	0	0	0
3	1	28	9	81	12	34	3	1	14	19	5
4	0	0	0	0	0	0	0	0	0	0	0
5	32	15	26	13	13	13	11	35	8	21	63
6	0	0	0	0	0	0	0	0	0	0	0
7	47	2	58	5	32	34	25	50	81	25	34
8	0	0	0	0	0	0	0	0	0	0	0
9	19	1	11	0	50	27	69	21	0	1	6
LSI	6.7	2.9	6.2	3.3	7.2	6.0	8.0	6.7	6.3	3.7	5.8
Total	99	73	108	107	107	108	108	107	103	94	108

Table **contd..**

Score	Location/Frequency of scores (0-9)									
	MTU	NDL	NVS	NWG	PNT	PTB	PTN	RPR	TTB	VRN
Inoculation	A	A	A	A	A	A	A	A	A	A
0	0	0	0	0	0	0	0	0	0	0
1	0	7	0	0	6	0	3	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	5	5	18	0	48	5	8	31
4	0	0	0	0	0	0	0	0	0	0
5	2	60	38	38	10	17	50	32	51	48
6	0	0	0	0	0	0	0	0	0	0
7	36	30	52	51	10	51	7	63	46	29
8	0	0	0	0	0	0	0	0	0	0
9	63	11	13	14	58	39	0	8	3	0
LSI	8.2	5.7	6.4	6.4	6.9	7.4	4.1	6.4	5.8	5.0
Total	101	108	108	108	102	107	108	108	108	108

(N: Natural; Artificial)

Table 65: NHSN entries with low susceptibility index (SI ≤5.5) with score ≤ 5 to BB at or more than 50% of the locations

P.No	E. No.	IET No.	ADT	CHN	CHT	GGV	IIRR	JGT	KJT	LDN	MNC	MSD	MTU	NDL	NVS	NWG	PNT	PTB	PTN	RPR	TTB	VRN	SI	*PI (≤3)	*PI (≤5)
46	3127	28148	3	7	1	7	3	3	5	7	0	5	7	5	5	3	7	5	5	7	5	3	4.7	35.0	70.0
59	3209	28160	9	3	3	7	3	7	5	5	0	5	7	5	5	7	3	5	7	5	3	5	5.0	30.0	70.0
40	3121	28143	7	1	3	9	3	9	5	3	3	7	5	5	7	5	1	9	5	3	5	5	5.0	35.0	70.0
61	3211	28162	7	5	3	7	3	9	5	3	0	5	-	7	5	7	3	5	5	7	5	5	5.1	26.3	68.4
5	3005	28114	5	1	3	7	3	9	7	7	3	5	9	9	5	5	3	5	3	3	7	3	5.1	40.0	65.0
32	3113	28136	-	1	3	9	3	9	5	3	3	7	7	1	7	7	3	7	7	7	5	5	5.2	36.8	52.6
84	3306	28181	9	3	3	9	7	7	7	3	0	5	7	7	5	7	5	5	3	7	3	3	5.3	35.0	55.0
26	3107	28131	5	3	3	9	3	9	7	3	-	7	7	5	5	5	3	7	3	7	5	5	5.3	31.6	63.2
63	3213	28163	-	5	3	9	3	9	7	7	0	3	7	7	7	9	3	7	3	5	3	5	5.4	36.8	52.6
58	3208	28159	9	3	3	5	3	9	5	7	3	9	7	9	7	5	1	7	3	5	5	3	5.4	35.0	60.0
12	3012	28120	5	5	3	9	3	9	5	5	3	7	7	7	7	5	1	5	5	7	5	5	5.4	20.0	65.0
64	3214	28164	7	5	3	9	3	9	5	5	0	5	9	7	7	7	5	7	3	5	5	3	5.5	25.0	60.0
104	RP-BIO-226		5	1	3	3	3	3	5	3	5	3	5	5	3	7	1	5	3	3	3	5	3.7	60.0	95.0
97	TN1		7	7	3	9	9	9	9	7	7	9	9	1	9	9	9	9	3	9	9	5	7.4	15.0	20.0
LSI			6.7	6.2	3.3	7.2	6	8	6.7	6.3	3.7	5.8	8.2	5.7	6.4	6.4	6.9	7.4	4.1	6.4	5.8	5			

(SI-Susceptibility Index;*Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

Table 66: Location severity index (LSI) and frequency distribution of bacterial blight scores of DSN, *Kharif'* **2019**

Score	Location/Frequency of scores (0-9)										
	ADT	CHP	CHT	CTK	GGV	IIRR	JGT	KJT	LDN	MNC	MSD
Inoculation	A	A	A	A	A	A	N	A	A	A	A
0	0	0	0	0	0	0	0	0	0	39	0
1	0	0	7	0	0	17	0	0	0	3	0
2	0	0	0	0	0	0	0	0	0	0	0
3	4	6	101	17	4	14	3	5	37	28	16
4	0	0	0	0	5	0	0	0	0	0	0
5	56	34	30	20	26	13	5	74	12	40	68
6	0	0	0	0	5	0	0	0	0	0	0
7	66	63	12	53	34	59	52	61	66	37	47
8	0	0	0	0	0	0	0	0	0	0	0
9	23	47	0	61	76	48	90	10	35	2	18
LSI	6.4	7	3.6	7.1	7.4	6.4	8.1	6	6.3	3.8	5.9
Total	149	150	150	151	150	151	150	150	150	149	149

Table contd..,

Score	Location/Frequency of scores (0-9)										
	MTU	NDL	NVS	NWG	PNT	POB	PTB	PTN	RPR	TTB	VRN
Inoculation	A	A	A	A	A	A	A	A	A	A	A
0	0	0	0	0	3	0	0	0	0	0	0
1	0	12	0	0	13	62	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	0	0	15	15	21	56	4	8	4	22	33
4	0	0	0	0	0	0	0	20	0	0	0
5	14	76	48	53	28	20	36	47	62	33	81
6	0	0	0	0	0	0	0	18	0	0	0
7	47	42	82	67	24	9	81	34	79	5	32
8	0	0	0	0	0	0	0	24	0	0	0
9	85	20	5	16	61	2	29	0	5	1	2
LSI	8	5.8	6	6.1	6.2	2.8	6.8	5.8	6.1	4.5	5
Total	146	150	150	151	150	149	150	151	150	61	148

(N: Natural; Artificial)

Table 67: DSN entries with low susceptibility index (SI ≤5.5) with score ≤ 5 to BB at or more than 45% of the locations

P.No.	Designations	ADT	CHP	CHT	CTK	GGV	IIRR	JGT	KJT	LDN	MNC	MSD	MTU	NDL	NVS	NWG	PNT	PTB	PTN	RPR	TTB	VRN	SI	*PI (≤3)	*PI (≤5)
32	KNM 7787	5	9	3	3	5	7	7	5	3	0	5	7	1	3	7	3	3	4	5	3	3	4.3	47.6	76.2
73	RP-Bio Patho-9	7	5	3	3	9	1	9	5	3	0	5	5	1	5	3	1	7	7	5	-	5	4.5	40.0	75.0
74	RP-Bio Patho-10	7	5	5	3	7	1	9	5	3	0	5	5	5	3	3	0	7	6	7	-	5	4.6	35.0	70.0
71	RP-Bio Patho-7	5	7	3	7	7	1	9	5	3	0	5	7	7	5	3	0	5	5	7	5	5	4.8	28.6	66.7
34	MSM-SB-52	5	9	3	5	5	5	9	7	7	0	3	7	1	7	7	5	5	5	5	-	3	5.2	25.0	65.0
42	ISM-2G-5412	5	5	3	3	9	3	9	3	3	5	7	5	9	3	5	7	7	5	5	3	5	5.2	33.3	71.4
31	KNM 7786	5	9	5	3	9	5	7	5	3	0	5	7	7	5	7	3	5	4	7	-	3	5.2	25.0	65.0
70	RP-Bio Patho-6	5	7	5	9	9	3	9	5	3	0	7	7	5	3	5	0	7	4	7	5	7	5.3	23.8	57.1
112	RMS-R-16	5	9	3	7	5	3	5	3	7	5	5	9	7	5	1	7	6	7	3	-		5.4	25.0	60.0
103	RMS-R-7	5	7	3	9	7	5	9	5	5	0	5	7	7	5	7	3	5	8	5	3	3	5.4	23.8	61.9
119	GSY-4-6	5	5	3	9	5	1	9	7	5	3	7	7	5	5	7	1	9	3	7	5	5	5.4	23.8	61.9
6	CR 4054-26-6-5	7	9	1	3	9	3	7	5	3	3	3	9	5	9	3	3	7	8	7	-	5	5.5	40.0	55.0
66	RP-Bio Patho-2	7	7	3	7	9	1	7	5	3	5	9	5	1	7	7	1	7	7	7	5	5	5.5	23.8	47.6
8	CR 4055-11-28-1	5	7	3	3	5	7	7	9	3	7	5	7	5	5	5	3	5	7	7	5	5	5.5	19.0	61.9
120	GSY-4-7	5	7	3	7	9	1	7	5	7	0	9	7	7	3	9	1	7	4	7	-	5	5.5	25.0	45.0
151	IET 25692	5	-	-	9	-	7	-	-	-	0	-	-	-	5	7	5	-	6	-	-	-	5.5	12.5	50.0
67	RP-Bio Patho-3	5	7	3	9	9	7	7	5	7	0	5	7	7	7	5	3	7	5	5	3	3	5.5	23.8	52.4
146	RP-BIO-226	7	5	3	3	4	1	9	3	3	1	3	5	7	3	9	3	5	5	3	-	5	4.4	50.0	80.0
139	T(N)1	9	9	3	9	9	9	9	5	7	7	9	9	9	9	7	9	9	4	9	-	5	7.8	5.0	20.0
	LSI	6.4	7	3.6	7.1	7.4	6.4	8.1	6	6.3	3.8	5.9	8	5.8	6	6.1	6.2	6.8	5.8	6.1	4.5	5			

(SI-Susceptibility Index;*Promising index (PI) based on no. of locations where the entry had scored ≤3 and ≤5)

❖ **RICE TUNGRO DISEASE (RTD)**

➤ **NSN-1**

The national screening nursery 1 (NSN-1) trial consisting of 353entries including checks was proposed and conducted at 2 locations *viz*., Coimbatore and IIRR. At both the locations the nursery was evaluated by artificial inoculations with the aid of leafhopper transmission in the glass house. The frequency distribution of disease scores and location severity indices are presented in Table 68. The disease pressure was high at IIRR (LSI 6.4) and moderate at Coimbatore
(LSI 4.9).

Table 68: Location severity index (LSI) and frequency distribution of rice tungro disease scores for NSN-1, *Kharif,* 2019

Score	Location/Frequency distribution of rice tungro disease scores (0-9 scale)	
	CBT	IIRR
1	0	0
3	95	15
5	185	103
7	72	233
9	1	0
Total	353	351
LSI	4.9	6.4
Screening method	A	A

(N- Natural; A- Artificial)

The entries performed better than the resistant check Vikramarya and showed resistance reaction to rice tungro disease arePusa Basmati -1, IET 28836, IET 26420, IET 27384, and FBR 1-15 (Table 69).

Table 69: NSN-1 entries with low susceptibility index (SI ≤ 5) against rice tungro disease, *Kharif,*2019

P. No.	IET No.	Location/Frequency of score (0-9)		SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
		CBT	IIRR						
125	28836	3	3	3.0	2	2	100	2	100
1306	26420	3	3	3.0	2	2	100	2	100
1307	27384	3	3	3.0	2	2	100	2	100
4836	FBR 1-15 (DP)	3	3	3.0	2	2	100	2	100
Vikramarya	Vikramarya	3	3	3.0	2	2	100	2	100
T(N)1	T(N1)	5	7	6.0	2	0	0	1	50
LSI		4.9	6.4						

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3 and ≤5)

➢ **NSN-2**

The national screening nursery 2 (NSN-2) trial consisting of 672 entries including checks was evaluated only at IIRR. The disease pressure recorded was high with LSI 6.5. Out of 672 lines tested, 15 lines showed score 3, 133 lines with score 5 and rest of the entries were susceptible to the disease. Best performing lines included IET28326, IET28369, IET28443, IET27908, IET28656, IET28678, IET28688, IET28316, IET28274, IET28629, IET28702, IET28708, IET28712, Dubraj, and IET28820 in addition to the resistant checks Vikramarya and Nidhi (Table 70)

Table 70: NSN-2 entries with low susceptibility index (SI ≤ 3) against rice tungro disease, *Kharif*, 2019

Ent. No.	IET No.	RTD score (0-9) at IIRR
5	28326	3
49	28369	3
92	28443	3
202	27908	3
236	28656	3
258	28678	3
269	28688	3
422	28316	3
443	28274	3
484	28629	3
524	28702	3
531	28708	3
536	28712	3
590	Dubraj (QC)	3
615	28820	3
662	Vikramarya	3
663	Nidhi	3

➢ **NSN-H**

One hundred and twenty entries were screened against rice tungro disease at IIRR under high disease pressure with LSI of 6.3. Out of which, only 2 lines (IET27461 and IET 26579) showed to be resistant for RTD.

➢ **NHSN**

The National Hybrid Screening Nursery (NHSN) consisted of 108 entries including checks. The entries were tested at two centers viz., Coimbatore and IIRR. The frequency distribution of disease scores and LSI are presented in Table 71. The disease pressure was high at IIRR (LSI 6.0) and Moderate at Coimbatore (LSI 5.7).

Table 71: Location severity index (LSI) and frequency distribution of rice tungro disease scores for NHSN, *Kharif,***2019**

Score	Location/Frequency of RTD score(0-9)	
	CBT	**IIRR**
1	0	0
3	6	3
4	0	0
5	60	49
7	40	55
9	2	0
Total	**108**	**107**
LSI	**5.7**	**6.0**
Screening method	A	A

(N- Natural; A- Artificial)

For the selection of promising entries both the locations were taken into consideration. The best entries which showed overall SI< 5 are listed in Table 72. The best entries are IET 28158, IET 28112, IET 28115 and IET 28115 along with check varieties Vikramarya and Nidhi.

Table 72: NHSN entries with low susceptibility index (SI ≤5) against rice tungro disease, *Kharif,* **2019**

P. No.	Designation	IET No.	CBT	IIRR	SI
57	IHRT-M-3207	28158	3	5	**4.0**
99	Nidhi	Nidhi	5	3	**4.0**
2	IHRT-E-3002	28112	5	5	**5.0**
3	IHRT-E-3003	US-314 (NCH)	5	5	**5.0**
6	IHRT-E-3006	28115	5	5	**5.0**
7	IHRT-E-3007	28116	5	5	**5.0**
98	Vikramarya	Vikramarya	3	3	**3.0**

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3 and ≤5)

➢ **DSN**

Donor screening nursery (DSN) comprising of 151 entries including checks were tested at Coimbatore and IIRR. The frequency distribution of disease scores and LSI are presented in Table 73. The disease pressure was high at IIRR (LSI 6.2) and Coimbatore (LSI 6.4).

Table 73: Location severity index(LSI) and frequency distribution of RTD scores of DSN *Kharif* **2019**

Score	Location/Frequency of score(0-9)	
	CBT	**IIRR**
1	0	0
3	9	11
5	37	41
7	93	99
9	10	0
Total	**149**	**151**
LSI	**6.4**	**6.2**
Screening method	A	A

(N- Natural; A- Artificial)

The DSN entries that showed a moderate level of resistance to rice tungro disease are listed in Table 74. The promising entries included are RP-Patho-12, RMS-R-8, RMS-R-12, RMS-R-13, RMS-R-15, RMS-R-16 and CB 15569

Table 74: DSN entries with low susceptibility index (SI <=5) against rice tungro disease, *Kharif,* **2019**

Designation	Location/Frequency of score (0-9)		SI	Total	<=3*	PI (<-3)**	<=5*	PI (<-5)**
	CBT	**IIRR**						
RP-Patho-12	3	3	3.0	2	**2**	**100**	**2**	**100**
Vikramarya	3	3	3.0	2	**2**	**100**	**2**	**100**
RMS-R-8	3	5	4.0	2	**1**	**50**	**1**	**50**
RMS-R-12	3	5	4.0	2	**1**	**50**	**1**	**50**
RMS-R-13	3	5	4.0	2	**1**	**50**	**1**	**50**
RMS-R-15	5	3	4.0	2	**1**	**50**	**1**	**50**
RMS-R-16	5	3	4.0	2	**1**	**50**	**1**	**50**
CB 15569	5	3	4.0	2	**1**	**50**	**1**	**50**
Nidhi	5	3	4.0	2	**1**	**50**	**1**	**50**
T(N)1	5	7	6.0	2	**0**	**0**	**0**	**0**
LSI	**6.4**	**6.2**						

(SI- Susceptibility Index; Promising Index (PI) based on percentage of locations the entry has scored ≤3 and ≤5)

➢ **MULTIPLE DISEASE RESISTANCE**

In NSN-1, a total of 13 entries had shown resistant/moderately resistant reaction to two or three diseases. One entry *i.e* IET # 27438 found promising against four diseases. This entry showed resistant reaction against NB and ShR while moderate resistant reaction against ShB and BS. Entries *viz.*, IET# 25212 (resistant against NB, moderate for ShB, ShR), 27077 (moderate raection against NB, BS, BLB) and 26118 (moderate reaction against NB, ShB, BS) showed resistant/moderate reaction against three diseases. The remaining nine entries viz., IET# 27736-(LB, ShR), 27743 (LB, NB), 27369 (LB, BS), 27781 (LB, ShB), 26684 (NB, ShB), 27280 (BS, ShR), 27378 (BLB, ShR), 28811 (LB, BLB) and 27637 (ShB, BLB) expressed resistant/moderate reaction against two diseases (Table 75)

Table 75: Multiple disease resistant lines in NSN-1, *Kharif* **-2019**

S.No	IET. No	Disease/Susceptible Index					
		LB	NB	ShB	BS	BLB	ShR
1	**27438**		3.4	5.0	4.9		3.1
2	**25212 (R)**		3.3	4.8			3.9
3	**27077**		3.8		4.2	4.2	
4	**26118**		3.8	5.0	4.8		
5	**27736**	3.9					3.9
6	**27743**	3.9	3.8				
7	**27369**	4.0			4.9		
8	**27781**	4.0		4.8			
9	**26684**		3.4	4.4			
10	27280				4.9		3.9
11	**27378**					4.0	4.0
12	**28811**	4.0				4.1	
13	**27637**			4.8		4.5	

(LB-Leaf Blast; NB-Neck blast; ShB-Sheath Blight; BS-Brown spot; BLB-Bacterial leaf blight; ShR – Sheath rot)

In NSN-2, IET # 28306 had shown high resistance to two diseases *viz.*, neck blast and sheath rot. In addition, IET # 28521 had shown high resistance to neck blast and moderate resistance to bacterial leaf blight. IET # 28732, 28301, 28304 shown resistance to neck blast and tolerance to sheath blight (Table 76).

Table 76: Multiple disease resistance in NSN-2, *Kharif* **– 2019**

S.No	IET. No	Disease/Susceptible Index			
		NB	ShR	BLB	ShB
1	28306	1.0	1.5		
2	28521	1.5		4.7	
3	28732	0.5			5.0
4	28301	2.0			4.8
5	28304	2.0			4.5

(NB-Neck blast; BS-Brown spot; BLB-Bacterial leaf blight; ShR – Sheath rot)

Under NSN-H, nine lines expressed resistant reaction to more than two diseases *viz*., IET # 26594 (moderately resistant to sheath blight, sheath rot and brown spot), 27466 (moderately resistant to neck blast, sheath blight and bacterial leaf blight). Seven entries *viz*., IET # 27465 (ShB, ShR), 27491 (LB, ShR), 28193 (LB, BS), 28211 (LB, BLB), 28212 (ShB, ShR), 28222 (LB, NB) and 28239 (NB, ShB) (Table 77).

Table 77: Multiple disease resistance in NSN-H, *Kharif* - 2019

S.No	IET. No	Disease/Susceptible Index					
		LB	NB	ShB	ShR	BS	BLB
1	**26594**			5.0	3.0	4.8	
2	**27466**		3.7	5.0			5.5
3	**27465**			5.0	4.0		
4	**27491**	4.8			4.0		
5	**28193**	4.6				4.7	
6	**28211**	4.8					4.5
7	**28212**			4.3	3.0		
8	**28222**	4.8	3.5				
9	**28239**		4.0	5.0			

(LB-Leaf blast; NB-Neck blast; ShB – Sheath blight; BS-Brown spot; BLB-Bacterial leaf blight; ShR – Sheath rot)

In NHSN, Out of 14 entries, 13 entries showed moderate/ resistant reaction to two diseases; except IET# 28148 expressed moderate resistance against three diseases (ShB, BS and BLB). Entries expressed moderate resistance or tolerance against two diseases are IET#28130 (LB, NB), 28115 (LB, RTD), 28117 (NB, ShR), 28129 (NB, ShR), 28154 (NB, ShB), 28160 (ShB, BLB), 28152 (ShB, BS), 28134 (BS, ShR) expressed moderate resistant reaction against two different diseases (Table 78).

Table 78: Multiple disease resistance in NHSN, *Kharif* – 2019

S.No	IET. No	Disease/Susceptible Index						
		LB	NB	ShB	BS	BLB	RTD	ShR
1	**28148**			5.2	4.3	4.7		
2	**28130**	3.9	4.0					
3	**28115**	3.7					5.0	
4	**28117**		3.4					4.0
5	**28129**		3.8					3.9
6	**28154**		3.8	5.4				
7	**28141**	3.9		5.3				
8	**28160**			5.3		5.0		
9	**28152**			5.4	4.9			
10	**28134**				4.8			4.2

(LB-Leaf blast; NB-Neck blast; ShB-Sheath blight; BS-Brown spot; BS-Brown spot; BLB-Bacterial leaf blight; ShR – Sheath rot; RTD- Rice tungro disease)

In DSN, CR 4209-2(moderate resistant to sheath blight, brown spot and sheath rot) and Phoghak (moderate resistant to neck blast, sheath blight and sheath rot) showed resistant reaction to three diseases. IET numbers showed moderate resistant reaction to two diseases were Gonalasha (sheath blight and sheath rot), HL18WS-20-4 (leaf blast and neck blast), IET 25692 (sheath blight and sheath rot), KNM 7787 (neck blast and bacterial leaf blight), RMS-R-11 (sheath blight and sheath rot), RMS-R-13 (neck blast and rice tungro virus), RMS-R-15 (RTD and sheath rot), RP-Bio Patho-10 (neck blast and BLB), RP-Bio Patho-7 (neck blast and BLB), RP-Patho-3(neck blast and sheath rot) and RP-Patho-9 (neck blast and sheath blight) (Table 79)

Table 79: Multiple disease resistance in DSN *Kharif* – 2019

S. No	IET. No	Disease/Susceptible Index						
		LB	NB	ShB	BS	BLB	RTD	ShR
1	CR 4209-2			4.9	4.6			4.1
2	Gonalasha			4.8				4.3
3	HL18WS-20-4	4.0	4.0					
4	IET 25692			4.1				3.8
5	KNM 7787		4.0			4.3		
7	Phoghak		3.3	4.6				4.0
8	RMS-R-11			4.9				3.6
9	RMS-R-13		4.0				4.0	
10	RMS-R-15						4.0	4.3
12	RP-Bio Patho-10		3.8			4.6		
13	RP-Bio Patho-7		3.7			4.8		
14	RP-Patho-3		3.8					3.8
15	RP-Patho-9		3.8	4.8				

(LB-Leaf blast; NB-Neck blast; ShB-Sheath blight; BS-Brown spot; BS-Brown spot; BLB-Bacterial leaf blight; ShR – Sheath rot; RTD- Rice tungro disease)

II. FIELD MONITORING OF VIRULENCE

1. *Pyricularia oryzae*

The experiment was conducted at 25 locations across India against *Pyricularia oryzae* during *Kharif* 2019. The aim of this experiment was to monitor virulence pattern in the population of rice blast pathogen. The nursery included twenty five cultivars consisting of near isogenic lines, international differentials, donors and commercial cultivars. The experiment was conducted at twenty five locations during the crop season to monitor the blast reaction on different host genotypes and is presented in Figure 1. The disease pressure was high (LSI 7.1, 6.8, 6.7, 6.5 and 6.1) at Coimbatore, Gudalur, Upper Shillong, Imphal and Cuttack. It was moderate (LSI 5.9 to 5.1) Lonovala, Gangavati, Almora, Ghaghraghat, Karjat, New Delhi, Nawagam and Navsari. It was low (LSI 4.7 to 2.5) at Jagityala, Mandya, Ponnampet, Jagdalpur, Hazaribagh, Pattambi, Mugad, IIRR, Ranchi, Rajendranagar, Khudwani and Malan. The data from these locations are presented in Table 80.

Raminad str-3, Tetep and Tadukan were resistant across the locations with SI 3.2, 3.5 and 3.5 respectively. Tetep was highly resistant at most of the locations about 17 locations that showed its potentiality as the best donors for resistance against blast disease. Tetep was susceptible at Coimbatore, Gudalur and Upper Shillong and moderately susceptible at Cuttack, Ghaghraghat and Gangavati. Raminad str-3 was susceptible at Coimbatore and Cuttack and also moderately susceptible at Imphal, Gudalur, Ghaghraghat and Karjat. Tadukan was showing resistant all the locations except Gangavati, Ghaghraghat, Coimbatore, Upper Shillong, Cuttack and Karjat. Zenith was highly susceptible at Gudalur and Upper Shillong; similarly NP-125 also highly susceptible at Coimbatore and Gudalur. The susceptible checks like HR-12 and Co-39 are showing susceptible reaction at most of the locations but HR-12 recorded moderately resistant reaction at Khudhwani and Co-39 also recorded low disease score at Ranchi, Karjat and Ghaghraghat. The resistant check Rasi was highly susceptible at Gudalur, Upper Shillong, Imphal, Almora, Nawagam, Cuttack, Gangavati, Mandy and Rajendranagar. IR 64 was sowing susceptible reaction at Coimbatore, Lonavala, Imphal, Gudalur and Cuttack.

The difference in disease reaction score of susceptible and resistant checks reveals that a shift in the pathogen population. Cluster analysis of *Pyricularia oryzae* reaction on 25 different genotypes at 25 locations was done and is presented in Figure 2. The reaction pattern of genotypes at all the locations was grouped into six major groups at 60 percent similarity coefficient. The reaction pattern at Almora, Gudalur, Cuttack, Ghaghraghat, Karjat, Imphal, Ponnampet, Navasari, Coimbatore, Uppper Shillong, Nawagam, Gangavati, Jagityal, Hazaribagh, Jagdalpur, Lonovala, New Delhi, IIRR, Mandya and Ranchi were in group one; Pattambi, Mugad, Malan, Khudhwani and Rajendranagar were in group two, three, four, five and six respectively.

Table 80: Reaction of rice differentials to *Pyricularia oryzae* at across the locations in India during *Kharif* -2019

Ent. No.	Differentials	CBT	GDL	USG	IMP	CTK	LNV	GGV	ALM	GHT	KJT	NDL	NWG	NVS	JGT	MND	PNP	JDP	HZB	PTB	MGD	IRR	RNC	RNR	KHU	MLN	SI	<=3*	<=5*	Total
	LSI	7.1	6.8	6.7	6.5	6.1	5.9	5.9	5.7	5.7	5.6	5.5	5.3	5.1	4.7	4.5	4.5	4.3	4.2	3.7	3.7	3.6	3.5	3.0	2.8	2.5				
	Screening Method	-	N	N	N	-	N	N/A	N	-	A	A	A	N/A	-	N/A	N	N	N	N	N	A	-	A	N/A	N/A				
12	Raminad -STR -3	7.0	5.0	4.0	6.0	7.0	3.0	3.0	1.0	5.0	5.0	0.0	4.0	3.0	3.5	0.5	4.5	2.0	2.5	3.0	3.0	1.0	1.3	1.5	2.0	1.0	3.2	15	22	25
22	Tetep	9.0	9.0	7.0	3.0	5.0	2.0	4.5	4.0	5.0	3.0	3.0	3.5	1.5	2.5	2.5	2.5	1.5	2.5	2.0	3.0	1.0	3.0	3.0	2.0	2.0	3.5	17	22	25
20	Tadukan	7.0	4.0	7.0	3.0	5.0	3.0	8.5	4.0	7.0	5.0	3.0	3.5	3.5	2.5	2.5	2.5	2.0	2.5	3.0	3.0	1.0	2.0	1.0	2.0	1.0	3.5	15	21	25
13	Zenith	3.0	7.0	7.0	5.0	5.0	5.0	4.5	5.0	6.5	5.0	3.0	4.5	5.5	4.5	1.0	4.5	0.5	2.5	4.0	3.0	2.0	3.0	2.0	3.0	2.0	3.9	11	21	25
14	NP - 125	8.0	3.0	9.0	6.5	5.0	4.5	5.0	1.0	5.0	5.0	5.0	3.0	3.0	4.0	1.0	4.5	5.0	3.0	3.0	5.0	1.0	3.3	1.5	3.0	1.0	3.9	11	22	25
11	C101 PKT	7.0	5.0	9.0	6.0	5.0	5.0	2.0	3.5	5.0	7.0	5.0	5.5	6.0	3.5	2.5	3.5	5.5	3.5	4.0	3.0	2.0	3.7	2.5	2.0	1.0	4.3	7	18	25
6	RIL - 29	8.0	5.0	4.0	7.0	7.0	5.5	5.0	4.0	5.0	6.5	5.0	5.0	5.0	4.5	3.5	3.5	4.0	3.5	3.5	3.0	3.0	2.0	1.0	3.0	2.0	4.3	6	20	25
7	*O. minuta*	9.0	7.0	4.0	6.0	5.0	8.0	8.0	4.5	5.0	6.0	3.0	5.5	5.0	4.5	2.5	4.0	3.5	2.5	4.0	3.0	3.0	2.3	3.0	2.0	1.5	4.5	9	18	25
10	A 57	6.0	6.0	9.0	7.0	7.0	4.5	2.5	4.5	7.0	6.5	5.0	6.5	6.0	2.5	2.5	4.5	4.0	2.5	4.0	3.0	4.0	4.3	2.5	2.0	1.0	4.6	8	16	25
4	C101 TTP	6.0	9.0	7.0	5.5	5.0	5.5	7.5	6.0	5.0	6.0	7.0	5.5	4.5	4.5	4.5	3.5	3.5	4.0	3.0	3.0	4.0	3.7	0.0	3.0	1.0	4.7	5	15	25
2	C101 A51	8.0	6.0	7.0	7.0	5.0	7.0	8.0	5.5	5.0	5.5	5.0	5.5	4.5	3.0	2.5	4.5	3.5	3.5	3.0	3.0	4.0	3.7	3.0	3.0	2.0	4.7	7	16	25
9	BL-245	3.0	6.0	8.0	5.5	7.0	5.0	2.5	6.0	5.0	7.0	7.0	5.5	6.5	3.5	7.5	5.0	4.5	4.0	4.0	3.0	3.0	3.7	2.5	2.0	1.0	4.7	7	15	25
21	IR - 64	9.0	7.0	0.0	8.5	7.0	9.0	8.5	6.5	5.0	3.5	5.0	4.5	4.5	3.5	3.5	4.0	2.5	3.0	4.0	4.0	4.0	2.7	3.5	4.0	1.5	4.7	5	18	25
1	C101 LAC	4.0	8.0	7.0	6.5	5.0	5.0	8.5	5.5	5.0	5.0	7.0	5.0	5.0	3.0	6.5	4.0	4.0	5.0	2.5	5.0	4.0	4.0	3.0	1.0	2.5	4.8	5	18	25
5	RIL - 10	5.0	7.0	8.0	7.5	5.0	5.0	5.0	7.0	5.0	7.0	5.0	3.0	3.5	5.0	6.5	3.5	4.5	4.5	3.0	5.0	5.0	4.3	3.5	2.0	1.5	4.9	4	19	25
16	Dular	9.0	3.0	8.0	6.5	5.0	4.0	4.0	9.0	7.0	7.0	7.0	5.5	4.5	6.5	1.0	5.5	6.0	3.5	3.0	5.0	1.0	1.3	1.0	2.0	6.0	4.9	7	13	25
8	BL-122	6.0	4.0	7.0	7.5	7.0	8.0	8.0	5.5	5.0	7.0	5.0	6.0	4.5	4.5	6.5	4.5	5.0	4.0	3.0	3.0	4.0	2.3	3.0	1.0	2.5	5.0	6	15	25
17	Kanto - 51	9.0	8.0	5.0	6.0	7.0	3.0	6.5	6.0	7.0	5.0	7.0	3.0	6.5	5.5	2.5	5.5	6.0	4.5	4.0	3.0	2.0	3.7	0.0	4.0	5.0	5.0	6	13	25
19	Calaro	7.0	7.0	8.0	6.0	5.0	9.0	6.0	5.5	7.0	5.0	7.0	6.0	5.5	5.5	6.5	3.5	2.5	4.0	5.0	5.0	4.0	4.3	1.0	3.0	4.0	5.3	3	12	25
18	Shi-tia-tao	7.0	9.0	2.0	7.5	7.0	7.5	4.0	9.0	7.0	5.0	7.0	5.5	6.0	5.0	8.5	4.5	3.5	8.5	4.0	2.0	7.0	4.7	0.0	3.0	5.0	5.6	4	12	25
24	Rasi	6.0	9.0	8.0	8.0	7.0	4.5	7.0	8.0	6.0	5.5	5.0	7.5	5.5	7.0	6.5	4.5	4.5	3.5	4.0	5.0	5.0	3.7	7.0	3.0	-	5.9	1	10	24
3	C104 PKT	9.0	9.0	8.0	7.5	5.0	8.5	7.5	8.0	5.0	6.5	7.0	5.0	5.0	5.0	7.5	5.5	5.5	6.0	3.5	3.0	4.0	4.7	6.0	4.0	2.5	5.9	2	11	25
15	USEN	9.0	9.0	8.0	7.0	7.0	9.0	4.5	8.0	7.0	5.0	7.0	7.5	6.0	6.0	8.5	5.5	6.5	4.0	4.0	3.0	5.0	4.3	7.0	3.0	5.0	6.2	2	9	25
25	Co - 39	9.0	9.0	7.0	7.5	9.0	9.0	8.5	7.5	5.0	5.0	9.0	9.0	7.5	9.0	7.0	6.5	8.5	9.0	6.5	5.0	6.0	4.3	9.0	6.0	-	7.5	0	4	24
23	HR - 12	8.0	9.0	9.0	8.0	9.0	9.0	9.0	9.0	6.0	5.5	9.0	8.0	8.5	8.0	9.0	8.5	8.5	8.5	6.5	6.0	9.0	6.7	7.5	4.0	6.0	7.8	0	1	25
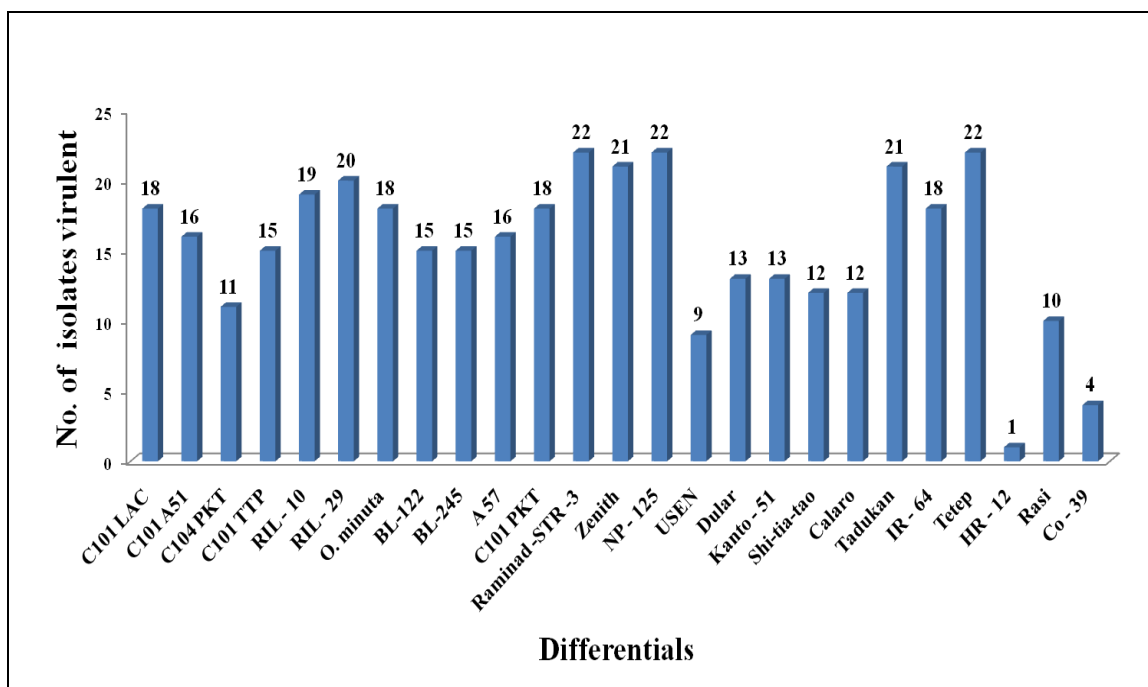
Figure 1: Differential reaction of hosts to rice blast pathogen (*Pyricularia oryzae)* at different locations - *Kharif 2019*
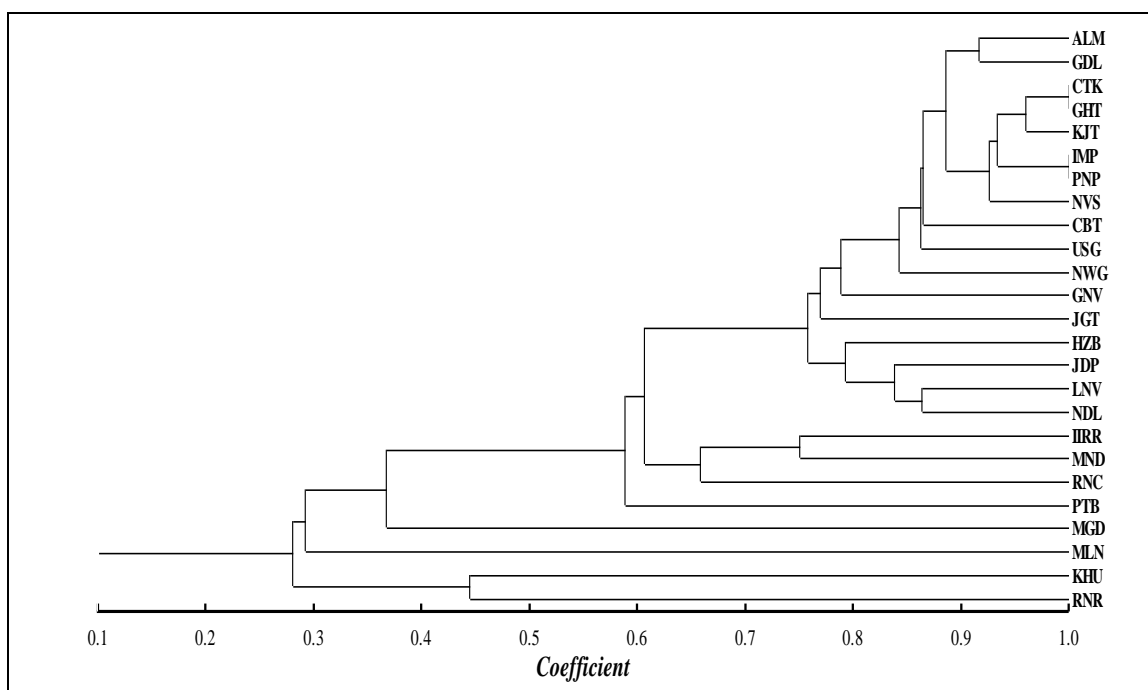
Figure 2: Dendrogram showing relatedness of different reactions of *P. oryzae* at different locations during *Kharif* -2019

2. *Xanthomonas oryzae* pv. *oryzae*

Trial on monitoring virulence of bacterial blight pathogen, *Xanthomonas oryzae* pv. *oryzae* was proposed at 26 hot spot location across India during *Kharif* season of 2019. Data was received from all the 26 locations. At Ludhiana, the trial was conducted with 10 different strains of *Xanthomonas oryzae* pv. *oryzae*. The rice differentials used in this trial consisted of twenty eight near isogenic lines (IRBB lines) possessing different bacterial blight resistant genes (singly) or various combination 5 BB resistance genes viz., *Xa4*, *xa5*, *Xa7*, *xa13* and *Xa21* in the background of rice cultivar IR 24. The differentials like DV 85, TN1 (susceptible check) and Improved Samba Mahsuri (RP Bio 226) (resistant check) were also included in the trial. The isolate from Maruteru, Arundhatinagar and Pattambi were extremely virulent and produced LSI (location severity index) of 6 or more. The isolates from Chiplima, Aduthurai, Gangavathi, New Delhi and Coimbatore were also categorized as highly virulent and the produced LSI between 5.7- 6. The MTU isolate was reported to be unique as it produced susceptible reaction on all the 31 differentials. The reaction pattern of this isolate should be re-confirmed. The isolate from Arundhatinagar also produced susceptible reactions (score >5) on 20 differentials and the reaction pattern of this isolate also should be re-confirmed. The isolates from Pattambi, Chiplima, Aduthurai, Gangavathi, New Delhi and Coimbatore produced susceptible reactions on 14-19 differentials. The isolates from Chatha, Karjat, Chinsurah, Faizabad, Raipur, Patna, Nawagam, Pantnagar, IIRR (collected from Warangal), Navsari, Rajendranagar and some isolates from Ludhiana (PbXo # 4, 5, 7, 8, 9, 10) were categorized as moderately virulent (LSI 4.3-5.5) and these isolates produced susceptible reactions on 8-18 differentials. The isolates from Sabour, Jagtiyal, Titabar, NRRI-Cuttack, Port Blair, Moncompu and some isolates from Ludhiana (PbXo # 1, 2, 3, 6) were categorized as less virulent (LSI <4.2) and these isolates produced susceptible reactions on 1-8 differentials. As far as performance of important genes is concerned, *Xa21* was found to be susceptible at 21 locations while *xa13* was found susceptible at 14 locations. Different 2 genes combinations (IRBB 50 to IRBB 55) showed susceptibility to 8-10 differentials. Gene combinations *Xa21 + xa13* was found susceptible at 10 locations. Different 3 genes combinations (IRBB 56-IRBB 59; IRBB 61-IRBB 63) showed susceptibility to 3-8 differentials at different locations. Different 4 and 5 genes combinations (IRBB 60; IRBB 64-IRBB 66) showed susceptibility to 5-8 differentials at different locations (Table 81). Cluster analysis of *Xanthomonas oryzae* pv. *oryzae* reaction on different genotypes at various locations was done and is presented in Figure 3. The isolates belonging to different virulence categories (high virulence, moderate virulence and low virulence) very clearly formed separate groups (Figure 4).

Table 81: Reaction of rice differentials to *Xanthomonas oryzae* pv. *oryzae* at different locations during *Kharif'*2019

Differentials	Gene combinations	Highly virulent								Moderately virulent									
		MTU	AND	PTB	CHP	ADT	GGV	NDL	Coim	CHT	KJT	CHN	FZB	RPR	PTN	NWG	PbXo-9	PbXo-10	PNT
IRBB - 1	*Xa1*	8	7	9	9	5	9	5	7	6	6	7	6	9	4	7	7	7	9
IRBB - 3	*Xa3*	9	9	8	9	4	8	7	8	2	7	8	5	7	5	7	7	7	9
IRBB - 4	*Xa4*	9	5	7	8	5	6	7	6	5	7	5	5	9	6	8	7	7	9
IRBB - 5	*xa5*	9	3	7	8	6	4	5	5	7	7	6	5	7	5	7	7	7	8
IRBB - 7	*Xa7*	9	9	9	8	5	4	5	4	5	6	6	6	7	4	6	7	7	4
IRBB - 8	*xa8*	9	7	7	9	7	7	5	5	8	5	7	5	5	5	4	7	7	5
IRBB - 10	*Xa10*	8	9	5	9	7	6	5	6	5	6	9	7	9	6	6	7	7	9
IRBB - 11	*Xa11*	9	9	7	8	5	6	5	3	7	7	9	7	9	6	8	7	7	7
IRBB - 13	*xa13*	9	5	7	6	7	5	5	6	2	6	7	6	9	6	6	3	3	7
IRBB - 14	*Xa14*	9	9	7	7	3	7	9	7	6	6	9	5	9	5	6	7	7	9
IRBB - 21	*Xa21*	8	9	7	6	7	4	5	6	7	6	9	5	7	5	8	7	7	6
IRBB - 50	*Xa4+xa5*	8	9	7	8	5	8	5	6	6	4	5	6	3	4	4	7	7	3
IRBB - 51	*Xa4+xa13*	7	7	7	4	5	7	1	8	5	6	3	4	7	6	2	3	3	3
IRBB - 52	*Xa4+Xa21*	6	7	7	5	5	4	1	7	6	7	3	5	7	6	3	5	3	1
IRBB - 53	*xa5+xa13*	7	9	5	4	7	3	5	5	7	7	7	5	7	6	3	5	3	6
IRBB - 54	*xa5+Xa21*	7	9	5	6	4	6	5	8	4	6	3	5	3	4	3	3	3	4
IRBB - 55	*xa13+Xa21*	8	9	5	4	5	6	5	7	6	5	6	6	7	5	3	3	3	4
IRBB - 56	*Xa4+xa5+xa13*	6	7	5	4	8	6	7	5	5	6	3	6	3	4	3	3	3	3
IRBB - 57	*Xa4+xa5+Xa21*	7	9	5	5	8	6	5	4	5	5	4	5	1	6	3	3	5	1
IRBB - 58	*Xa4+xa13+Xa21*	6	5	4	3	7	4	5	3	5	4	3	5	3	5	2	3	3	9
IRBB - 59	*xa5+xa13+Xa21*	7	3	5	3	7	3	5	6	4	6	4	6	3	5	6	3	3	1
IRBB - 60	*Xa4+xa5+xa13+Xa21*	7	9	3	3	7	2	7	7	7	4	6	4	3	4	3	3	3	1
IRBB - 61	*Xa4 + xa5 + Xa7*	7	-	5	5	5	8	7	3	6	5	3	5	3	6	4	7	5	4
IRBB - 62	*Xa4 + Xa7 + Xa21*	7	5	5	6	7	8	5	7	5	4	3	4	1	5	6	3	3	1
IRBB - 63	*xa5 +Xa7 + xa13*	7	3	5	4	5	6	5	6	6	5	6	5	3	6	8	3	3	2
IRBB - 64	*Xa4 + xa5 + Xa7 + Xa21*	7	5	5	4	6	7	5	3	6	5	5	3	3	4	6	3	3	2
IRBB - 65	*Xa4 + Xa7 + xa13 + Xa21*	7	3	5	4	4	6	7	6	7	5	3	6	1	6	3	3	3	1
IRBB - 66	*Xa4 + xa5 + Xa7 + xa13 + Xa21*	7	7	3	3	4	4	7	5	6	4	3	4	3	5	2	3	3	6
DV - 85	-	7	7	5	5	9	6	9	4	6	5	4	7	5	5	6	7	7	7
ISM	*xa5+xa13+Xa21*	7	5	5	4	2	2	9	6	3	3	2	3	3	6	6	3	3	1
TN1	-	8	9	9	9	6	9	9	7	7	7	9	9	9	7	9	9	9	9
LSI		7.6	6.9	6.0	5.8	5.7	5.7	5.7	5.7	5.5	5.5	5.4	5.3	5.3	5.2	5.1	5.0	4.9	4.9
Min Score		6	3	3	3	2	2	1	3	2	3	2	3	1	4	2	3	3	1
Max Score		9	9	9	9	9	9	9	8	8	7	9	9	9	7	9	9	9	9
# entries > 5		31	20	14	15	15	20	11	19	18	17	15	12	15	13	17	14	13	14

Table 81: Reaction of rice differentials to *Xanthomonas oryzae* pv. *oryzae* at different locations during *Kharif'*2019

Differentials	Gene combination	Moderately virulent							Less virulent									
		PbXo-4	IIRR	PbXo-5	NVS	PbXo-7	PbXo-8	RNR	PbXo-1	PbXo-6	SBR	JJT	TTB	PbXo-3	NRRI	PbXo-2	PBL	MCP
IRBB - 1	*Xa1*	7	9	7	7	7	7	3	7	7	5	6	7	7	7	5	3	4
IRBB - 3	*Xa3*	7	9	5	6	7	7	3	7	7	5	6	7	7	7	5	5	5
IRBB - 4	*Xa4*	7	7	7	7	7	3	4	5	5	6	5	7	3	5	3	3	2
IRBB - 5	*xa5*	5	5	7	5	7	3	7	5	3	9	4	7	3	3	3	3	4
IRBB - 7	*Xa7*	7	9	7	6	7	5	3	7	7	9	4	5	5	5	3	1	4
IRBB - 8	*xa8*	5	5	7	6	7	7	6	5	3	7	4	5	3	3	3	5	1
IRBB - 10	*Xa10*	7	9	7	5	7	7	5	7	7	5	6	6	7	5	3	7	3
IRBB - 11	*Xa11*	7	9	7	5	7	7	3	7	7	7	6	5	7	5	5	5	2
IRBB - 13	*xa13*	3	3	3	3	3	7	4	3	3	5	4	5	3	3	3	7	1
IRBB - 14	*Xa14*	7	9	7	4	7	7	6	7	7	5	5	7	7	3	5	5	4
IRBB - 21	*Xa21*	7	5	7	4	7	7	6	5	7	2	3	5	5	3	3	7	0
IRBB - 50	*Xa4+xa5*	3	5	5	5	5	1	4	3	3	3	4	5	3	3	3	1	0
IRBB - 51	*Xa4+xa13*	3	3	3	2	3	3	4	3	3	4	4	4	3	1	3	1	0
IRBB - 52	*Xa4+Xa21*	5	7	3	3	3	3	4	3	3	2	3	3	3	1	1	1	0
IRBB - 53	*xa5+xa13*	3	1	3	4	3	3	4	3	3	3	2	4	3	1	1	1	1
IRBB - 54	*xa5+Xa21*	7	3	7	4	3	3	5	3	3	3	4	3	3	1	1	1	0
IRBB - 55	*xa13+Xa21*	3	1	3	3	3	7	7	3	3	3	5	4	3	1	3	1	2
IRBB - 56	*Xa4+xa5+xa13*	3	1	1	4	1	3	4	1	3	3	3	3	3	3	1	3	3
IRBB - 57	*Xa4+xa5+Xa21*	5	1	3	3	3	3	3	3	3	2	3	2	5	1	3	1	1
IRBB - 58	*Xa4+xa13+Xa21*	3	1	1	2	3	3	3	3	3	1	2	3	3	1	3	3	0
IRBB - 59	*xa5+xa13+Xa21*	3	1	3	1	3	3	3	3	3	2	3	1	3	1	3	3	0
IRBB - 60	*Xa4+xa5+xa13+Xa21*	3	1	3	3	1	3	4	3	3	3	3	2	1	1	3	1	0
IRBB - 61	*Xa4 + xa5 + Xa7*	3	7	5	2	5	1	4	3	3	4	5	3	3	3	3	1	0
IRBB - 62	*Xa4 + Xa7 + Xa21*	3	5	3	5	1	3	3	3	3	3	4	3	3	3	3	1	0
IRBB - 63	*xa5 +Xa7 + xa13*	3	3	3	6	1	3	4	3	3	3	4	4	3	1	3	1	0
IRBB - 64	*Xa4 + xa5 + Xa7 + Xa21*	3	3	3	7	1	3	3	3	3	3	4	2	3	3	3	1	2
IRBB - 65	*Xa4 + Xa7 + xa13 + Xa21*	3	1	1	5	1	3	6	3	3	3	4	1	1	3	1	1	1
IRBB - 66	*Xa4 + xa5 + Xa7 + xa13 + Xa21*	3	1	1	3	1	3	3	3	3	2	2	1	1	3	1	1	0
DV - 85	-	3	7	7	7	9	3	7	3	3	5	3	3	3	5	3	3	1
ISM	*xa5+xa13+Xa21*	3	1	3	2	3	3	1	3	3	4	2	1	3	3	1	1	0
TN1	-	9	9	9	8	9	9	7	9	9	6	9	7	9	9	7		8
LSI		4.6	4.5	4.5	4.4	4.4	4.3	4.3	4.2	4.2	4.1	4.1	4.0	3.8	3.1	2.9	2.6	1.6
Min Score		3	1	1	1	1	1	1	1	3	1	2	1	1	1	1	1	0
Max Score		9	9	9	8	9	9	7	9	9	9	9	7	9	9	7	7	8
# entries > 5		10	11	12	9	12	10	8	7	8	6	5	7	6	3	1	3	1
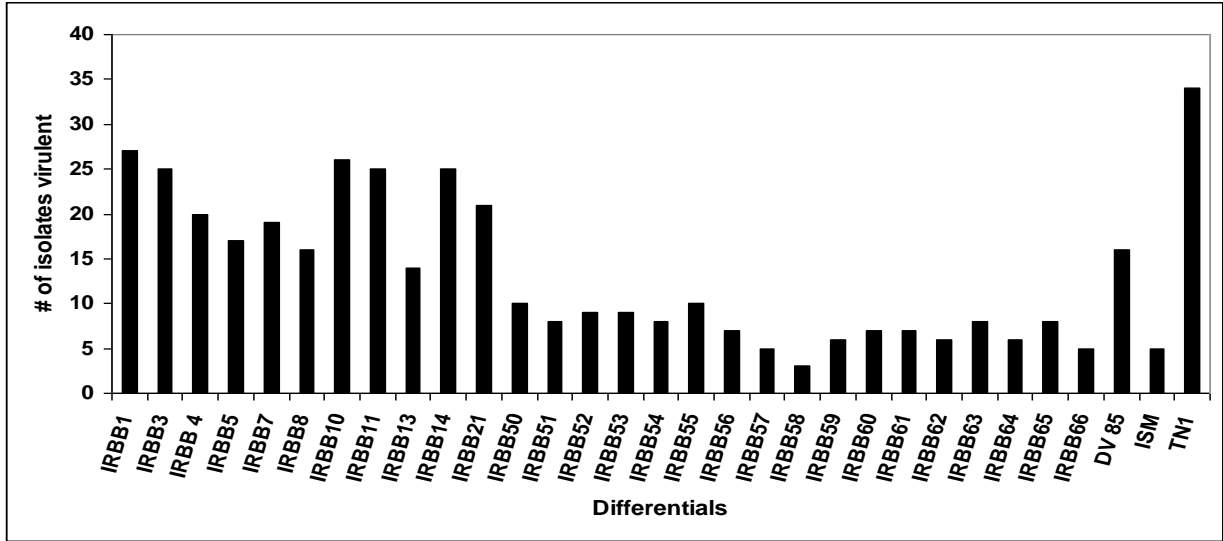
Figure 3: Number of *Xoo* isolates showing moderate to high virulence on different BB resistance genes and their combinations during *Kharif'* 2019
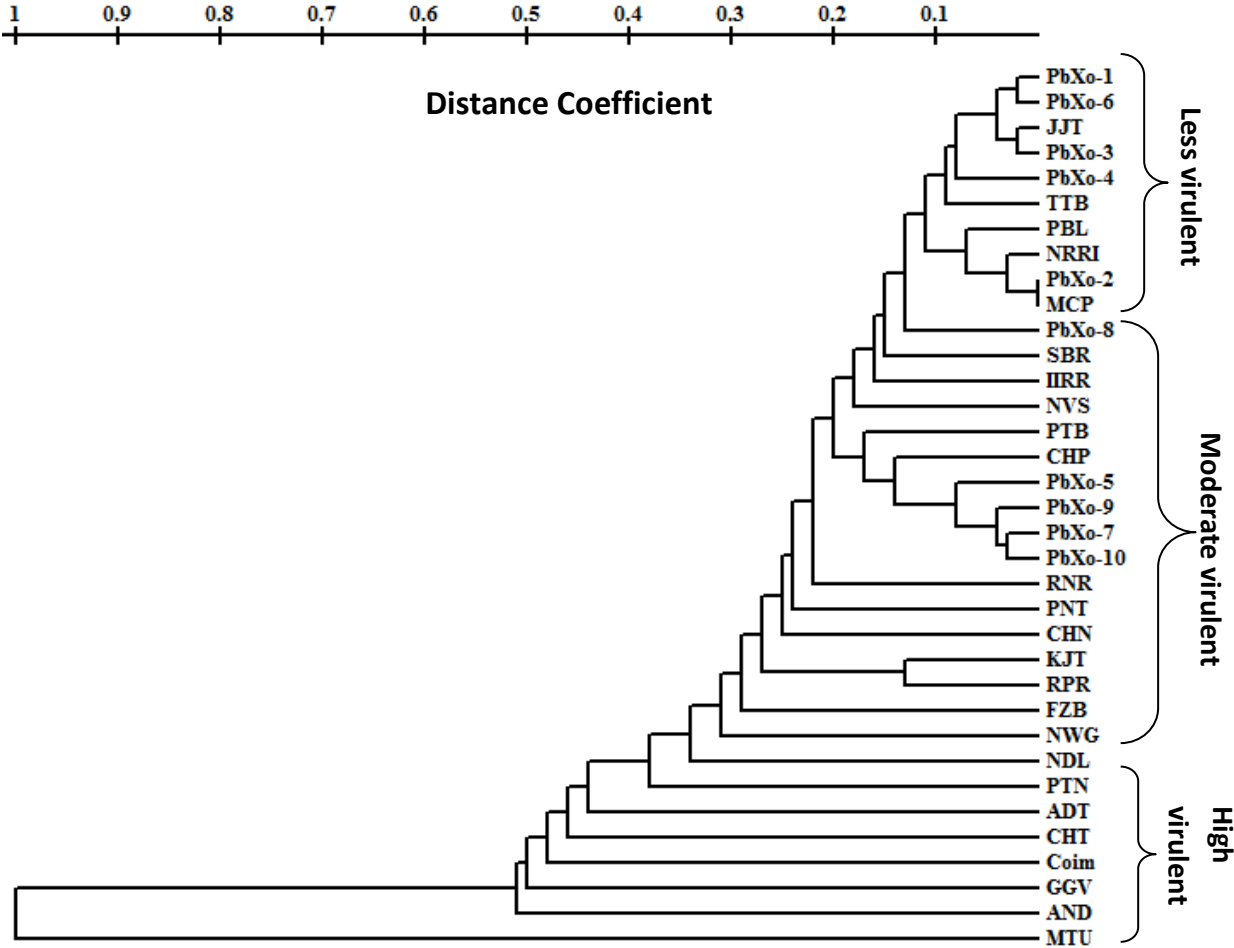
Figure 4: Dendrogram showing the relatedness of different *Xanthomonas oryzae* pv. *oryzae* isolates from various locations during *Kharif'* 2019

III. DISEASE OBSERVATION NURSERY – *Kharif*-2019

Disease observation nursery (DON) trial was conducted at 10 locations with different sowing dates *viz.*, early, normal and late with respect to the respective locations with an aim to estimate the effect of such varied sowing/planting dates on the occurrence and severity of the disease in the respective endemic regions. It is generally known that the availability of susceptible host, virulent pathogen and prevalence of favorable weather condition play important role in the process of disease development. In this context the trial was formulated with susceptible variety to take up sowing in three different dates to collect the information on the incidence of the disease and also data was recorded as percent disease index of various rice diseases throughout the cropping period in a particular locality. Knowledge on the occurrence of particular disease on specific location based on susceptible host and time of sowing may help us to formulate the management strategy. The trial was proposed at 10 locations Chinsurah, Cuttack, Gangavathi, Kaul, Malan, Mandya, Maruteru, Moncompu, Nawagam, Pusa and Raipur. The data was received from 9 centres except from Cuttack. The salient findings of this study are presented on location-wise below.

Chinsurah: Three different sowing dates viz., 27.05.19, 27.06.19 and 26.07.19 were followed as early, normal and late sowing periods respectively. The variety MTU 7029 was used to study the disease progress of different diseases in that region. The diseases that were prevalent in this centre were sheath blight, sheath rot, brown spot and bacterial leaf blight (BLB). The observations were taken from 30 DAT to 100 DAT. In general, the incidence of sheath blight disease was found early and tillering stages of the crop (30 to 70 DAT) and during the early and normal sowing periods (23 to 58.5% PDI and 16.5 to 32.5 % PDI respectively) and very less during the late sown crop i.e., 1 to 5 % PDI. Sheath rot disease was present in the grain filling stage in all the sowing periods (80 to 100 DAT) and relatively more in the late sown crop (33.5 to 38.5% PDI) than when compared to the early (2 to 5% PDI) and normal sown crop (11 to 19% PDI). Similarly, brown spot disease was found to occur more in the tillering to grain filling stages (60 to 100 DAT) and more in the late sown crop (5.5 to 22.5% PDI) when compared to early sown crop (PDI - 1.0 to 5.5%) and normal sown crop (PDI - 1.5 to 9.0%). In the case of BLB, the disease was very less (2.5 and 5% PDI) and it was only during the early stages of the crop. The infected plants recovered with the age of the plants and did not show further symptoms (Table 82a).

Table 82a: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 - Chinsurah

Location/ Date of sowing	DAT	Percent Disease Index											
		Sheath blight			Sheath rot			Brown spot			BLB		
		(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)
V- MTU 7029	30 DAT	23.0	16.5	1.0									
E: 27.05.19	40 DAT	27.5	19.0	2.0							2.5	-	-
N: 27.06.19	50 DAT	37.5	23.5	3.0							5.0	-	-

Location/ Date of sowing	DAT	Percent Disease Index											
		Sheath blight			Sheath rot			Brown spot			BLB		
		(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)
L: 26.07.19	60 DAT	47.5	27.5	5.0					1.5	5.5			
	70 DAT	58.5	32.5	5.0				1.0	2.0	10.0			
	80 DAT				2.0	11.0	33.5	2.5	4.5	16.5			
	90 DAT				4.0	16.5	38.0	4.0	5.5	22.5			
	100 DAT				5.0	19.0	-	5.5	9.0				

Pusa: Variety Pankaj was used for the purpose of studying the effect of sowing dates in the incidence and progress of brown spot disease of rice. The crop was sown on *viz.*, 15.06.19 (early), 30.06.19 (normal) and 15.07.19 (late). The disease was found to initiate in the early stage of the crop (30DAT) and progress steadily during the entire duration of the crop. Late sown crops showed maximum incidence of the brown spot disease in Pusa (7.5 to 75% PDI) followed by early sown (2.5 to 42.5% PDI) and normal sown crop (1.5 to 35.20% PDI) (Table 82b).

Table 82b: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 – Pusa

Location/ Date of sowing	Percent Disease Index		
	Pusa		
	Brown spot		
V/DOS	DAT	(E)	(N)	(L)
Pankaj (HS)				
E: 15-06-19	30 DAT	2.50	1.50	7.50
N: 30-06-19	40 DAT	5.50	2.75	13.00
L: 15-07-19	50 DAT	7.50	6.25	14.50
	60 DAT	14.00	11.00	22.50
	70 DAT	24.50	21.00	32.50
	80 DAT	32.50	26.50	41.00
	90 DAT	37.50	31.00	52.50
	100 DAT	40.00	33.00	62.50
	110 DAT	42.50	35.50	75.00

Malan: In case of the leaf blast disease of rice in Malan, the variety HPU 2216 was selected as the susceptible variety and the crop was sown relatively earlier i.e., 21.05.19 (early), 05.06.19 (normal) and 20.06.19 (late). The early sown crop was found to be relatively disease free (2.6 and 5.05% PDI) when compared to the normal (14.45 to 28.9% PDI) and late sown (6.96 to 34.2% PDI) crop. More availability of moisture during the early stages of the crops under the late sown conditions led to the more incidence of the disease. In the case of early sown conditions, initial stage of the crop was relatively dry and the crop matured when the humidity starts building up during late stages of the crop (Table 82c).

Table 82c: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 - Malan

Location/ Date of sowing	Percent Disease Index			
	Malan			
	Blast			
V/DOS	DAT	(E)	(N)	(L)
V- HPU 2216	30 DAT			6.95
E: 21.05.19	40 DAT			18.5
N: 05.06.19	50 DAT		14.45	25.5
L: 20.06.19	60 DAT	2.6	20.5	34.2
	70 DAT	5.05	28.9	
	80 DAT			
	90 DAT			
	100 DAT			

Kaul: Different varieties were tested for different sowing dates which was not as per the technical programme finalized during the workshop. All the three cropping dates should have been planted for comparison, but has not been done in this case. The very purpose of comparing the disease severity during the different sowing periods has not been served with the conduct of this experiment. The cooperator is requested to explain this deviation from the finalized protocol for the conduct of DON experiments (Table 82d).

Table 82d: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 - Kaul

Location/ Date of sowing	Foot rot / Bakanae		Leaf and Neck Blast		Brown Spot		Sheath blight			
	DAT	(E)	(N)	(L)	Variety/DOS	(N)	Variety/DOS	DAT	(E)	(N)
V- PB 1121	30 DAT	15.95	10.5				V- HKR 126	30 DAT		
E: 07-06-19	40 DAT	-	23.5				E: 19-06-19	40 DAT		
N: 15-07-19	50 DAT	23.20					N: 25-06-19	50 DAT		
	60 DAT	34.60						60 DAT		
	70 DAT	30.95						70 DAT		
	80 DAT	28.55		33				80 DAT	29.5	31.0
	90 DAT	27.85						90 DAT	53.5	52.5
	100 DAT	21.85						100 DAT		
	110 DAT	17.50						110 DAT		
V- CSR 30	30 DAT	13.0	7.5		V- CSR 30		V- HKR 127	30 DAT		
E: 07-06-19	40 DAT	-	14		N: 21-06-19		E: 19-06-19	40 DAT		
N: 15-07-19	50 DAT	16.95			V- CSR 30		N: 25-06-19	50 DAT		
	60 DAT	21.75				4.5		60 DAT		
	70 DAT	19.95				5.5		70 DAT		
	80 DAT	17.10		37		8.5		80 DAT	24.5	24
	90 DAT	17.50				12.5		90 DAT	42.5	43
	100 DAT	14.00				4.5		100 DAT		
	110 DAT	12.65						110 DAT		

Gangavathi: Four major diseases including blast, brown spot, false smut and BLB were observed in all the sowing periods. Except false smut, the other three diseases were present in very less percentage (1 to 5.0 % PDI) in all the stages of the crop (30 to 90 DAT). However, the incidence of false smut was observed in the grain filling to early maturity stage (70 to 90 DAT) and in more scale 9.5 to 15 % PDI in the early sown crops followed by medium scale (8.5 to 12.5% PDI) and very less scale in the late sown crop (3 to 7% PDI) (Table 82e).

Table 82e: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 - Gangavathi

Location/ Date of sowing	DAT	Percent Disease Index											
		Blast			Brown spot			False smut			BLB		
		(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)
V- MTU 7029	30 DAT	2.0	3.5	1.5	6.0	5.5	5.5				2.0	3.5	4.0
E: 20-07-2019	40 DAT	2.5	3.5	2.5	5.0	4.5	4.5				2.5	5.0	3.5
N: 05-08-2019	50 DAT	4.0	2.5	2.0	5.5	4.5	5.5				1.5	4.5	5.0
L: 20-08-2019	60 DAT	2.5	2.0	1.5	6.0	6.5	4.5				3.0	5.0	4.0
	70 DAT	5.0	1.5	1.5	6.5	6.5	5.5	9.5	8.5	3.0	2.5	3.5	2.5
	80 DAT	1.5	1.5	2.0	7.5	6.0	4.5	12	9.5	5.0	3.0	3.5	2.0
	90 DAT	1.0	1.5	1.5	5.0	3.5	4.0	15	12.5	7.0	2.5	3.0	2.5
	100 DAT	-	-	-	-	-	-	-	-	-	-	-	-

Mandya: Two varieties *viz*., MTU 1001 and IR - 64 were sown under three different sowing dates i.e, 08.07.19 (early), 30.07.19 (normal) and 18.09.19 (late) to study the effect on four different diseases *viz*., sheath blight, brown spot, leaf blast and neck blast. Overall among the two varieties tested, IR-64 showed better tolerance for the three diseases *viz*., brown spot, leaf blast and neck blast under all the sowing conditions when compared with the variety MTU 1001. The variety IR-64 was more susceptible to the sheath blight disease when compared to the variety MTU1001. Among the diseases, leaf blast was found only in the late sown crop and was found to be more in the MTU1001 variety (2.22 to 17.77% PDI) when compared with the variety IR-64 (2.22 to 8.88% PDI). Neck blast was found in crops sown in all the three sowing dates and the disease was observed to be more in the early sown crop of variety MTU1001 (15.55 and 17.85%) when compared to the same day sown crop of variety IR-64 (5.55 to 8.33% PDI). Sheath blight was more prevalent (maximum of 63.88 and 33.32% PDI) in the early sowing conditions in IR-64 and MTU1001 respectively. The disease was observed in all the stages of the crop, with the initial significant symptoms appearing during the 40 DAT in the variety MTU1001 and even earlier, i.e, 30 DAT in the case of variety IR-64 (Table 82f).

Table 82f: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* **– 2019 – Mandya**

Location/ Date of sowing	DAT	Percentage of Disease Severity											
		Sheath blight			Brown spot			Leaf blast			Neck Blast		
		(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)
Mandya													
MTU1001	30 DAT	0.00	0.00	0.00	0.00	0.00	3.85	0.00	0.00	2.22			
E: 08-07-2019	40 DAT	1.11	0.00	1.11	0.00	3.33	7.77	0.00	0.00	3.88			
N: 30-07-2019	50 DAT	3.33	3.33	3.33	1.11	7.77	13.33	0.00	0.00	6.66			
L: 18-09-2019	60 DAT	7.77	5.55	5.55	3.37	11.66	18.58	0.00	0.00	9.44			
	70 DAT	11.10	7.77	7.77	5.55	15.55	26.66	0.00	0.00	11.66			
	80 DAT	15.55	9.44	10.00	7.77	18.88	33.33	0.00	0.00	14.44			
	90 DAT	18.88	13.33	13.33	11.10	25.55	40.00	0.00	0.00	17.77			
	100 DAT	24.44	17.77	15.55	14.44	29.44	49.10	0.00	0.00	17.77	15.55	17.77	0.00
	110 DAT	33.32	24.44	17.77	17.77	35.55	58.33	0.00	0.00	-	17.85	31.10	8.88
IR-64	30 DAT	4.44	3.33	0.00	0.00	0.00	0.00	0.00	0.00	2.22			
E: 08-07-2019	40 DAT	8.89	6.66	2.22	0.00	0.00	0.00	0.00	0.00	3.33			
N: 30-07-2019	50 DAT	13.33	12.22	5.55	0.00	3.33	0.00	0.00	0.00	4.44			
L: 18-09-2019	60 DAT	22.22	17.78	7.77	0.00	6.66	3.33	0.00	0.00	6.66			
	70 DAT	31.11	25.55	10.00	1.11	11.11	5.55	0.00	0.00	6.66			
	80 DAT	38.89	31.11	12.22	3.33	15.55	10.00	0.00	0.00	7.77			
	90 DAT	46.67	35.00	14.44	5.55	18.89	13.33	0.00	0.00	8.88			
	100 DAT	55.00	38.33	16.66	7.77	26.66	16.66	0.00	0.00	8.88	5.55	9.44	0.00
	110 DAT	63.88	44.44	22.22	12.22	29.44	19.44				8.33	12.22	5.55

Maruteru: The Maruteru centre has tested two varieties viz., BPT5204 and Swarna with three different sowing dates i.e, 18.06.19 (early), 05.07.19 (normal) and 19.07.19 (late), for the variations in the incidence and severity of the three major diseases of the region viz., sheath blight, BLB and neck blast. In general the crop sown in the late season was relatively disease free during the late period of the crop for all the three diseases, except for BLB in case of BPT 5204 (42.78% PDI during 80DAT) and sheath blight in case of variety Swarna (53.83% in 60DAT and 46.91% PDI in 80DAT). Among the two varieties tested, the variety BPT5204 was found to be more susceptible to sheath blight in the normal sown conditions (78.60% PDI on 70DAT) when compared with the variety Swarna (72.97% PDI on 80DAT). Under the late sown conditions, both the varieties showed peak infection during 50-60 DAT (19.16% in BPT 5204 and 53.83% in Swarna). There was no fixed pattern of the disease development in the early and normal sowing conditions. However, the late sown crop (after 90DAT) was disease free in both the varieties later period of the crop.

In case of BLB disease, the both the varieties, BPT 5204 and Swarna, sown during normal sowing season were having highest incidence from 110 DAT (81.38 and 69.98% PDI). The variety BPT5204 showed more incidence of disease during the early (40.62% PDI) and late sown (42.78%) when compared to the variety Swarna (7.4% PDI). In case of neck blast the disease was more on both the varieties viz., Swarna (51.63% PDI) and BPT 5204 (45.05% PDI) sown during normal sowing time when compared to early sowing. Both the varieties that were sown late, totally free from neck blast during the cropping period (Table 82g).

Table 82g: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 – Maruteru

Location/ Date of sowing	DAT	Percentage of Disease Index								
		Sheath blight			BLB			Neck Blast		
		(E)	(N)	(L)	(E)	(N)	(L)	(E)	(N)	(L)
Maruteru	30 DAT			0.00						
BPT 5204	40 DAT		0.00	13.47			0.00			
E: 18-06-2019	50 DAT	0.00	0.00	19.16			0.00			
N: 05-07-2019	60 DAT	9.06	24.19	15.97			0.00			0.00
L: 19-07-2019	70 DAT	27.50	78.60	1.91		0.00	31.85			
	80 DAT	-	46.13	1.44		0.00	42.78			0.00
	90 DAT	49.94	45.57		12.96	51.55			45.05	
	100 DAT	45.31	9.68		12.00	76.66				
	110 DAT	47.93	12.26		40.62	81.38		39.82	42.17	
Swarna	30 DAT			0.00						
E: 18-06-2019	40 DAT		0.00	30.69			0.00			
N: 05-07-2019	50 DAT	0.00	36.37	27.74			0.00			
L: 19-07-2019	60 DAT	44.67	46.43	53.83			0.00			0.00
	70 DAT	53.28	53.68	38.83		0.00	0.00			
	80 DAT	-	72.97	46.91		0.00	0.00			0.00
	90 DAT	65.99	50.17		0.00	31.67			38.76	
	100 DAT	59.89	52.54		0.00	68.44				
	110 DAT	55.76	38.52		7.40	69.98		41.71	51.63	

Moncompu: Four varieties viz., Pournami, Shreyas, Prathyasa and Uma were sown on different dates i.e, 07.06.19 (early), 25.06.19 (normal) and 26.08.19 (late) for the studies on the effect of the different periods of sowing on sheath blight and BLB intensity on rice. The results indicated that both sheath blight and BLB were prevalent in all the varieties tested, in all the stages of the crop and in all the three sowing periods. However, the intensity of the disease differed in different varieties sown during different periods. In the case of sheath blight disease, the variety Uma was more susceptible (maximum of 75.55% PDI) than the other varieties viz., Shreyas (37.78%), Prathyasa (33.33%) and Pournami (23.05%). In the case of the differences between the sowing periods, the variety Uma had highest infection (75.55 % PDI) only in the late sown crop when compared to very less severity in the normal (9.44% PDI) and early sown (16.66% PDI) crops. Further the disease reached a sudden peak in the late maturity stages i.e, 3.01% PDI at 50 DAT jumping to 75.55% PDI at 110 DAT, in the late sown crops. This was not the trend in the case of early sown (4.9% PDI at 50DAT to a maximum of 16.66% PDI at 110 DAT) and normal sown crops (3.67% PDI at 50 DAT to a maximum of 9.44% PDI at 110 DAT. This differing trend needs to be analyzed and correlated with the other biotic and abiotic factors. This sort of abnormal trend was not observed in the other three varieties, where the disease was progressing in a gradual manner. Further the higher incidence of disease in the case of early sown crop in all the three varieties differing from the variety Uma needs to be analyzed in relation to the prevalent predisposing factors favoring the disease.

In the case of BLB, the trend with the variety Uma, where in the disease peaked suddenly during the late stage of the crop (48.33% PDI at 110 DAT) when compared with the minimum of 2.38% PDI on 50 DAT. In contrast the disease increased in its severity gradually in the early (1.22 to 8.05% PDI) and normal (2.48 to 18.88% PDI) sown crops. In the case of other varieties too the severity of the disease was highest in the in the late sown crop and the increase in the disease was steep in case of all the sowing periods when approaching the maturity stage. This trend needs to be analyzed in relation to other factors (Table 82h).

Table 82h: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 – Moncompu

Location/ Date of sowing		Percentage of Disease Index					
		Sheath blight			BLB		
	DAT	(E)	(N)	(L)	(E)	(N)	(L)
Pournami	30 DAT	0.00	0.00	0.00	0.00	2.20	0.00
MTU1001	40 DAT	0.00	0.00	0.00	0.00	1.68	0.00
E: 07-06-2019	50 DAT	4.76	2.50	2.69	1.89	4.31	2.15
N:25-06-2019	60 DAT	13.33	3.50	4.72	2.22	3.19	3.85
L: 26-08-2019	70 DAT	15.00	8.11	4.13	1.83	1.54	4.00
	80 DAT	15.55	3.89	2.73	5.92	2.70	4.90
	90 DAT	18.55	7.89	1.77	6.59	3.57	6.56
	100 DAT	17.55	14.16	0.00	11.74	13.05	8.89
	110 DAT	23.05	2.78	10.00	16.11	2.78	26.94
Shreyas	30 DAT	0.00	0.00	0.00	0.00	3.00	0.00
E: 07-06-2019	40 DAT	0.00	0.00	0.00	0.00	5.20	0.00
N:25-06-2019	50 DAT	3.31	6.67	6.56	4.47	3.36	2.21
L: 26-08-2019	60 DAT	17.44	3.72	1.16	3.11	2.90	4.25
	70 DAT	14.44	7.61	3.70	2.82	2.97	3.58
	80 DAT	13.33	4.98	2.11	7.87	2.83	5.13
	90 DAT	19.27	11.39	3.22	6.41	2.14	4.60
	100 DAT	19.67	10.83	0.28	11.83	16.90	9.72
	110 DAT	30.55	6.11	37.78	15.00	5.55	38.61
Prathyasa	30 DAT	0.00	0.00	0.00	0.00	3.64	0.00
E: 07-06-2019	40 DAT	0.00	0.00	0.00	0.00	3.05	0.00
N:25-06-2019	50 DAT	4.43	4.61	4.15	6.06	3.36	1.80
L: 26-08-2019	60 DAT	13.86	5.16	5.55	1.68	1.74	3.60
	70 DAT	15.55	4.83	5.11	2.06	3.74	4.44
	80 DAT	12.61	2.22	3.86	6.26	3.45	6.07
	90 DAT	14.44	9.19	2.78	8.45	4.00	5.78
	100 DAT	22.89	11.94	1.39	11.23	14.72	18.33
	110 DAT	31.11	16.94	33.33	15.27	18.89	31.22
Uma	30 DAT	0.00	0.00	0.00	0.00	4.62	0.00
E: 07-06-2019	40 DAT	0.00	0.00	0.00	0.00	2.48	0.00
N:25-06-2019	50 DAT	4.90	3.67	3.01	3.32	5.25	2.38
L: 26-08-2019	60 DAT	10.78	4.24	5.74	1.22	7.03	5.11
	70 DAT	13.05	5.27	4.06	1.25	7.35	5.45
	80 DAT	12.78	4.11	4.23	6.71	3.90	4.79
	90 DAT	12.95	4.44	1.49	6.73	7.20	6.53
	100 DAT	13.41	9.44	1.11	7.29	18.88	9.72
	110 DAT	16.66	9.44	75.55	8.05	14.44	48.33

Nawagam: Two varieties viz., Gurjari and P-203 were used as test varieties for the purpose of estimating the effects of sowing period viz., early (15.06.19), normal (01.07.19) and late (15.07.19) for the occurrence of sheath rot disease in Nawagam. In the case of variety Gurjari, it was observed that the incidence of the disease was relatively more in the late stages of the crop (80 to 100 DAT) in all the three different sowing periods i.e., early (20.56 to 36.11% PDI), normal (25 to 38.89% PDI) and late (35 to 42.23% PDI). However, the symptoms start to appear during the late tillering stage (60 DAT), except in case of the late sown crop where the disease was found to initiate even earlier (40DAT) and progresses gradually. Among the three sowing periods the incidence of sheath rot was found to be maximum in the late sown crop. The trend was similar in case variety P-203, with the initial symptoms starting to appear during about 70 DAT and progressing gradually. Further, the percentage disease index was relatively less in the case of the variety P-203 (1.11 to 28.24% PDI) when compared to the variety Gurjari (2.78 to 42.23%). Similar to the trend of early appearance in the late sown crop in the variety Gurjari, the disease appears early (40DAT) in this variety also and progresses gradually (Table 82i).

Table 82i: Occurrence of different rice diseases in disease observation nursery at different test locations, *Kharif* – 2019 – Nawagam

Location/ Date of sowing	Percent Disease Index			
	Nawagam			
	Sheath rot			
	DAT	(E)	(N)	(L)
Gurjari	30 DAT	0.00	0.00	0.00
E: 15-06-19	40 DAT	0.00	0.00	2.78
N: 01-07-19	50 DAT	0.00	2.78	13.89
L: 15-07-19	60 DAT	3.89	10.00	21.67
	70 DAT	15.00	19.45	28.89
	80 DAT	20.56	25.00	35.00
	90 DAT	31.67	33.33	40.56
	100 DAT	36.11	38.89	42.23
P-203	30 DAT	0.00	0.00	0.00
E: 15-06-19	40 DAT	0.00	0.00	1.11
N: 01-07-19	50 DAT	0.00	0.00	8.33
L: 15-07-19	60 DAT	0.00	2.78	14.44
	70 DAT	1.11	5.00	17.23
	80 DAT	6.67	10.00	19.45
	90 DAT	11.67	15.56	23.89
	100 DAT	15.56	22.23	28.34

Influence of weather parameters and date of sowing on sheath blight and neck blast disease intensity at various locations

To study the impact of weather parameters (temperature, relative humidity and rainfall) in the progress of the disease, the area under disease progress curve was measured and analysed. Accordingly, at the Mandya centre on leaf blast, sheath blight and brown spot diseases were analysed with the data obtained for two varieties *viz*., IR64 and MTU1001. The results indicated

that the leaf blast disease was more rapidly progressing in MTU1001 (738) when compared to IR64 (433). The progress was nil during the early and normal sowing conditions, and more in the late sown crop. However, sheath blight disease and the brown spot disease was observed to progress during all the three different sowing dates. The progress of brown spot disease was found to be more rapid in the variety MTU1001 (2199 maximum in late sown conditions) when compared to the variety IR64 (969 maximum under normal sown conditions), while it was reverse in the case of sheath blight disease, the variety IR64 had the maximum AUDPC of 2503 under early sown conditions when compared to 988 in MTU1001 under same condition. It was also observed that the sheath blight disease was more favoured by rainfall, maximum AUDPC (988 and 2503) in both the varieties viz., MTU1001 and IR64 respectively, was observed in the early sown crops with total rainfall 592.6mm. This may be due to the fact that rainfall would have helped the pathogen mycelia to spread more easily to the surrounding plants. In the case of brown spot disease, it appears that the excessive rainfall has washed off the leaf dwelling fungus and hence the occurrence of the disease has significantly reduced as the rainfall increased (Table 83a).

Table 83a: Disease Progression with respect to weather factors at Mandya

	AUDPC						Temperature		Relative Humidity		Rain fall (mm)
	Leaf Blast		Sheath blight		Brown spot						
	MTU 1001	IR 64	MTU 1001	IR 64	MTU 1001	IR 64	Maxi.	Mini.	Mor.	Eve	
Early	0	0	988	2503	522	239	30.6	18.6	90.5	79.9	592.6
Normal	0	0	694	1905	1300	969	30.8	18.6	91.0	77.1	479.7
Late	738	433	655	800	2199	586	29.8	18.0	91.0	76.2	238.1

Similar was the trend in the case of sheath rot disease in Nawagam centre. The AUDPC decreased as the rainfall increased even though the RH and temperature were almost similar in all the growing seasons. The maximum AUDPC was observed in the case of variety Gurjari (1639) in the late sown crop when the rainfall was the lowest (290.3mm) when compared to the lowest AUDPC (892) in the early sown crop and where the rainfall was highest (807.20mm). Similar was the trend with the other variety P203, though the AUDPC was significantly less (maximum 986 and minimum 272) when compared to the variety Gurjari (Table 83b).

Table 83b: Disease Progression with respect to weather factors at Nawagam

	AUDPC – Sheath rot		Temperature		Relative Humidity		Rain fall (mm)
	Gurjari	P 203	Maximum	Minimum	Morning	Evening	
Early	892	272	32.30	24.48	85.57	71.08	807.20
Normal	1100	445	32.13	23.91	85.32	69.97	449.20
Late	1639	986	32.36	22.89	83.14	65.67	290.30

The AUDPC of BLB was observed to differ among the four varieties tested at Moncompu centre. The AUDPC was highest (616) in the lowest rainfall season (normal sown with lowest rainfall (616.50mm) in the variety Uma, while it was reverse in the case of the other three varieties tested viz., Pournami, Shreyas and Prathyasa, where the AUPDC was sound to be directly proportional to the intensity of the rainfall. However, all the four varieties showed a similar trend of increase in the AUDPC with the total rainfall. Among the different varieties, Uma had the highest AUDPC for BLB (616) and Shreyas for Sheath blight (1027) (Table 83c).

Table 83c: Disease Progression with respect to weather factors at Moncompu

	AUDPC								Temperature		Relative Humidity		Rain fall (mm)
	BLB				Sheath blight				Maxi.	Mini.	Morning	Evening	
Variety	V1	V2	V3	V4	V1	V2	V3	V4					
Early	382	440	434	305	963	1027	993	762	31.26	23.50	89.11	86.50	1473.90
Normal	325	406	453	616	414	483	464	359	33.00	22.75	88.75	84.50	614.50
Late	438	488	556	581	210	359	395	574	33.95	22.29	87.32	80.19	1063.80

(V1- Pournami; V2 – Shreyas; V3 – Prathyasa; V4 – Uma)

The AUDPC was in general very less in Gangavati for all the four diseases tested viz., blast (170), brownspot (360), false smut (318) and BLB (248), where even the rainfall was much below the centres (418.40 to 174.80mm). While the diseases blast (170), brown spot (360) and false smut (318) showed a clear trend of maximum AUDPC in maximum rainfall conditions, the BLB disease did not follow a standard pattern (Table 83d).

Table 83d: Disease Progression with respect to weather factors at Gangavati

	AUDPC				Temperature		Relative Humidity		Rain fall (mm)
	Blast	Brown spot	False smut	BLB	Maxi.	Mini.	Morning	Evening	
Early	170	360	318	148	30.10	21.45	83.36	53.37	418.40
Normal	135	325	263	248	29.89	20.49	86.64	51.90	375.20
Late	110	293	135	203	29.82	19.78	87.06	48.05	174.80

IV. DISEASE MANANGMENT TRIALS

1. EVALUATION OF FUNGICIDES AGAINST LOCATION SPECIFIC DISEASES

The trial was formulated and conducted with an objective to evaluate new fungicidal molecules *viz.*, Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) and Prochloraz 45% EC (2.0 ml/l) against different disease of rice caused by fungi. Test molecules were compared with other standard fungicides *viz.*, tricyclazole 75% WP (0.6 g/l), azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC (1 ml/l), difenoconazole 25 EC (1.0 ml/l), hexaconazole 5% EC (2.0 ml/l) and propiconazole 25% EC (1.0 ml/l). All the check fungicides are recommended to manage the various rice diseases in India. Trail was conducted in endemic areas in all the agro-climatic zones. These molecules comprises of different formulations such as suspension concentrates (SC), suspo-emulsion (SE) and emulsifyable concentrates (EC). The trail was conducted during *Kharif*-2019 by using Randomised Block Design (RBD) as a statistical method with three or four replications in each centre.

The trial was proposed at 38 centres and conducted the experiment at 35 centres *viz.,* Aduthurai, Arundhatinagar, Bankura, Chatha, Chinsurah, Chiplima, Coimbatore, ICAR-IIRR, Cuttack (ICAR-NRRI), Faizabad (Masodha), Gangavati, Gerua, Ghaghraghat, Hazaribagh, Jagdalpur, Kaul, Lonavala, Ludhiana, Malan, Mandya, Maruteru, Moncompu, Navsari, Nawagam, Pantnagar, Pattambi, Ponnampet, Pusa, Raipur, Rajendranagar, Ranchi, Rewa, Sabour, Titabar and Varanasi across the rice growing regions in India. The experiment was conducted with locally popular disease susceptible rice varieties among the farmers. In general, sowings were taken up during June and July across the locations except in Aduthurai where sowing was done in the month of September. At Ludhiana sowing was done at early in the month of May. The details related to test variety used, date of sowing, date of transplanting, method of screening, date of initial symptoms observed, number of spray, spraying dates, disease observation and date of harvesting are mentioned in the Table 84. In general fungicides were sprayed immediately after noticing the initial symptoms at all the locations. Each fungicidal product were applied at the rate of two sprays with an intravel of 10-15 days in all the test centres except Aduthurai, Ghaghraghat, Jagdalpur and Titabar where various number of sprays were given. The fungicides were evaluated against leaf blast (10 locations), neck blast (eight locations), sheath blight (15 locations), sheath rot (five locations), brown spot (six locations) false smut (two locations) and grain discoloration (two locations).

Leaf blast: The fungicides were evaluated against leaf blast disease at ten locations across the rice growing region of the country. In all the centres uniformly two sprays of fungicides were applied except Ghagaraghat and Jagadalpur where three and four sprays were given, respectively. Disease severity was recorded at all the test locations. Besides, disease incidence was also observed at three locations *viz.,* Hazaribagh, Lonavala and Nawagam. The test fungicidal products were evaluated against the disease under natural incidence at six location except Coimbatore, IIRR, Nawagam and Rewa where through artificial inoculation.

Disease severity at test locations in check plots varied from 25.6% (Rewa) to 67.3% (Ghagaraghat). Severity on check plot was very high (>50%) at Ghagaraghat (67.3), Ponnampet (60.9%), Hazaribagh (53.9%), IIRR (52.1%) and; high (>30-50%) at Jagdalpur (45.0%), Lonavala (43.4%), Nawagam (38.6%), Coimbatore (36.3%) and Ranchi (35.9%) and moderate (20-29%) at Rewa (25.6%). Disease incidence at test locations in check plots varied from 62.1% (Rewa) to 86.1% (Nawagam).

All seven fungicidal treatments significantly reduced the disease severity and incidence at all test locations when compared to control. Test product *viz.,* Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) was significantly reduced the leaf blast severity at three locations *viz.*, Coimbatore, Lonavala and Rewa and incidence at one location (Nawagam). Besides, the same fungicide minimised the disease severity at two locations *viz.,* Coimbatore and Nawagam and disease incidence at two locations (Hazaribagh and Lonavala). The other combi-product azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) was found significantly reducing the disease severity at five locations *viz.,* Hazaribagh, ICAR-IIRR, Jagadalpur, Nawagam and Ponnempet and disease incidence at two locations (Hazaribagh and Lonavala). However, test product prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) showed low mean disease severity (18.0%) and disease incidence (32.3%) compared to other treatments from ten the test centres. Treatment (T4) azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) showed mean disease severity and incidence of 18.3% and 31.7% on par with new test molecule (Fig. 5 and Table 85).

In addition to these two products, other test product Prochloraz 45% EC (2.0 ml/l) (T2) and tricyclazole 75% WP (0.6g/l) (T3) also reduced the disease severity and incidence on par with the better products (T1 and T4) in different test locations. The grain yield data was recorded at all ten test locations and observed that all treated plots was superior to check plot (2945 Kg/ha). Treatment (T4) azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) was superior reducing leaf blast and increasing the mean yield (4011 Kg/ha). This is followed by prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) compared to the other treatments. These two treatments (T4 and T1) showed correlation between disease reduction and yield increase (Table 86).
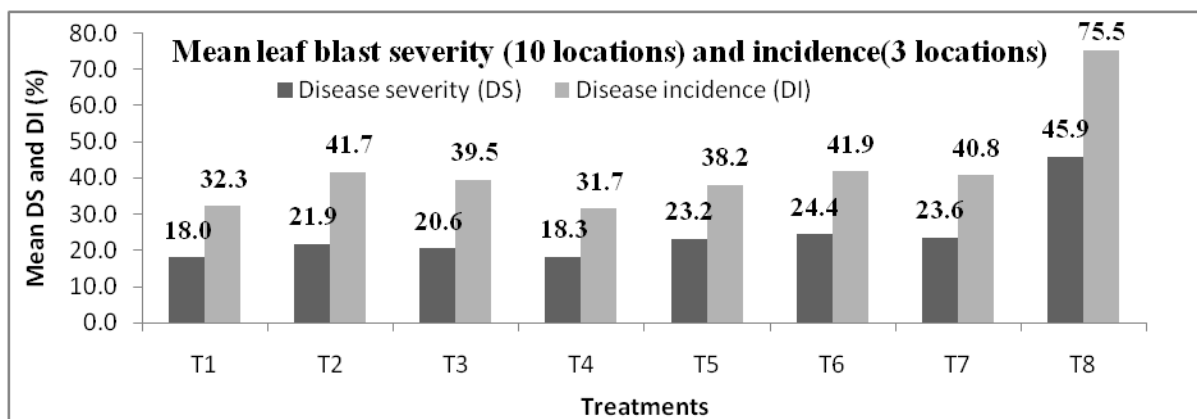
Figure 5: Effect of fungicides against leaf blast of rice, *Kharif*-2019

Table 1: Experimental details of fungicidal evaluation against location specific diseases of rice during, *Kharif*-2019

S. No	Location	Disease Recorded	Test Variety	Screening	Sowing/ Transplanting	Inoculation	Initial symptom	No of Spray	Spraying	Observation	Harvesting
										Date of activities	
1	Aduthurai	Brown spot; Sheath rot	BPT-5204	Natural	12.09.2019/ 14.10.2019	-	-	1	06.12.2019	-	23.01.2020
2	Arundhutinagar	Sheath blight	-	-	-	-	-	-	-	-	-
3	Bankura	Sheath blight	Swarna (MTU7029)	Artificial	25.06.2019/ 30.07.2019	16.09.2019	20.09.2019	2	27.09.2019 16.10.2019	20&27.09.2019 16&31.10.2019	19.11.2019
4	Chatha	Brown spot	Basmati-370	Natural	21.06.2019/ 29.07.2019	-	25.09.2019	2	27.09.2019 11.10.2019	-	10.12.2019
5	Coimbatore	Leaf blast	CO39	Artificial	05.10.2019/ 06.11.2019	28.11.2019; 01.12.2019	-	2	14.12.2019 20.12.2019	6.01.2020	21.01.2020
6	Chinsurah	Sheath blight	Swarna (MTU 7029)	Artificial	27.06.2019/ 30.07.2019	06.09.2019	15.09.2019	2	18.09.2019 26.09.2019	-	04.12.2019
		Sheath rot	Swarna (MTU 7029)	Artificial	26.07.2019/ 27.08.2019	24.10.2019	05.11.2019	2	08.11.2019 15.11.2019	-	02.12.2019
7	Chiplima	Sheath blight	-	Artificial	28.06.2019/ 25.07.2019	30.08.2019	12.09.2019	2	18.09.2019 03.10.2019	30.09.2019 17.10.2019	26.11.2019
8	Cuttack (ICAR-NRRI)	False smut	Moudamani	Natural	20.07.2019/ 12.08.2019	-	20.11.2019	-	01.11.2019 11.11.2019	28.11.2019	03.12.2019
		Sheath blight	Tapaswini	Artificial	29.07.2019/ 02.09.2019	01.10.2019	09.10.2019	2	19.10.2019 28.10.2019	02.11.2019 11.11.2019	20.12.2019
9	ICAR-IIRR	Leaf blast	HR-12	Artificial	13.06.2019/ 20.07.2019	15.08.2019; 20.08.2019	02.09.2019	2	02.09.2019 10.09.2019	27.09.2019 07.10.2019	26.10.2019
		Sheath blight	BPT-5204	Artificial	20.06.2019/ 24.07.2019	19.09.2019	21.09.2019	2	21.09.2019 01.10.2019	11.10.2019 25.10.2019	26.11.2019
10	Faizabad (Masodha)	Sheath blight	Pusa Basmati-1	Artificial	16.07.2019/ 14.08.2019	-	03.10.2019	2	12.10.2019 26.10.2019	24.10.2019 12.11.2019	01.12.2019
11	Gangavati	Sheath blight	GNV-10-89	Artificial	08.08.2019/ 07.09.2019	16.10.2019	20.10.2019	2	21.10.2019 06.11.2019	20.10.2019 05&21.11.2019	-
12	Gerua	Sheath blight	-	Artificial	09.08.2019/ 30.08.2019	04.10.2019	14.10.2019	2	22.10.2019 06.11.2019	-	04.12.2019
13	Ghagaraghat	Leaf blast; Neck blast	Jalpriya	-	26/6/2019/ 31/7/2019	-	-	3	28.09.2019 29.10.2019 06.11.2019	25.08.2019	27.12.2019
14	Hazaribagh	Leaf blast	Co-39	Artificial	08.7.2019/ 26.07.2019	06.09.2019	10.09.2019	2	14.09.2019 30.09.2019	16.09.2019 01.10.2019	25.10.2019
15	Jagadalpur	Leaf blast; Neck blast	Swarna	Natural	20.06.2019/ 27.07.2019	-	-	4	15&30.09.2019 15&30.10.2019	13&27.09.2019 13.10.2019	25.12.2019
16	Kaul	Neck blast	Basmati CSR 30	Natural	01.07.2019/ 26.07.2019	-	22.09.2019	2	01.20.2019 15.10.2019	LB:28.10.2019 NB:8.12.2019	10.11.2019
17	Lonavala	Leaf Blast	EK-70	Natural	-	-	-	-	-	-	23.10.2019
		Neck blast	EK-70	Natural	-	-	-	-	-	20.10.2019	23.10.2019
18	Ludhiana	Sheath blight	PR114	Artificial	27.05.2019/	09.06.2019	-	2	09.09.2019	10.05.2019	20.10.2019

S. No	Location	Disease Recorded	Test Variety	Screening	Date of activities						
					Sowing/ Transplanting	Inoculation	Initial symptom	No of Spray	Spraying	Observation	Harvesting
					27.06.2019				20.09.2019		
19	Malan	Neck blast	HPU 2216	Natural	18.06.2019/ 23.07.2019	-	-	2	09.09.2019 24.09.2019	21.10.2019	22.11.2019
20	Mandya	Sheath blight	MTU 1001	Artificial	14.08.2019/ 16.09.2019	30.10.2019	07.11.2019	2	09.11.2019 24.11.2019	-	31.12.2019
		Neck blast	MTU 1001	Natural	14.08.2019/ 16.09.2019	-	-	1	24.11.2019	31.12.2019	31.12.2019
21	Maruteru	Sheath blight	Swarna (MTU 7029)	Artificial	10.07.2019/ 07.08.2019	06.09.2019	13.09.2019	2	19.09.2019 03.10.2019	18&27.09.2019 07.11.2019	05.12.2019
		Neck blast	Swarna (MTU 7029)	Natural	-	-	-	-		30.11.2019	05.12.2019
22	Moncompu	Sheath blight and Grain discolouration	Uma (MO16)	Natural	06.06.2019/ 26.06.2019	-	20.08.2019	2	23.08.2019 09.07.2019	Shb:24.10.2019 GD:11.04.2019	11.06.2019
23	Navasari	Sheath rot	Jaya	Natural	24.06.2019/ 23.07.2019	-	08.09.2019	2	26.09.2019 07.10.2019	03.10.2019 15.10.2019	18.11.2019
24	Nawagam	Leaf blast; Sheath rot	Gurjari	Artificial	20.07.2019/ 28.08.2019	-	-	2	09.10.2019 24.09.2019	09.10.2019 24.09.2019 08.11.2019	02.12.2019
25	Pantnagar	Sheath blight	Pant Dhan-4	Artificial	17.06.2019 12.07.2019	12.09.2019	17.09.2019	2	20.09.2019 06.10.2019	25.09.2019	14.11.2019
26	Pattambi	Brown spot	Uma	Natural	22.07.2019/ 20.08.2019	-	08.11.2019	2	10.11.2019 18.11.2019	08.11.2019 .04.12.2019	11.12.2019
27	Ponnampet	Leaf blast	Intan	Natural	16.07.2019/ 20.08.2019	-	14.08.2019	2	23.09.2019 06.12.2019	21.10.2019	08.11.2019
		Neck blast	Intan	Natural		-	26.11.2019	2		02.01.2019	08.11.2019
28	Pusa	Brown spot	Pankaj (HS)	Natural	15.06.2019/ 10.07.2019	-	28.08.2019	2	06.08.2019 17.08.2019	-	-
29	Raipur	Sheath blight	Swarna	Artificial	02.07.209/ 31.08.2019	06.10.2019	10.10.2019	2	10.10.2019 17.10.2019	27.10.2019	23.11.2019
30	Rajendranagar	Neck blast; shrt; GD	Tellahamsa	Artificial	05.07.2019/ 04.08.2019	27.09.2019	09.10.2019	2	10.10.2019 01.11.2019	30.10.2019 GD:19.11.2019	25.11.2019
31	Ranchi	Leaf blast; Neck blast	-	Natural	-	-	-	-	-	-	-
32	Rewa	Leaf blast	PS4	Artificial	05.07.2019/ 07.08.2019	25.08.2019	05.09.2019	2	16.09.2019 26.09.2019	30.09.2019 15.10.2019	25.11.2019
33	Sabour	Brown spot	Rajendra Mahsuri-1	Natural	26.06.2019/ 24.07.2019	-	22.10.2019	2	26.10.2019 10.11.2019	30.10.2019 15.11.2019	05.12.2019
34	Titabar	Sheath rot	Gitesh	Artificial	21.07.2019/ 21.08.2019	10.10.2019	20.10.2019	3	20&30.10.2019 10.11.2019	20/10/2019	12-12-2019
35	Varanasi	False smut	RP Bio 226	Natural	28.06.2019/ 27.07.2019	-	10.10.2019	2	28.10.2019 11.11.2019	20.11.2019	22.11.2019

Table 85: Evaluation of fungicides against leaf blast disease severity and incidence of rice, *Kharif*- 2019

Treatment	Dose/L	Leaf blast severity (%)											Leaf blast incidence (%)			
		CBT	GGT	HZB	IIRR	JDP	LNV	NWG	PNP	RCI	REW	Mean	HZB	LNV	NWG	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	9.0 (17.4)	19.1 (25.9)	19.9 (26.5)	24.1 (31.3)	27.2 (31.4)	21.5 27.6)	15.9 (23.5)	19.5 (26.1)	11.5 (19.7)	12.4 (3.7)	**18.0**	16.0 (23.6)	19.2 (37.9)	61.6 (51.7)	**32.3**
T2- Prochloraz 45% EC	2 ml	11.5 (19.8)	22.1 (28.0)	32.2 (34.6)	31.6 (36.0)	26.1 (30.7)	24.3 29.5)	19.2 (26.0)	25.7 (30.4)	9.1 (17.4)	16.7 (4.0)	**21.9**	30.0 (33.2)	28.4 (40.1)	66.8 (54.8)	**41.7**
T3- Tricyclazole 75% WP	0.6 g	9.5 (17.9)	9.5 (17.9)	22.8 (28.5)	23.1 (30.3)	27.8 (31.8)	36.1 36.9)	25.1 (30.0)	23.8 (29.2)	13.8 (21.6)	14.2 (4.1)	**20.6**	20.7 (27.1)	22.8 (54.7)	75.0 (60.0)	**39.5**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	11.3 (19.6)	16.4 (23.8)	18.5 (25.4)	22.6 (25.5)	26.1 (30.7)	26.0 30.6)	14.5 (22.4)	17.7 (24.8)	15.3 (23.0)	14.5 -	**18.3**	14.2 (22.1)	18.2 (42.8)	62.7 (52.4)	**31.7**
T5- Difenoconazole 25 EC	1ml	13.3 (21.3)	15.0 (22.8)	25.7 (30.4)	26.3 (32.1)	32.2 (34.6)	32.1 34.5)	19.9 (26.5)	27.2 (31.3)	23.0 (28.6)	17.2 (3.9)	**23.2**	21.3 (27.5)	24.0 (49.5)	69.2 (56.3)	**38.2**
T6- Hexaconazole 5% EC	2 ml	18.5 (25.4)	13.7 (21.7)	24.5 (29.6)	25.3 (34.3)	27.8 (31.8)	33.7 35.5)	28.7 (32.4)	31.8 (34.2)	26.1 (30.6)	13.8 (3.9)	**24.4**	21.2 (27.4)	24.3 (51.7)	80.2 (63.8)	**41.9**
T7- Propiconazole 25% EC	1 ml	16.5 (23.9)	12.5 (20.7)	26.0 (30.6)	25.7 (33.8)	30.6 (33.5)	29.4 32.8)	22.3 (28.1)	29.7 (32.9)	17.9 (25.0)	25.6 (4.2)	**23.6**	22.4 (28.3)	24.8 (45.8)	75.2 (60.1)	**40.8**
T8- Control	-	36.3 (37.0)	67.3 (55.1)	53.9 (47.2)	52.1 (64.1)	45.0 (42.1)	43.4 41.2)	38.6 (38.4)	60.9 (51.3)	35.9 (36.8)	25.6 (4.0)	**45.9**	78.2 (62.2)	62.1 (61.6)	86.1 (68.2)	**75.5**
General Mean		**15.7**	**21.9**	**27.9**	**28.8**	**30.3**	**30.8**	**23.0**	**29.5**	**19.1**	**17.5**	**-**	**28.0**	**28.0**	**72.1**	**-**
LSD @ 5% (P= 0.05)		2.1	0.8	1.1	0.9	1.8	1.6	1.8	2.9	6.2	N/A	-	1.8	3.3	4.2	-
SE(m)		0.7	0.3	0.4	0.3	0.6	0.6	0.6	1.0	2.0	0.1	-	0.6	1.1	1.4	-
SE(d)		1.0	0.4	0.5	0.4	0.9	0.8	0.9	1.4	2.9	0.2	-	0.9	1.6	2.0	-
CV (%)		6.2	1.9	2.4	1.4	3.7	3.3	4.3	6.1	13.9	6.0	-	3.9	4.6	4.9	-
Transformation		AS	AS	AS	AS	AS	AS	AS	AS	AS	AS	-	AS	NT	AS	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; NT- No transformation)

Table 86: Effect of fungicides on grain yield with respect to leaf blast, *Kharif*-2019

Treatment	Dose/ L	Grain yield against leaf blast (Kg/Ha)										
		CBT	GGT	HZB	IIRR	JDP	LNV	NWG	PNP	RCI	REW	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	4248	1350	3451	4127	4988	2912	6545	3596	4011	4166	**3939**
T2- Prochloraz 45% EC	2 ml	4167	1104	2525	4273	5100	2629	6361	3307	4200	4036	**3770**
T3- Tricyclazole 75% WP	0.6 g	4238	2113	3243	4310	4758	2287	5999	3550	3933	4070	**3850**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	4198	1688	3657	4677	4820	2596	6789	3817	3733	4138	**4011**
T5- Difenoconazole 25 EC	1ml	4155	1825	3001	4430	4405	2482	6464	3180	3411	4112	**3746**
T6- Hexaconazole 5% EC	2 ml	4007	1825	2855	4273	4685	2374	5893	2973	3500	3911	**3630**
T7- Propiconazole 25% EC	1 ml	4049	1975	3011	4467	4510	2524	6198	3094	3678	4093	**3760**
T8- Control	-	3274	938	1979	3983	3783	1765	4524	2422	3233	3552	**2945**
General Mean		**4042**	**1602**	**2965**	**4318**	**4631**	**2446**	**6096**	**3242**	**3712**	**4010**	**-**
LSD @ 5% *(P= 0.05)*		178	112	99	214	339	19	925	344	487	89	-
SE(m)		60	38	33	70	115	6	312	116	159	29	-
SE(d)		85	53	47	99	162	9	442	164	225	41	-
CV (%)		3.0	4.7	2.3	2.8	4.9	0.5	10.2	7.2	7.4	1.3	-

Neck blast: The trail was conducted at ten locations to know the efficacy of the test product against neck blast disease. Disease incidence was recorded at six centres and disease severity was noted at four centres *viz.,* Ghagaraghat, Kaul, Mandya and Rajendranagar. Grain yield data was recorded at all the locations except Kaul. Two sprays of fungicidal treatments were given at all the centres. The test fungicidal products were evaluated against neck blast under natural condition at all the centres. Disease incidence in control plot was very high (>50%) at Lonavala (79.8%), Malan (61.9%) Jagdalpur (55.6%), Ponnampet (53.8%) and Marateru (52.2%); and low (>20%) at Ranchi (19.0%). The severity on check plots was about 72.3% and 42.9% at Mandya and Kaul, respectively.

The performance of all the six fungicidal treatments was superior in reducing the neck blast incidence and severity at all the test locations compare to control (Mean DI: 53.7% and Mean DS: 55.3%). This trial showed statistically no significant difference among the treatments at Maruteru. Formulation prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) (T1) significantly reduced the incidence of the neck blast at two locations (Lonavala and Malan,) and on par with the best treatment at Jagdalpur (T2), Marateru (T3) and Ponnampet (T4). In addition to this, low mean disease incidence (24.6%) was observed from the plots where prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) applied followed by azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) (Fig.6 and Table 87). In respect to disease severity, tricycazole 75% WP (0.6g) treatment (T3) significantly reduced the neck blast (16.0%) at all four test locations *viz.,* Ghagaraghat, Kaul, Mandya and Rajendranagar. Test product prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) spray was found second best in reducing the severity (20.5%).

The mean yield across the locations in check plot was 2631 Kg/ha. Among the eight fungicidal treatments, prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) sprayed plots gave highest mean yield (3991 Kg/ha) followed by azoxystrobin 11% + tebuconazole 18.3% w/w SC (1.5 g/l) (3936 Kg/ha) compared to other treatments (Table 88). The treatment T1 and T3 significantly increased the yield at all the test locations.
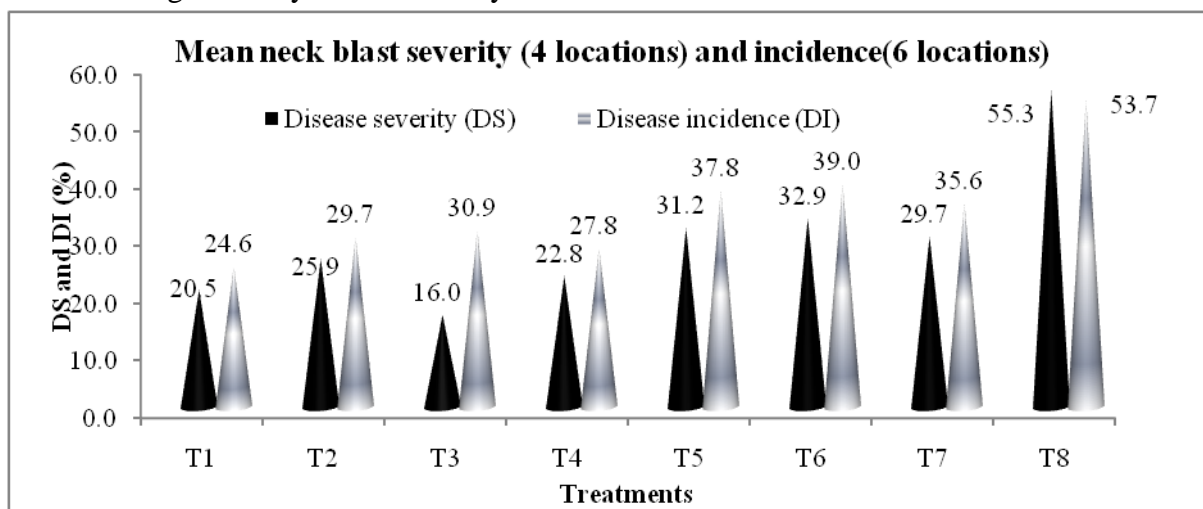
Figure 6: Effect of fungicides against neck blast of rice, *Kharif*-2019

Table 87: Evaluation of fungicides against neck blast severity and incidence of rice, *Kharif-* 2019

Treatments	Dose/L	Neck blast severity (%)					Neck blast incidence (%)						
		GGT	KUL	MND	RNR	Mean	JDP	LNV	MLN	MTU	PNP	RCI	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	14.7 (22.6)	16.1 (23.6)	9.6 (17.6)	33.6 (33.6)	**20.5**	33.9 (33.9)	34.1 (34.1)	15.2 (22.8)	41.4 (39.0)	16.0 (23.5)	7.0 (2.8)	**24.6**
T2- Prochloraz 45% EC	2 ml	15.5 (23.2)	20.9 (27.2)	16.3 (23.7)	43.6 (43.6)	**25.9**	32.9 (32.9)	41.0 (41.0)	32.4 (34.6)	46.7 (46.9)	19.7 (26.0)	5.7 (2.5)	**29.7**
T3- Tricyclazole 75% WP	0.6 g	8.2 (16.6)	11.9 (20.2)	6.7 (14.9)	29.2 (29.2)	**16.0**	35.9 (35.9)	65.3 (65.3)	18.4 (25.3)	39.8 (45.9)	17.8 (25.0)	8.0 (3.0)	**30.9**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	13.5 (21.5)	21.2 (27.3)	8.1 (16.2)	41.1 (41.1)	**22.8**	34.8 (34.8)	47.1 (47.1)	18.5 (25.4)	44.2 (38.8)	13.6 (22.0)	8.3 (3.0)	**27.8**
T5- Difenoconazole 25 EC	1ml	12.8 (20.9)	30.4 (33.4)	34.1 (35.6)	43.4 (43.4)	**31.2**	39.1 (39.1)	58.4 (58.4)	52.2 (46.2)	45.6 (44.8)	20.8 (28.1)	11.0 (3.4)	**37.8**
T6- Hexaconazole 5% EC	2 ml	11.9 (20.1)	27.8 (31.8)	46.7 (43.1)	42.5 (42.5)	**32.9**	35.6 (35.6)	62.2 (62.2)	56.3 (48.6)	43.2 (43.5)	22.0 (27.8)	14.7 (3.9)	**39.0**
T7- Propiconazole 25% EC	1 ml	10.1 (18.5)	20.3 (26.7)	37.8 (37.9)	45.5 (45.5)	**29.7**	36.8 (36.8)	51.8 (51.8)	44.1 (41.6)	44.2 (48.3)	25.2 (30.1)	11.3 (3.5)	**35.6**
T8- Control	-	60.4 (51.0)	42.9 (40.9)	72.3 (58.3)	54.2 (54.2)	**55.3**	55.6 (55.6)	79.8 (79.8)	61.9 (51.9)	52.2 (40.7)	53.8 (47.9)	19.0 (4.5)	**53.7**
General mean		**18.4**	**23.9**	**28.9**	**41.6**	**29.3**	**38.1**	**55.0**	**37.4**	**44.7**	**23.6**	**10.6**	**34.9**
LSD @ 5% *(P= 0.05)*		0.2	2.6	7.4	9.5	-	6.8	2.2	4.8	N/A	3.3	1.0	-
SE(m)		0.1	0.9	2.4	3.2	-	2.3	0.7	1.6	2.7	1.1	0.3	-
SE(d)		0.1	1.3	3.4	4.5	-	3.2	1.0	2.2	3.8	1.6	0.4	-
CV (%)		0.7	6.1	13.5	15.3	-	12.1	2.7	7.4	10.6	7.8	16.2	-
Transformation		AS	AS	AS	NT	-	NT	NT	AS	NT	AS	ST	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; ST- Square root transformation; NT- No transformation)

Table 88: Effect of fungicides on grain yield with respect to neck blast, *Kharif-* **2019**

Treatments	Dose/L	Grain yield against neck blast (Kg/Ha)									Mean
		GGT	JDP	LNV	MLN	MND	MTU	PNP	RNR	RCI	
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	1350	4988	2912	4757	4730	3700	3596	5879	4011	**3991**
T2- Prochloraz 45% EC	2 ml	1104	5100	2629	3413	3610	3574	3307	5680	4200	**3624**
T3- Tricyclazole 75% WP	0.6 g	2113	4758	2287	4248	4095	4493	3550	5951	3933	**3936**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	1688	4820	2596	3522	4285	5050	3817	5734	3733	**3916**
T5- Difenoconazole 25 EC	1ml	1825	4405	2482	2796	3216	4261	3180	6106	3411	**3520**
T6- Hexaconazole 5% EC	2 ml	1825	4685	2374	2505	3298	4976	2973	5273	3500	**3490**
T7- Propiconazole 25% EC	1 ml	1975	4510	2524	2651	3305	4715	3094	5876	3678	**3592**
T8- Control	-	938	3783	1765	1561	2826	2754	2422	4395	3233	**2631**
General Mean		**1602**	**4631**	**2446**	**3182**	**3671**	**4190**	**3242**	**5612**	**3712**	-
LSD @ 5% *(P= 0.05)*		112	339	19	731	539	1351	344	644	487	-
SE(m)		38	115	6	239	176	456	116	217	159	-
SE(d)		53	162	9	338	249	645	164	307	225	-
CV (%)		4.7	4.9	0.5	13.0	8.3	21.8	7.2	7.7	7.4	-

Sheath blight: Fungicides were evaluated against sheath blight disease at 15 disease hot spot locations. The experiment was conducted under artificial inoculation at all the test locations except Arundhutinagar and Moncompu. Both disease severity and incidence was observed at five locations *viz.,* Bankura, Cuttack, Faizabad (Masodha), Ludhiana, Maruteru, and Pantnagar. All other ten locations only disease severity was observed during the experiment. Two sprays of fungicidal treatments were given at all the centres. Disease severity in check plots was varied between 43.1% (Ludhiana) and 95.8% (IIRR). Disease severity on untreated plot was very high (>50%) at IIRR (95.8%), Gangavathi (88.9%), Raipur (86.7%), Maruteru (78.6%), Bankura (75.0%), Faizabad (73.2%), Gerua (72.8%), Cuttack (72.6%), Mandya (71.8%), Chinsurah (71.7%), Pantnagar (66.6%), Moncompu (65.8%), Arundhutinagar (64.2%), Chiplima (56.1%); and high (30-50%) at Ludhiana (43.1% and). Disease incidence varied between 51.5% (Faizabad) and 100% (Bankura). It was very high at Bankura (100%), Maruteru (96.0%), Ludhiana (92.1%), Pantnagar (77.8%), Cuttack (79.2%) and Faizabad (51.5%).

All fungicidal applications significantly reduced the sheath blight compared to control across the test locations. The combination fungicide azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) (T4) maximum reduced the severity at nine locations (Arundhutinagar, Chinchura, Chiplima, Gerua, IIRR, Ludhiana, Maruteru, NRRI and Pantnagar) and showed on par with best treatment (T2) at another two locations (Gangavathi, and Moncompu). Besides, treatments *viz.,* difenoconazole 25 EC (1.0 ml/l) and hexaconazole 5% EC (2.0 ml /l) significantly reduced the disease severity at three and two locations, respectively. The mean disease severity was low at azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (26.7%) treatment followed by difenoconazole 25 EC (1.0 ml/l) (32.5%) and hexaconazole 5% EC (2.0 ml /l) (32.7%) (Table 89).
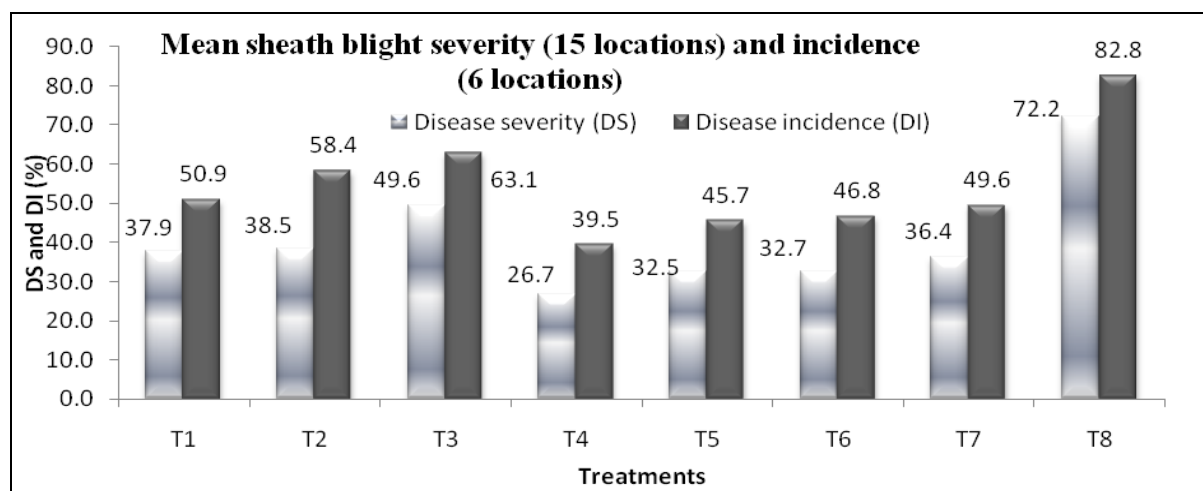
Figure 7: Effect of fungicides against sheath blight of rice, *Kharif*-2019

Combination fungicide azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0ml/l) significantly reduced the intensity at four locations (Ludhiana, Maruteru, NRRI and Pantnagar) and also showed low mean disease incidence. This was followed by difenoconazole 25 EC (1.0 ml/l) and hexaconazole 5% EC (2.0 ml /l) showed less disease incidence of 45.7% and 46.8%, respectively (Fig.7 and Table 90).

Table 89: Evaluation of fungicides against sheath blight severity of rice, *Kharif*-2019

T. No	Dose/L	Sheath blight severity (%)															Mean
		ARD	BAN	CHN	CHP	FZB	GNV	GER	IIRR	LDN	MND	MTU	MNC	NRRI	PNT	RPR	
T1	2 ml	53.6 (47.0)	32.8 (34.9)	65.7 (54.1)	18.9 (25.7)	28.1 (32.0)	43.1 (41.0)	43.0 (41.0)	74.2 (59.5)	7.1 (15.4)	25.9 (30.5)	63.2 (52.8)	22.8 (28.3)	17.6 (24.8)	30.1 (33.2)	42.2 (40.3)	**37.9**
T2	2 ml	56.3 (48.6)	46.6 (43.0)	57.6 (49.4)	21.1 (27.3)	29.4 (32.8)	34.9 (36.1)	42.5 (40.7)	69.7 (56.6)	12.4 (20.6)	23.0 (28.6)	66.6 (54.9)	11.8 (19.3)	20.8 (27.0)	39.5 (38.9)	45.9 (42.6)	**38.5**
T3	0.6 g	60.0 (50.8)	53.3 (47.0)	66.9 (54.9)	26.3 (30.8)	36.5 (37.1)	64.0 (53.1)	46.0 (42.7)	73.6 (59.1)	17.3 (24.5)	54.1 (47.3)	70.3 (57.1)	21.3 (27.1)	44.0 (41.5)	42.1 (40.4)	68.9 (58.2)	**49.6**
T4	1 ml	35.7 (36.6)	48.9 (44.3)	23.4 (28.9)	11.5 (19.8)	25.7 (30.4)	35.1 (36.2)	34.5 (36.0)	23.3 (28.8)	5.2 (13.1)	34.8 (36.1)	39.5 (38.6)	13.6 (21.1)	16.4 (23.7)	28.3 (32.1)	25.2 (28.6)	**26.7**
T5	1ml	38.9 (38.5)	54.2 (47.4)	24.5 (29.6)	20.0 (26.5)	20.8 (27.1)	60.6 (51.1)	43.0 (41.0)	38.2 (38.1)	5.8 (13.9)	30.4 (33.4)	43.0 (40.7)	21.9 (27.9)	30.3 (33.3)	39.7 (39.1)	15.6 (23.1)	**32.5**
T6	2 ml	42.4 (40.6)	49.4 (44.7)	25.0 (30.0)	19.3 (26.0)	28.8 (32.4)	42.9 (40.9)	39.5 (38.9)	44.6 (41.8)	9.1 (17.6)	37.8 (37.9)	42.9 (40.9)	24.7 (28.8)	28.7 (32.3)	39.1 (38.7)	15.6 (23.0)	**32.7**
T7	1 ml	43.1 (41.0)	57.2 (49.2)	26.2 (30.8)	22.6 (28.3)	22.1 (28.0)	59.0 (50.1)	43.0 (41.0)	60.1 (50.8)	8.8 (17.3)	33.3 (35.2)	49.7 (44.8)	27.8 (31.7)	38.2 (38.1)	38.0 (38.0)	16.3 (23.8)	**36.4**
T8	Control	64.2 (53.3)	75.0 (60.0)	71.7 (57.8)	56.1 (46.7)	73.2 (58.8)	88.9 (70.5)	72.8 (58.5)	95.8 (71.5)	43.1 (41.0)	71.8 (58.2)	78.6 (62.5)	65.8 (54.3)	72.6 (51.1)	66.6 (54.7)	86.7 (69.4)	**72.2**
General Mean		**49.3**	**52.2**	**45.1**	**24.5**	**33.1**	**53.6**	**45.5**	**60.0**	**13.6**	**38.9**	**56.7**	**26.2**	**33.6**	**40.4**	**39.5**	**-**
LSD @ 5% *(P= 0.05)*		3.6	9.4	1.9	4.4	3.1	5.5	1.6	7.1	1.6	5.4	9.3	9.2	8.2	2.3	18.1	-
SE(m)		1.2	3.2	0.6	1.4	1.0	1.8	0.5	2.3	0.5	1.8	3.1	3.1	2.8	0.8	5.9	-
SE(d)		1.7	4.5	0.9	2.0	1.5	2.5	0.8	3.3	0.7	2.5	4.4	4.4	3.9	1.1	8.3	-
CV (%)		5.5	13.6	3.0	8.7	5.9	6.6	2.6	7.9	4.4	7.9	12.8	20.9	16.4	3.3	26.5	-
Transformation		AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	AT	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Table 90: Evaluation of fungicides against sheath blight incidence of rice, *Kharif*-2019

Treatments	Dose/L	Sheath blight incidence (%)						
		BAN	FZB	LDN	MTU	NRRI	PNT	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	100.0 (10.1)	31.4 (34.0)	32.7 (34.9)	77.5 (63.3)	26.8 (31.0)	37.3 (37.6)	**50.9**
T2- Prochloraz 45% EC	2 ml	100.0 (10.1)	32.5 (34.7)	61.4 (51.6)	74.0 (60.0)	30.4 (33.4)	52.2 (46.2)	**58.4**
T3- Tricyclazole 75% WP	0.6 g	100.0 (10.1)	38.8 (38.5)	65.1 (53.8)	75.2 (60.6)	48.2 (43.9)	51.1 (45.6)	**63.1**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	100.0 (10.1)	28.1 (32.0)	14.8 (22.6)	35.8 (36.5)	22.6 (28.2)	35.9 (36.8)	**39.5**
T5- Difenoconazole 25 EC	1ml	100.0 (10.1)	21.9 (27.9)	14.8 (22.5)	48.2 (43.9)	37.4 (37.6)	51.8 (46.0)	**45.7**
T6- Hexaconazole 5% EC	2 ml	100.0 (10.1)	30.2 (33.3)	26.1 (30.7)	39.1 (38.6)	34.3 (35.7)	51.0 (45.6)	**46.8**
T7- Propiconazole 25% EC	1 ml	100.0 (10.1)	23.0 (28.6)	27.7 (31.7)	53.6 (47.1)	41.0 (39.7)	52.0 (46.1)	**49.6**
T8- Control	-	100.0 (10.1)	51.5 (45.8)	92.1 (74.1)	96.0 (81.7)	79.2 (63.0)	77.8 (61.9)	**82.8**
General mean		**100.0**	**32.2**	**41.8**	**62.4**	**40.0**	**51.1**	**54.6**
LSD @ 5% *(P= 0.05)*		N/A	2.5	3.7	13.4	7.2	2.2	-
SE(m)		0.0	0.8	1.2	4.5	2.4	0.7	-
SE(d)		0.0	1.2	1.7	6.4	3.5	1.0	-
CV (%)		0.0	4.9	5.2	16.8	12.5	2.8	-
Transformation		ST	AT	AT	AT	AT	AT	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Grain yield in the experimental plots were recorded at all the test locations. It was observed that grain yield was more in fungicide treated plots compared to check plot (3802 Kg/ha). Highest yield was recorded in the plots where azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0ml/l) sprayed (5444 Kg/ha) followed by hexaconazole 5% EC (2.0 ml /l) (5212 Kg/ha) and difenoconazole 25 EC (1.0 ml/l) (4816 Kg/ha) sprayed plots (Table 91).

Sheath rot: The fungicidal molecules were tested against sheath rot disease at six locations namely Aduthurai, Chinsurah, Nawagam, Navasari, Rajendranagar and Titabar. Both disease severity and incidence was recorded at Navasari, Nawagam and Titabar. Only disease severity was observed at Chinsurah and disease incidence was observed at Aduthurai and Rajendranagar. The test fungicidal products were evaluated against the disease under natural incidence at most of the locations except Chinsurah and Titabar. Uniformly two sprays of fungicides were applied in all the centres except Titabar where three sprays were given. Disease severity in check plots was very high (>50%) at Chinsurah (76.5%); high (30-50%) at Nawagam (42.9%), Titabar (40.5%) and Navasari (38.2%). Disease incidence in check plots was varied from 88% to 32%.

Table 91: Effect of fungicides on grain yield with respect to sheath blight, *Kharif*-2019

Treatments	Dose/L	Grain yield against sheath blight (Kg/Ha)															Mean
		ARD	BAN	CHN	CHP	FZB	GNV	GER	IIRR	LDN	MND	MTU	MNC	NRRI	PNT	RPR	
T1	2 ml	3313	4348	4668	5200	3275	5436	6053	3033	7489	4730	3700	3311	5264	6085	5915	**4788**
T2	2 ml	3073	5844	4743	4817	3113	5980	6265	3580	6744	3610	3574	3784	5040	5811	9127	**5007**
T3	0.6 g	2830	4170	4001	4378	2825	4567	6055	3033	6478	4095	4493	4150	3928	5757	9260	**4668**
T4	1 ml	3768	5197	6209	5450	3513	6257	6888	5120	7678	4285	5050	3763	5580	6148	6763	**5444**
T5	1ml	3565	3664	5742	5061	3838	4817	6008	3807	7489	3216	4261	3795	4350	5842	6785	**4816**
T6	2 ml	3520	4670	5826	5172	3288	5613	6650	4373	7639	3298	4976	3548	4676	5782	9150	**5212**
T7	1 ml	3350	3204	5735	4658	3725	4683	6090	3307	7272	3305	4715	3300	4290	5816	8967	**4828**
T8	-	2370	2734	3702	3350	2113	4130	5763	2320	5750	2826	2754	2654	3582	5221	7767	**3802**
General mean		**3224**	**4229**	**5078**	**4761**	**3211**	**5185**	**6221**	**3572**	**7067**	**3671**	**4190**	**3538**	**4589**	**5808**	**7967**	
LSD @ 5% *(P= 0.05)*		487	1219	434	587	328	579	247	1104	600	539	1351	N/A	1203	161	N/A	
SE(m)		165	412	147	192	111	189	83	361	196	176	456	399	406	53	1674	
SE(d)		233	582	207	271	157	267	118	510	277	249	645	564	575	74	2368	
CV (%)		10.2	19.5	5.8	7.0	6.9	6.3	2.7	17.5	4.8	8.3	21.8	22.6	17.7	1.6	36.4	

Incidence was very high at Nawagam (88.0%); high at Navasari (45.3%), Titabar (48.3%), Aduthurai (37.1) and Rajendranagar (32.0%). All the fungicides significantly reduced the disease incidence and severity when compared to check and also increased the yield.

The new test product prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) (T1) and azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0ml/l) (T4) significantly reduced the sheath rot severity at each two locations. These two treatments (T1 and T4) showed minimum average disease severity (DS: 19.9% and 20.1%) from six test locations. Besides, T1 and T4 sprayed plots showed minimum average disease incidence of 30.6% and 30.5% respectively. However, these two products *viz.,* azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1 ml/l) and prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) were found better in reducing the disease severity as well as incidence on par with each other (Figure 8 and Table 92).

The mean yield across the experimental locations in check plot was 4190 Kg/ha. Among the treatments, azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1 ml/l) yielded more (5562 Kg/ha) followed by prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) (5485Kg/ha) when compare to other treatments (Table 94). These two treatment showed the correlation between disease reduction and yield increase.
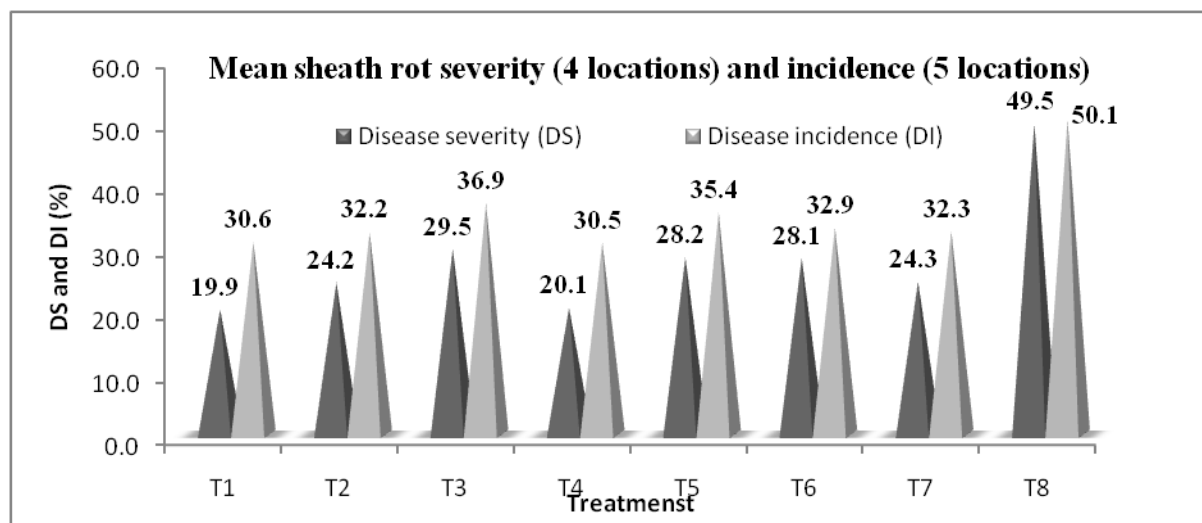
Figure 8: Effect of fungicides against sheath rot of rice, *Kharif*-2019

Brown spot: Fungicides were evaluated against brown spot at six different locations. Disease severity was recorded from five locations namely Aduthurai, Chatha, Hazaribagh, Pattambi, Pusa and Sabour. Only disease incidence was recorded at Hazaribagh and Sabour. Disease severity in control plot was very high (>50%) at Pusa (61.0%) and Pattambi (57.2%)); and high at Chatha (49.8%), Sabour (47.3%) Aduthurai (33.3%) and moderate at Hazaribagh (24.8%). The high disease incidence (67.9%) was noticed at Hazaribagh. Bio-efficacy of the fungicides was tested

under natural infection at all the centres except Hazaribagh where disease pressure was augmented with artificial inoculation.

All seven fungicidal treatments performed better in reducing the brown spot at all six centres compared to untreated control. Among all the treatment, hexaconazole 5%EC (2.0 ml/l) significantly reduced the disease severity at two locations (Chata and Patambi) and showed low mean severity (20.9%) compared to other treatments. Besides, propiconazole 25% EC (1.0 ml/l) and azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1 ml/l) also showed better in minimising the brown spot (Fig. 9 and Table 93). Regarding yield data, fungicide sprayed plots showed significantly higher yield compared to control plot (3162 Kg/ha). Highest mean yield (4659 Kg/ha) was obtained from the plots where azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) sprayed (Table 94).
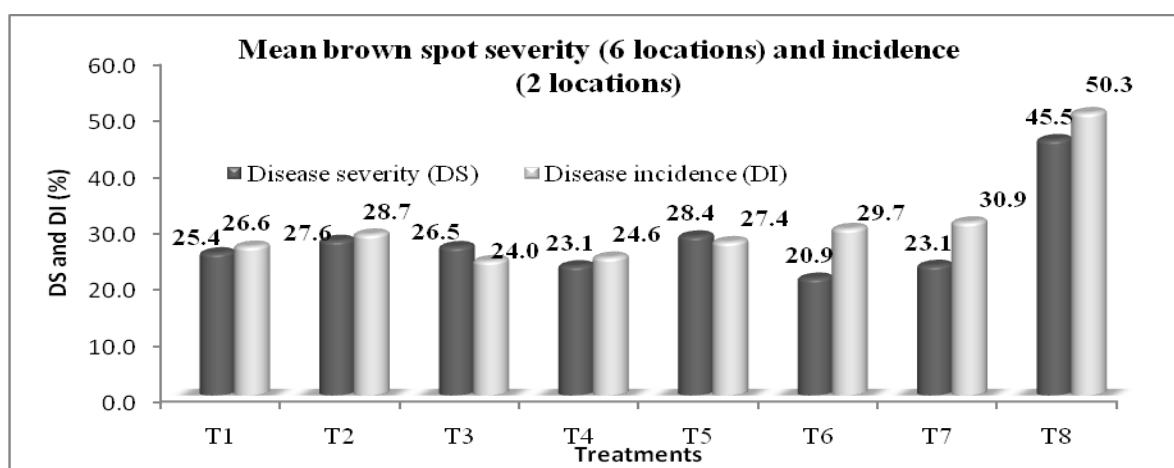
Figure 9: Effect of fungicides against brown spot of rice, *Kharif*-2019

False smut: Trail was conducted at Cuttack and Varanasi through natural incidence. Panicle and spikelet infection was observed from both the centres. Moderate level of panicle infection was noticed at NRRI (22.0%) and Varanasi (27.2%). This trail showed statistically no significant difference among the treatments in spikelet infection at both the centres. Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) sprayed showed minimum panicle infection (12.7%) and spikelet infection (14.1) compare to other treatments (Table 95).

Grain discoloration: Experiment was conducted at Moncompu and Rajendranagar through natural incidence. Disease incidence and disease severity was observed at Moncompu and Rajendranagar, respectively. Low level of incidence (21.1%) and moderate severity (51.7%) was recorded in control plots. Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC (1.0 ml/l) sprayed plots showed less disease incidence and severity followed by prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE (2.0 ml/l) (Table 95).

Table 92: Evaluation of fungicides on sheath rot severity and incidence of rice, *Kharif*-2019

Treatments	Dose/ L	Sheath rot severity (%)					Sheath rot incidence (%)					
		CHN	NVS	NAW	TTB	Mean	ADT	NVS	NWA	RNR	TTB	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	28.3 (32.0)	16.6 (24.0)	15.8 (23.4)	18.8 (25.7)	**19.9**	20.3 (26.7)	26.5 (26.5)	60.8 (51.3)	24.2 (28.9)	21.5 (27.6)	**30.6**
T2- Prochloraz 45% EC	2 ml	35.6 (36.5)	23.1 (28.7)	20.8 (27.1)	17.3 (24.5)	**24.2**	13.8 (21.7)	35.1 (35.1)	70.4 (57.1)	22.2 (26.7)	19.5 (26.2)	**32.2**
T3- Tricyclazole 75% WP	0.6 g	49.5 (44.7)	25.7 (30.4)	32.5 (34.8)	10.3 (18.7)	**29.5**	29.6 (32.9)	38.0 (38.0)	78.2 (62.2)	(24.7 (29.8)	13.8 (21.8)	**36.9**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	36.7 (37.2)	13.5 (21.5)	16.5 (23.9)	13.9 (21.9)	**20.1**	24.3 (29.5)	21.1 (21.1)	64.5 (53.4)	26.7 (30.6)	16.2 (23.7)	**30.5**
T5- Difenoconazole 25 EC	1ml	44.3 (41.7)	24.0 (29.3)	24.7 (29.7)	19.8 (26.4)	**28.2**	28.9 (32.5)	36.0 (36.0)	69.9 (56.8)	19.5 (22.7)	22.5 (28.3)	**35.4**
T6- Hexaconazole 5% EC	2 ml	41.7 (40.2)	15.1 (22.8)	34.4 (35.9)	21.1 (27.3)	**28.1**	13.6 (21.5)	25.7 (25.7)	82.3 (65.2)	17.8 (21.6)	25.3 (30.2)	**32.9**
T7- Propiconazole 25% EC	1 ml	40.3 (39.3)	21.8 (27.8)	26.1 (30.7)	9.1 (17.5)	**24.3**	22.9 (28.5)	32.1 (32.1)	75.0 (60.0)	19.5 (22.8)	12.3 (20.5)	**32.3**
T8- Control	-	76.5 (61.0)	38.2 (38.1)	42.9 (40.9)	40.5 (39.5)	**49.5**	37.1 (37.5)	45.3 (45.3)	88.0 (70.0)	32.0 (34.3)	48.3 (44.0)	**50.1**
General Mean		**44.1**	**22.2**	**26.7**	**18.9**	**-**	**23.8**	**32.5**	**73.6**	**23.3**	**22.4**	**35.1**
LSD @ 5% *(P= 0.05)*		4.8	3.7	2.4	1.8	-	4.2	5.7	4.8	N/A	1.8	-
SE(m)		1.6	1.2	0.8	0.6	-	1.4	1.9	1.6	4.9	0.6	-
SE(d)		2.3	1.8	1.1	0.9	-	2.0	2.7	2.3	6.9	0.9	-
CV (%)		7.8	8.9	5.3	4.8	-	9.9	11.8	5.4	35.8	4.5	-
Transformation		AT	AT	AT	AT	-	AT	AT	AT	AT	AT	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

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Table 93: Evaluation of fungicides on brown spot severity and incidence of rice, *Kharif*-2019

Treatments	Dose/L	Brown spot disease severity (%)							BS- disease incidence (%)		
		ADT	CHT	HZB	PTB	PUS	SAB	Mean	HZB	SAB	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	15.1 (22.8)	40.8 (39.6)	10.4 (3.4)	42.7 (42.7)	10.0 (18.4)	33.2 (35.2)	**25.4**	30.8 (33.7)	22.3 (28.2)	**26.6**
T2- Prochloraz 45% EC	2 ml	10.5 (18.9)	41.3 (39.9)	19.2 (4.2)	46.9 (46.9)	20.3 (26.6)	27.4 (31.6)	**27.6**	38.6 (38.4)	18.8 (25.7)	**28.7**
T3- Tricyclazole 75% WP	0.6 g	23.9 (29.2)	33.7 (35.5)	17.2 (4.3)	54.5 (54.5)	11.9 (20.1)	17.6 (24.8)	**26.5**	36.1 (36.9)	11.8 (20.1)	**24.0**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	25.8 (30.4)	21.0 (27.2)	9.7 (4.3)	39.7 (39.7)	11.4 (19.7)	30.8 (33.7)	**23.1**	28.2 (32.0)	21.0 (27.3)	**24.6**
T5- Difenoconazole 25 EC	1ml	17.3 (24.5)	27.8 (31.8)	16.1 (3.3)	43.9 (43.9)	36.5 (37.1)	28.6 (32.3)	**28.4**	35.0 (36.3)	19.7 (26.3)	**27.4**
T6- Hexaconazole 5% EC	2 ml	12.9 (20.9)	13.3 (21.2)	16.2 (3.9)	33.9 (33.9)	13.1 (21.2)	35.8 (36.8)	**20.9**	35.2 (36.4)	24.2 (29.4)	**29.7**
T7- Propiconazole 25% EC	1 ml	16.5 (23.9)	15.5 (23.0)	15.6 (4.1)	43.0 (43.0)	9.1 (17.6)	39.1 (38.7)	**23.1**	35.5 (36.5)	26.3 (30.8)	**30.9**
T8- Control	-	33.3 (35.2)	49.8 (44.9)	24.8 (4.1)	57.2 (57.2)	61.0 (51.3)	47.3 (43.4)	**45.5**	67.9 (55.5)	32.7 (34.9)	**50.3**
General Mean		**19.4**	**30.4**	**16.1**	**45.2**	**21.6**	**32.5**	**-**	**38.4**	**22.1**	**-**
LSD @ 5% *(P= 0.05)*		3.4	3.4	0.5	6.6	3.0	1.5	**-**	0.7	1.0	**-**
SE(m)		1.2	1.2	0.2	2.2	1.0	0.5	**-**	0.3	0.3	**-**
SE(d)		1.6	1.6	0.2	3.2	1.4	0.7	**-**	0.4	0.5	**-**
CV (%)		9.0	7.1	7.7	9.9	7.6	2.5	**-**	1.3	2.0	**-**
Transformation		AT	AT	ST	NT	AS	AS	**-**	AT	AT	**-**

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; ST- Square root transformation; NT- No transformation)

Table 94: Effect of fungicides on grain yield with respect to sheath rot and brown spot, *Kharif-***2019**

Treatments	Dose/ L	Grain yield against sheath rot (%)							Grain yield against brown spot (%)						
		ADT	CHN	NVS	NWG	RNR	TTB	Mean	ADT	CHT	HZB	PTB	PSA	SBR	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	5388	4792	5967	6545	5879	4340	**5485**	5388	2480	4248	5363	3917	4517	**4318**
T2- Prochloraz 45% EC	2 ml	6388	4590	5293	6361	5680	4360	**5445**	6388	2423	3259	5000	2950	5933	**4325**
T3- Tricyclazole 75% WP	0.6 g	5413	3972	5063	5999	5951	4570	**5161**	5413	2750	3312	4975	3566	6067	**4347**
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	5788	4444	6288	6789	5734	4330	**5562**	5788	3060	4495	5195	3734	5683	**4659**
T5- Difenoconazole 25 EC	1ml	5350	4111	5170	6464	6106	4270	**5245**	5350	2840	3965	5338	2654	5783	**4322**
T6- Hexaconazole 5% EC	2 ml	6200	4250	6059	5893	5273	4275	**5325**	6200	3370	3935	5015	3014	4417	**4325**
T7- Propiconazole 25% EC	1 ml	5375	4403	5385	6198	5876	5530	**5461**	5375	3250	3647	4963	4065	4017	**4219**
T8- Control	-	4975	3208	4205	4524	4395	3835	**4190**	4975	1830	2457	3938	2008	3767	**3162**
General Mean		**5609**	**4221**	**5428**	**6096**	**5612**	**4439**	**5234**	5609	2750	3665	4973	3238	5023	-
LSD @ 5% *(P= 0.05)*		432	484	758	925	644	836	-	432	389	81	669	348	229	-
SE(m)		146	163	256	312	217	282	-	146	131	27	226	118	75	-
SE(d)		206	231	362	442	307	399	-	206	186	39	319	166	106	-
CV (%)		5.2	7.7	9.4	10.2	7.7	12.7	-	5.2	9.5	1.5	9.1	7.3	2.6	-

Table 95: Evaluation of fungicides on false smut and grain discoloration of rice, *Kharif*-2019

| Treatments | Dose /L | False smut | | | | | | | | | Grain discoloration | | | | |
| | | Panicle infection (%) | | | Spikelet infection (%) | | | Yield (Kg/Ha) | | | DI (%) | | DS (%) | | Yield (Kg/Ha) |
		NRRI	VNS	Mean	NRRI	VNS	Mean	NRRI	VNS	Mean	MNC	RNR	MNC	RNR	Mean
T1- Prochloraz 23.5% w/w + tricyclazole 20.0% w/w SE	2 ml	11.7	16.0	13.8	1.2	22.6	11.9	5100	5450	5275	10.6	15.6	3311	5879	4595
T2- Prochloraz 45% EC	2 ml	10.9	18.5	14.7	1.0	24.4	12.7	6567	5450	6008	9.7	16.1	3784	5680	4732
T3- Tricyclazole 75% WP	0.6 g	13.8	20.4	17.1	2.7	33.2	18.0	4567	5050	4808	9.1	22.5	4150	5951	5050
T4- Azoxystrobin 18.2 % w/w + difenoconazole 11.4% w/w SC	1 ml	11.3	14.3	12.8	1.0	20.7	10.8	5933	5550	5742	9.0	16.7	3763	5734	4748
T5- Difenoconazole 25 EC	1ml	12.9	20.3	16.6	1.5	26.6	14.0	4567	5125	4846	10.0	28.9	3795	6106	4950
T6- Hexaconazole 5% EC	2 ml	13.6	23.7	18.6	1.5	27.8	14.6	4467	5050	4758	11.2	22.8	3548	5273	4410
T7- Propiconazole 25% EC	1 ml	12.6	19.8	16.2	1.4	25.8	13.6	4200	5375	4788	10.0	22.2	3300	5876	4588
T8- Control	-	22.0	27.2	24.6	3.1	33.2	18.1	3367	4875	4121	21.1	51.7	2654	4395	3524
General Mean		**13.6**	**20.0**	**-**	**1.7**	**26.8**	**-**	**4845**	**5240**	**-**	**11.3**	**24.6**	**3538**	**5612**	**-**
C.D.		0.4	N/A	-	N/A	N/A	-	N/A	N/A	-	0.3	9.1	N/A	644	-
SE(m)		0.1	2.3	-	0.1	3.4	-	711	321	-	0.1	3.1	399	217	-
SE(d)		0.2	3.2	-	0.2	4.7	-	1006	455	-	0.1	4.4	564	307	-
C.V.		5.6	17.2	-	16.1	21.8	-	25.4	12.3	-	5.8	21.5	22.6	7.7	-
Transformation		ST	AT	-	ST	AT	-	-	-	-	ST	AT	-	-	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; ST- Square root transformation)

2. INTEGRATED DISEASE MANAGEMENT, *Kharif* -2019

To study the effect of Integrated Disease Management (IDM) practices on the incidence of different diseases in rice, the trials were proposed at about eighteen locations i.e., Arundhutinagar, Chiplima (CHP) Faizabad (FZB), Gerua, Hazaribagh (HZB), IIRR, Jagdalpur (JDP), Lonavala, Malan (MLN), Mandya (MND), Maruteru (MTU), Moncompu (MNC), NRRI, Pantnagar (PNT), Pattambi (PTB), Ponnampet (PNP), Rewa (REW), Titabar (TTB), and it was conducted at fourteen locations. The layout suggested was RBD with 3 replications adopting a net plot size of 5 x 2 m and a spacing of 15 x 15 cm. Locally popular variety was suggested for the trial. The fertilizers recommended were (N:P: K: Zn-120:60:40:25)-Apply fertilizer @ 120 kg N/ha, 60kg P_2O5/ha and 40 K_2O/ha. Apply entire P and K and ½ N as basal dose and the remaining ½N at maximum tillering stage. Apply additional 25% N at booting stage. Apply $ZnSO_4$ @ 25 kg/ha as basal dose.

The different components for IDM trial are

T1	Seed treatment with bio-control agent (10 g/kg seeds) (Bio-control agent formulation was supplied by ICAR-NRRI).
T2	Seed treatment with bio-control agent + one application of bio-control agent at 15-20 DAT (10 g/litre)
T3	Seed treatment with bio-control agent + one application of propiconazole (1 g/litre) at booting stage
T4	Seed treatment with bio-control agent + one application of bio-control agent at 15-20 DAT (10 g/litre) + One blanket application of propiconazole (1 g/litre) at booting stage
T5	Seed treatment with carbendazim (2 g/kg) + one blanket application of combination fungicide (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage
T6	Control (No seed treatment, No spraying of bio-control agent or any fungicide)

The experiments were conducted in randomized block design under natural condition in hot spot locations. If the disease is not occurring naturally, artificial inoculation was done. The details on the trial conducted in different locations are presented in Table 96.

Effect of integrated management practices against severity of leaf blast of rice - *Kharif*, 2019

Jagdalpur, Hazaribagh, Malan, Ponnampet and Rewa centres conducted the study to analyze the effects of the IDM treatments on the disease severity of leaf blast in rice. Among the three centres tested, PNP showed maximum disease severity (59.94% DS) in control followed by Jagdalpur (58.89% DS), Hazaribagh (52.82% DS), Malan (31% DS) and Rewa (14.3% DS). Among the different treatments, the seed treatment with carbendazim (2 g/kg) + one blanket application of combination fungicide (Trifloxystrobin 25% + Tebuconazole 50%) @ 0.4 g/l at booting stage (T5) was found to be very effective, giving the maximum reduction percentage disease over control (80.61% DS) Table 97.

Table 96: Experimental details of IDM for the management of rice diseases, *Kharif*-2019

S. No	Location	Disease Recorded	Test Variety	Screening	Date of activities					
					Sowing/ Transplanting	Inoculation	Initial symptom	Spraying Date	Observation	Harvesting
1	Chiplima	Sheath blight	Swarna	Artificial	18.07.2019 22.08.2019	21.09.2019	30.09.2019	16.10.2019	30.10.2019 11.11.2019	19.12.2019
2	Faizabad	Sheath blight	Pusa Basmati 1	Artificial	29.06.2019 27.07.2019	24.09.2019	01.10.2019	28.09.2019 06.10.2019	05.10.2019	08.11.2019
3	Hazaribagh	Leaf blast	CO-39	Artificial	08.07.2019 26.07.2019	06.09.2019	10.09.2019	14.09.2019	13.09.2019 27.09.2019	25.10.2019
4	Jagdalpur	Leaf blast, Neck blast	Swarna	Natural	20.06.2019 29.07.2019	-	10.09.2019	28.09.2019 14.09.2019	26/09/19 11/10/19	28.12.2019
5	Malan	Leaf blast, Neck blast	HPU 2216	Natural	11.07.2019 14.08.2019	-	05.09.2019	24.09.2019 25.09.2019	05.10.2019	29.11.2019
6	Mandya	Sheath blight	Jyothi	Artificial/ Natural	14.08.2019 16.09.2019	27.10.2019	03.11.2019	13.11.2019	08.11.2019 29.11.2019	25.12.2019
7	Moncompu	Sheath blight	UMA (MO 16)	Natural	03.09.2019 24.09.2019	-	30.11.2019	02.12.2019	03.01.2020	14.01.2020
8	Maruteru	Sheath blight	Swarna (MTU-7029)	Artificial	10.07.2019 07.08.2019	11.09.2019	18.09.2019	11.10.2019	07.09.2019 28.09.2019 26.10.2019	05.12.2019
		BLB	Krishnaveni (MTU-2077)	Artificial	10.07.2019 23.08.2019	01.10.2019	07.10.2019	28.10.2019	05.11.2019 22.11.2019 07.12.2019	19.12.2019
9	Pantnagar	Sheath blight	Pant Dhan-4	Natural	15.07.2019 07.08.2019	-	10.10.2019	15.10.2019	14.10.2019 26.10.2019	25.11.2019
10	Pattambi	Sheath blight	Jyothi	Natural	22.07.2019 21.08.2019	-	25.09.2019	01.10.2019	25.09.2019 15.11.2019	02.12.2019
11	Ponnampet	Leaf blast Neck blast	Intan	Natural	16-07-2019 20-08-2019	-	14.08.2019-LB 26.11.2019-NB	11.09.2019 03.10.2019	21-10-2019 02-01-2020	08.01.2020
12	Rewa	Leaf blast	PS4	Artificial	24.07.2019 08.08.2019	26.08.2019	07.09.2019	30.09.2019	05.10.2019 15.10.2019	26.11.2019
13	Titabar	Sheath rot	Gitesh	Artificial	06.07.2019 08.08.2019	10.10.2019	22.10.2019	22.10.2019	01-11-2019 11-11-2019 21-11-2019	12.12.2019

However, the effectivity among the treatments was found to differ among the centres, in case of Ponnampet, seed treatment with *Trichoderma* followed by application at 15-20 DAS (T2) was found to have significant effect on the suppression of the disease severity (63.46% reduction of DS over control) and is comparable with the chemical treatment T5. It was observed that one spray of propiconazole at the booting stage along with the treatment T2 did not have any significant effect in suppressing the disease severity (60.21% reduction of DS over control) when compared with T2 alone (63.46% reduction of DS over control). In the case of Jagdalpur centre with second high disease severity among the centres, treatment T5 was the most effective in percentage decrease disease severity over control (28.30%) followed by T4 (23.58%). The trend was similar in the case of Hazaribagh, where the treatment T4 was most successful in percentage decrease disease severity over control (67.55%) after the chemical control T5 (80.61%) and other treatments with bioagent T3 and T2 were also found to be effective (56.52 and 43.27% respectively). The highest increase in the percentage of grain yield over control was as expectedly observed in the chemical alone treatment with maximum decrease in the disease, 80.61% in the case of T5 in Hazaribagh. However, among the integrated treatment with bioagents and propiconazole, the treatment T4 in the Hazaribagh centre was found to be having the highest increase in grain yield percentage (67.55%) followed by T3 and T4 in the same centre (67.55 and 56.52% respectively). In the case of PNP, all the bioagents treatments (T1-T4) were found to be on par with each other, indicating that propiconazole spray did not have any significant effect on the yield of the plant (Table 97).

Effect of integrated management practices against severity of neck blast and grain yield at different locations - *Kharif*, 2019

Three centres viz., MLN, JDP and PNP conducted IDM trials on the effect of the bioagents along with chemicals for the management of neck blast disease in rice. Among the three centres PNP and JDP were found to have maximum disease in the control plots (53.70 and 52.16% disease index). MLN had significantly less disease (21% DI) when compared to the other two centres. Among the five treatments, the chemical treatment, T5 was found to be most effective (72.58 and 70.05 % decrease of disease index over control). However, in the case of JDP and PNP, the treatment T4 (seed treatment followed by field application of bioagent and spray of propiconazole) was found to be near (33.33 and 65.74% reduction in PDI over control respectively) to the effect of chemical alone treatment, T5 (35.70 and 72.58% reduction in PDI over control respectively). PNP centre reported the maximum suppression of disease over control (68.48%) in the bioagent alone treatment applied as seed treatment followed by the foliar application on 15-20 DAT (treatment T2). With respect to the increase in grain yield of the crop over control, the PNP centre showed maximum increase (56.97%) in the treatment T5 followed. The treatments with bioagent alone (T1 and T2) and an additional spray of propiconazole with the bioagent (T3 and T4) were on par with each other. However, in the case of JDP, the additional spray of propiconazole with the bioagent (T4 and T3) had significantly increased the percentage suppression of disease over control (33.33 and 28.69% respectively) and increased the percentage grain yield over control (21.55 and 18.25% respectively) when compared with (T2 and T1), the bioagents alone treatments, percentage suppression of disease over control (16.53 and 13.4% respectively) and the percentage grain yield over control (8.84 and 4.39% respectively) (Table 98).

Table 97: Effect of integrated management practices against severity of leaf blast and grain yield - *Kharif*, 2019

Treatment	Leaf blast								
	JDP			HZB			MLN		
	DS (%)	% decrease over control (DS)	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	50.00 (45.17)	15.09	4.39	35.72 (36.69)	32.37	43.03	25.50 (30.28)	17.74	7.50
T2 = T1 + bio-control agent at 15-20 DAT	49.44 (43.54)	16.04	8.84	29.96 (33.17)	43.27	52.21	23.00 (28.56)	25.81	19.56
T3 = T1 + one spray of propiconazole at booting stage	46.11 (37.19)	21.70	18.25	22.96 (28.62)	56.52	67.15	20.20* (26.67)	34.84	21.47
T4 = T2 + one spray of propiconazole at booting stage	45.00 (34.77)	23.58	21.55	17.14 (24.44)	67.55	82.23	24.00 (29.24)	22.58	20.00
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	42.22* (33.53)	28.30	28.05	10.24* (18.65)	80.61	97.97	22.90 (28.58)	26.13	23.97
T6 = control	58.89 (52.15)	-	-	52.82 (46.60)	-	-	31.00 (33.83)	-	-
C.V (%)	8.69	-	4.03	1.61	-	1.02	6.18	-	8.95
LSD @ 5% *(P= 0.05)*	5.37	-	251	0.75	-	48.0	3.32	-	127
Transformation	AT	-		AT	-		AT	-	

(* - Best treatment; DS – Disease Severity; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

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Table 97: Effect of IDM practices against severity of leaf blast and grain yield - *Kharif*, 2019

Treatment	Leaf blast					
	PNP			REW		
	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	30.33 (33.33)	49.41	35.48	11.2 (3.34)	21.7	6.92
T2 = T1 + bio-control agent at 15-20 DAT	21.90 (27.80)	63.46	40.98	9.6 (3.10)	32.9	8.86
T3 = T1 + one spray of propiconazole at booting stage	33.50 (35.30)	44.11	35.36	9.2 (3.02)	36.4	11.53
T4 = T2 + one spray of propiconazole at booting stage	23.85 (29.21)	60.21	37.48	8.9 (2.98)	37.8	13.76
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	19.78* (26.30)	67.01	56.97	7.9* (2.80)	45.5	16.50
T6 = Control	59.94 (50.72)	-	-	14.3 (3.78)	-	-
C.V (%)	7.18	-	8.80	3.61	-	1.90
LSD @ 5% *(P= 0.05)*	3.60	-	443	0.20	-	142
Transformation	AT	-	-	ST	-	-

(* - Best treatment; DS – Disease Severity; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; ST- Square root transformation)

Table 98: Effect of integrated management practices against severity of neck blast and grain yield at different locations - *Kharif***, 2019**

Treatment	Neck Blast								
	MLN			JDP			PNP		
	DI (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DI (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DI (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	18.50 (25.33)	11.90	7.50	45.17 (42.20)	13.40	4.39	22.88 (28.51)	57.40	35.48
T2 = T1 + bio-control agent at 15-20 DAT	17.60 (24.79)	16.19	19.56	43.54 (41.26)	16.53	8.84	16.93 (24.08)	68.48	40.98
T3 = T1 + one spray of propiconazole at booting stage	14.50 (22.15)	30.95	21.47	37.19 (37.55)	28.69	18.25	24.35 (29.55)	54.66	35.36
T4 = T2 + one spray of propiconazole at booting stage	18.00 (24.98)	14.29	20.00	34.78 (36.09)	33.33	21.55	18.40 (25.38)	65.74	37.48
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	4.40* (11.97)	79.05	23.97	33.54* (35.31)	35.70	28.05	14.73* (22.32)	72.58	56.97
T6 = Control	21.00 (27.23)	-	-	52.16 (46.22)	-	-	53.70 (47.10)	-	
C.V (%)	12.59	-	8.95	5.32	-	4.03	9.99	-	8.80
LSD @ 5% *(P= 0.05)*	5.2	-	127	3.18	-	251	4.44	-	443
Transformation	AT	-	-	AT	-	-	AT	-	-

(* - Best treatment; DI – Disease Incidence; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Effect of integrated management practices against severity of sheath blight and grain yield at different locations - *Kharif*, 2019

A total of seven centres viz., Chiplima, Faizabad, Mandya, Maruteru, Moncompu, Pantnagar and Pattambi conducted the IDM trials to study the effect of the bioagent and standard chemical application to study their effect on the severity and incidence on the sheath blight disease of rice. Among the different centres, Maruteru had the highest PDI in the control plots (79.61%) followed by Mandya (73.33), Faizabad (68.50), Pattambi (66.00%), Pantnagar (65.24%), Moncompu (61.94%), Chiplima (46.94%). The standard chemical treatment, seed treatment with carbendazim @2g/kg of seeds plus spray of 0.4g/l of trifloxystrobin 25%+ tebuconazole 50% (T5) resulted in the most effective decrease in the PDI percentage over control. The treatment where seeds are treated with the biocontrol agent @10g/kg followed by application of the bioagent at 15-20DAT and one spray of propiconazole at the booting stage (T4) was the most effective after T5, the Moncompu centre at 74.35% decrease in PDI over control followed by Faizabad (67.78%), Mandya (60.60%) and Maruteru (54.29%). Faizabad centre reported the maximum suppression of disease over control (36.10%) in the bioagent alone treatment applied as seed treatment followed by the foliar application on 15-20 DAT (treatment T2), followed by Moncompu (33.86%) (Table 99).

With respect to the increase in the percentage of increase in the grain yield over control, in general there was no direct effect of the bioagents in the grain yield increase and the decrease in the disease especially in the case of Maruteru, Moncompu, Pantnagar and Pattambi centres. This trend was unique to the sheath blight disease. However, as an exception, the treatment T3 and T4 in the Faizabad centre showed significant increase in the percentage of increase in grain yield over control (52.17% and 60.22% respectively) which is above even the chemical alone treatment T5 (53.76%) (Table 99).

Effect of integrated management practices against severity of Brown spot disease of rice

Hazaribagh centre has conducted the trial on use of bioagents along with the chemicals. At this location, the disease severity was 21.3% and disease incidence was 54.42% in control treatment. Among the different treatments, the chemical only treatment T5, was found to be the most effective in reducing the disease over control (61.89%) followed by the treatment T4, where in the bioagents were applied as seed treatment followed by foliar spray and spray of combi product (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage (48.10%). Bioagent alone applied as seed treatment followed by application on 15-20 DAT was able to suppress the disease to about 27.95% over control. Though both the disease severity and index were less in the brown spot The general increase in the percentage grain yield over was significantly in all the bioagent and propiconazole spray treatments (T1 to T4) with the highest in T4 (60.24) followed by T3 (54.16). The chemical alone treatment T5 gave the highest increase in grain yield percentage (89.01%) over control (Table 100).

Table 99: Effect of integrated management practices against severity of sheath blight and grain yield at different locations - *Kharif*, 2019

Treatment	CHP			FZB			MND		
	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control (DS)	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	39.72 (38.99)	15.38	8.03	54.60 (47.62)	20.29	12.90	57.78 (49.51)	21.21	13.31
T2 = T1 + bio-control agent at 15-20 DAT	35.28 (36.30)	24.84	14.81	43.77 (41.40)	36.10	29.03	48.89 (44.34)	33.33	20.42
T3 = T1 + one spray of propiconazole at booting stage	27.78 (31.62)	40.82	23.47	28.30 (32.09)	58.69	52.17	43.33 (41.15)	40.91	20.23
T4 = T2 + one spray of propiconazole at booting stage	25.56 (30.23)	45.56	28.39	22.07* (27.97)	67.78	60.22	28.89 (32.38)	60.60	29.69
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	14.72* (22.47)	68.64	46.31	26.00 (30.61)	62.04	53.76	21.11* (27.38)	71.21	46.63
T6 = Control	46.94 (43.22)	-	-	68.50 (55.86)	-	-	73.33 (59.08)	-	-
C.V (%)	12.94	-	8.18	5.36	-	7.12	9.69	-	9.00
LSD @ 5% *(P= 0.05)*	6.59	-	500	3.17	-	336	6.17	-	441
Transformation	AT	-	-	AT	-	-	AT	-	-

(* - Best treatment; DS – Disease Severity; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Table 99: Effect of integrated management practices against severity of sheath blight and grain yield at different locations - *Kharif*, 2019

Treatment	MTU			MNC		
	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	47.03 (43.24)	40.92	4.66	43.75 (41.39)	29.37	7.89
T2 = T1 + bio-control agent at 15-20 DAT	58.43 (49.96)	26.60	11.26	40.97 (49.69)	33.86	18.42
T3 = T1 + one spray of propiconazole at booting stage	52.22 (46.30)	34.41	2.96	33.89 (34.51)	45.29	17.11
T4 = T2 + one spray of propiconazole at booting stage	36.39 (36.94)	54.29	7.86	15.27 (22.88)	75.35	23.68
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	34.34* (35.29)	56.86	51.41	14.30* (21.35)	76.91	39.58
T6 = Control	79.61 (63.27)	-	-	61.94 (52.01)	-	-
C.V (%)	21.51	-	23.39	15.78	-	16.92
LSD @ 5% *(P= 0.05)*	14.85	-	1170	8.43	-	569
Transformation	AT	-	-	AT	-	-

(* - Best treatment; DS – Disease Severity; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Table 99: Effect of integrated management practices against severity of sheath blight and grain yield at different locations - *Kharif*, 2019

Treatment	PNT			PTB		
	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	60.74	6.91	0.35	65.52 (54.16)	0.73	5.48
T2 = T1 + bio-control agent at 15-20 DAT	54.07	17.12	1.27	68.8 (55.60)	4.24	5.12
T3 = T1 + one spray of propiconazole at booting stage	38.69	40.69	6.89	48.6 (43.83)	26.36	6.16
T4 = T2 + one spray of propiconazole at booting stage	35.89	44.98	9.17	47.73* (43.66)	27.68	4.11
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	32.70*	49.88	10.73	53.30 (46.71)	19.24	5.15
T6 = Control	65.24	-	-	66.00 (52.44)	-	-
C.V (%)	4.08	-	1.55	7.62	-	10.64
LSD @ 5% *(P= 0.05)*	2.94	-	133	5.71	-	590
Transformation	-	-	-	AT	-	-

(* - Best treatment; DS – Disease Severity; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Effect of integrated management practices against severity of sheath rot

Titabar centre conducted the trails on the integrated management of sheath rot using bioagent along with the chemicals. The centre has reported a maximum disease severity of 38.77% and 40.50% of disease incidence in the control plots. The chemical alone treatment was the most effective in reducing about 76.61% of the disease over control. However the treatment T4 with the bioagents applied twice as seed treatment followed by application as foliar spray on 15-20 DAT and a foliar application of propiconazole at booting stage was also found to be very effective in suppressing the disease to the tune of 71.76% over control. The bioagent alone treatment T2, was able to suppress the disease to the tune of 46.35% over control. The percentage disease suppression in the case of sheath rot of rice by the above treatments did not directly affect the percentage increase in the grain yield of rice in the respective treatments. The maximum percentage increase in the grain yield over control was observed in the chemical alone treatment T5 (20.84) followed by other treatments T4 and T3 (17.20 and 16.89% respectively). The bioagents alone treatments (T1 and T2) were on par with the treatments T3 and T4 (Table 100).

Effect of integrated management practices against severity of Bacterial leaf blight

Only Maruteru centre had conducted the trial on the management of BLB in rice using the bioagent supplied along with the standard chemical practices. The centre has reported high disease severity and it was observed that none of the treatments had controlled the disease satisfactorily. In control treatment 78.43% of disease incidence and 94.78% of disease severity was recorded. The maximum percent decrease in disease severity over control (9.21%) was observed in the case of treatment T4. The values were too low to consider them any significant for an effective disease control strategy. The bioagent alone treatment, T2 was able to suppress the disease to the tune of about 3.81% over control. Lack of effectivity of any of the five treatments to suppress the percentage disease index and severity over control resulted in only a maximum of 23.37% increase in the grain yield over control in treatment T4 and is on par with the chemical alone treatment T5 (22.91%). The other treatments (T1 to T3) were on par with each in the increase of grain (Table 100).

Table 100: Effect of integrated management practices against severity of brown spot, sheath rot and Bacterial leaf blight - *Kharif***, 2019**

Treatment	Brown spot				Sheath rot				BLB			
	HZB				TTB				MTU			
	DI (%)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DI (%)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)	DI (%)	DS (%)	% decrease over control	% increase in Grain Yield (Kg/ha)
T1 = ST with Bio-control agent @ (10 g/kg)	29.00 (32.57)	17.13 (4.13)	19.52	23.08	33.30 (35.22)	26.50 (30.96)	31.65	14.35	71.38 (57.95)	89.33 (71.03)	5.75	14.78
T2 = T1 + bio-control agent at 15-20 DAT	25.83 (30.53)	15.34 (3.91)	27.95	34.00	27.80 (31.79)	20.80 (27.11)	46.35	15.90	77.49 (61.82)	91.17 (72.74)	3.81	13.82
T3 = T1 + one spray of propiconazole at booting stage	19.91 (26.48)	13.34 (3.65)	37.32	54.16	23.50 (28.97)	15.30 (23.01)	60.54	16.89	67.21 (55.65)	88.22 (69.99)	6.92	7.31
T4 = T2 + one spray of propiconazole at booting stage	18.17 (25.22)	11.05 (3.32)	48.10	60.24	14.40 (24.25)	10.95 (19.28)	71.76	17.20	66.90* (54.92)	86.05 (68.17)	9.21	23.37
T5 = ST with carbendazim (2 g/kg) + spray of (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 g/l at booting stage	14.78* (22.60)	8.11 (2.85)	61.89	89.01	12.50* (20.66)	9.07 (17.50)	76.61	20.84	67.57 (55.49)	86.35 (68.67)	8.89	22.91
T6 = Control	54.42 (47.52)	21.30 (4.61)	-	-	40.50 (39.50)	38.77 (38.49)	-	-	78.43 (62.50)	94.78 (76.89)	-	-
C.V (%)	1.16	2.16	-	1.25	8.83	3.40	-	3.14	4.10	2.70	-	11.67
LSD @ 5% *(P= 0.05)*	0.53	0.12	-	66.65	7.72	1.33	-	207	1.85	2.89	-	607.40
Transformation	AT	ST	-	-	AT	AT	-	-	AT	AT	-	-

 (* - Best treatment; DI – Disease Incidence; DS – Disease Severity; Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; ST- Square root transformation)

TRIAL NO: 14 SPECIAL TRIAL ON THE EVALUATION OF ESSENTIAL OILS AGAINST RICE DISEASES

. The overuse of fungicides for the management of major rice diseases is a matter of concern and alternative or complementary protection practices are important and need of the hour to reduce the use of pesticides for achieving a sustainable environment. Last year results of this trial suggest that, the oils were not effective against bacterial blight and hence this year, this trial was proposed only for the management of fungal diseases. The trial was laid out with ten treatments and a control *viz.*, T1 - Citronella oil @ 2.0ml/l; T2- Eucalyptus oil @ 2.0ml/l; T3- Cedar wood oil@ 2.0ml/l; T4-Nirgundi oil@ 2.0ml/l; T5-Lemon grass oil@2.0ml/l; T6-Clove oil@2.0ml/l; T7-Neem essential oil@2.0ml/l; T8-Emulsifier@2.0ml/l; T9-Carbendazim@0.6g/l and T10-Control. The trial was proposed at different hot spot locations for different rice diseases viz., 8 locations for leaf blast; 9 locations for sheath blight and 5 locations for brown spot. In *Kharif* 2019, essential oils were tested for their performance at 17 different locations *i.e.,* against leaf blast at 3 locations (Hazaribagh, Jagdalpur and Mandya), against neck blast at 2 locations (Jagdalpur, Malan, Lonavala); against sheath blight at 8 locations (Chinsurah, Chiplima, IIRR, Ludhiana, Maruteru, Masodha (Faizabad), Moncompu, Raipur); against brown spot at Sabour and against false smut at Maruteru and Pantnagar. Data was not received from Karjat, Nellore (Leaf blast), Pantnagar (Sheath blight); Hazaribagh, Mugad, Pusa and Ranchi (Brown spot). The trial details are presented in Table 101. Trial on leaf blast was conducted under artificial and natural disease pressure; trial on sheath blight was conducted under artificial disease pressure; trial on brown spot was conducted under natural disease pressure and trial on false smut was conducted both under natural and artificial disease pressure.

Effect of essential oils against leaf and neck blast disease at different locations

Trial on leaf blast was conducted at Hazaribagh and Mandya; on neck blast at Malan and Lonavala; on both leaf and neck blast the trial was conducted at Jagdalpur. Leaf blast and neck blast was recorded in terms of disease severity at all locations. Leaf blast severity was very high at Hazaribagh (78.73%), Jagdalpur (60.74%); and high at Mandya (49.14%). With respect to neck blast, very high disease severity of 60.27%, 51.30%, and 50.59% was recorded at all the three locations *viz.*, Lonavala, Malan and Jagdalpur respectively. Among the different essential oils tested for their efficacy against leaf blast at Jagdalpur and Mandya, application of two sprays of Neem oil @ 2 ml/l (T7) effectively reduced the leaf blast severity and per cent of disease reduction was varied from 41.21% to 37.80% compared to control. Similarly, the same treatment recorded high grain yield (JDP – 4603 kg/ha; MND - 4404 kg/ha). At Hazaribagh, application of two sprays of Clove oil @ 2 ml/l (T6) significantly reduced the disease severity from 78.73% to 42.63% and increased the grain yield from 1984 kg/ha to 3244 kg/ha. The fungicide treatment (T9 - Carbendazim @0.6g/l) performed well in all the three locations in reducing the disease severity (Table 102). With respect to neck blast, application of Neem oil @ 2.0ml/l (T7) significantly reduced the neck blast disease severity at Jagdalpur (DS - 27.01%; Control - 50.59%) and Malan (DS - 43.50%; Control - 51.30%). The same treatment significantly increased the grain yield compared to control (JDP = T6 – 4603 kg/ha; Control – 3320 kg/ha; MLN = T6 – 2538 kg/ha; Control – 1440 kg/ha). At Lonavala, except Carbendazim @0.6g/l (T9), all the other treatments did not show much difference in reducing the disease severity (Table 103).

Table 101: Experimental details of Special trial on essential oils for the management of rice diseases, *Kharif*-2019

S. No	Location	Disease Recorded	Test Variety	Screening	Date of activities					
					Sowing/ Transplanting	Inoculation	Initial symptom	Spraying	Observation	Harvesting
1	Chinsurah	Sheath Blight	Swarna (MTU 7029)	Artificial	27.06.2019 02.08.2019	06.09.2019	15.09.2019	18.09.2019 26.09.2019	18.10.2019	04.12.2019
2	Chiplima	Sheath Blight	Swarna	Artificial	28.06.2019 25.07.2019	21.09.2019	-	24.09.2019 01.10.2019	04.11.2019	26.11.2019
3	Faizabad	Sheath Blight	Pusa Basmati-1	Artificial	29.06.2019; 27.07.2019	24.09.2019	01.10.2019	28.09.2019; 06.10.2019	05.10.2019	08.11.2019
4	Hazaribag	Leaf Blast	C0-39	Artificial	09.072019; 27.07.2019	06.09.2019	08.09.2019	08.09.2019 16.09.2019	19.09.2019	25.10.2019
5	IIRR	Sheath Blight	TN 1	Artificial	24.07.19	07.10.19	10.10.2019	17.10.2019	21.10.2019	26.11.2019
6	Jagdalpur	Leaf blast Neck blast	Swarna	Natural	20.06.2019; 25.07.2019	-	30.08.2019	28.09.2019; 14.10.2019;	26.09.2019	29.12.2019
7	Lonavala	Neck blast	EK-70	Natural	15.06.2019; 22.07.2019	-	16.09.2019	14.09.2019 24.09.2019	12.09.2019	25.10.2019
8	Ludhiana	Sheath Blight	PR114	Artificial	27.05. 2019; 27.06.2019	02.09.2019	05.09.2019	04.09.2019; 14.09.2019	05.09.2019	20.10.2019
9	Malan	Neck Blast	HPU 2216	Natural	18.06.2019; 23.07.2019	-	-	09.09.2019; 16.09.2019	05.11.2019	20.11.2019
11	Mandya	Leaf blast	MTU1001	Artificial	14.08.2019; 16.09.2019	-	10.10.2019	16.10.2019; 23.10.2019	15.10.2019	05.01.2020
12	Maruteru	False smut	Swarna (MTU-7029)	Artificial- ShB Natural - FS	10.07.2019; 07.08.2019	17.09.2019	20.09.2019	21.09.2019; 03.10.2019	20.10.2019 19.11.2019	09.12.2019
13	Moncompu	Sheath blight	UMA(MO 16)	Natural	03.09/2019; 24.09.2019	-	08.10.2019	10.10.2019; 22.10.2019	03.01.2020	14.01.2020
14	Pantnagar	False Smut	Pant Dhan-4	Artificial	22.06.2019; 19.07.2019	12.10.2019	20.10.2019	21.10.2019; 28.10.2019	04.11.2019	15.11.2019
15	Chiplima	Sheath blight	Swarna	Artificial	28.06.2019; 25.07.2019	21.09.2019	-	24.09.2019; 01.10.2019	14.10.2019; 04.11.2019	26.11.2019
16	Sabour	Brown spot	Rajendra Sweta	Natural	26.06.2019; 25.07.2019	-	22.09.2019	25.09.2019; 10.10.2019	28.09.2019	28.11.2019
17	Raipur	Sheath blight	Swarna	Artificial	02.07.2019; 31.08.2019	09.10.2019	13.10.2019	13.10.2019; 19.10.2019	30.10.2019	23.11.2019
18	Pusa	Brown spot	Pankaj (HS)	Natural	15.06.2019; 10.07.2019	.	-	-	-	-

Table 102: Effect of essential oils against Leaf blast and grain yield at different locations *Kharif*, 2019

T. No	Treatment	Leaf blast								
		HZB			JDP			MND		
		Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)
T 1	Citronella oil @2.0ml/l	44.43 (41.79)	43.57	3032	51.85	14.64	3710	31.36	36.18	3740
T 2	Eucalyptus oil @2.0ml/l	46.86 (43.18)	40.48	2866	48.89	19.51	3850	29.88	39.19	4256
T 3	Cedar wood oil @2.0ml/l	52.47 (46.40)	33.35	2580	42.96	29.27	4497	33.83	31.16	4344
T 4	Nirgundi oil @2.0ml/l	48.11 (43.90)	38.90	2726	50.37	17.07	3763	28.64	41.72	4253
T 5	Lemon grass oil @2.0ml/l	48.27 (43.99)	38.69	2458	45.19	25.60	4293	30.37	38.20	4246
T 6	Clove oil @2.0ml/l	42.63 (40.75)	45.85	3244	48.15	20.73	3867	31.60	35.69	4022
T 7	Neem oil @2.0ml/l	49.60 (44.75)	37.00	2697	37.78	37.80	4603	28.89	41.21	4404
T 8	Emulsifier @2.0ml/l	55.54 (48.16)	29.46	2087	47.41	21.95	4033	30.86	37.20	4619
T 9	Carbendazim @0.6g/l	39.28 (38.79)	50.11	3405	36.30	40.24	5013	28.15	42.71	4808
T10	Control	78.73 (62.58)	-	1984	60.74	-	3320	49.14	-	3514
	C.V (%)	2.3	-	1.51	4.0	-	1.87	3.33	-	5.13
	LSD @ 5% *(P= 0.05)*	1.79	-	70.12	3.22	-	131	1.97	-	371
	Transformation	AT	-		-	-	-	-	--	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

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Table 103: Effect of essential oils against Neck blast and grain yield at different AICRIP locations, *Kharif*, 2019

T. No	Treatment	Neck Blast								
		JDP			MLN			LNV		
		Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)
T 1	Citronella oil @2.0ml/l	41.59 (40.14)	17.78	3710	46.10	10.14	2401	57.20	5.09	1772
T 2	Eucalyptus oil @2.0ml/l	36.15 (36.94)	28.53	3850	44.03	14.23	2229	54.78	9.11	1825
T 3	Cedar wood oil @2.0ml/l	28.62 (32.33)	43.41	4497	47.17	7.99	2023	58.21	3.42	1732
T 4	Nirgundi oil @2.0ml/l	38.85 (38.54)	23.19	3763	47.97	6.43	2058	55.95	7.16	1839
T 5	Lemon grass oil @2.0ml/l	29.73 (33.03)	41.23	4293	44.33	13.65	2675	56.20	6.75	1744
T 6	Clove oil @2.0ml/l	33.60 (35.41)	33.58	3867	44.30	13.65	2298	57.87	3.98	1600
T 7	Neem oil @2.0ml/l	27.01 (31.30)	46.61	4603	43.50	15.20	2538	55.79	7.43	1922
T 8	Emulsifier @2.0ml/l	32.06 (34.46)	36.61	4033	47.70	7.02	2023	59.70	0.95	1837
T 9	Carbendazim @0.6g/l	26.28 (30.83)	48.04	5013	33.10	35.48	3052	45.00	25.34	2325
T10	Control	50.59 (45.32)	-	3320	51.30	-	1440	60.27	-	1737
	C.V (%)	2.94	-	1.87	11.79	-	14.59	2.11	-	1.17
	LSD @ 5% *(P= 0.05)*	1.80	-	131	9.08	-	569	2.03	-	36
	Transformation	AT	-	-	-		-	-	-	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Effect of essential oils against sheath blight disease at different locations

Trial on the effect of essentials oils for the management of sheath blight disease severity was conducted at Chinsurah, Chiplima, IIRR, Ludhiana, Maruteru, Masodha (Faizabad), Moncompu, Raipur and Sabour. Disease severity was very high at IIRR (96.12%), Maruteru (76.59%), Raipur (75.55%), Moncompu (72.96%), Masodha (71.10%), Chinsurah (70.37%); high at Chiplima (47.03%) and moderate at Ludhiana (35.60%). Among the different essential oils tested, spraying of Neem oil @2.0ml/l (T7) was effective in reducing the disease severity at Chinsurah and Ludhiana. The percentage of disease reduction was varied between 18.05% and 23.57% compared to control and similarly the grain yield was also increased compared to control (CHN – 4900 kg/ha; LDN – 7133 kg/ha). Spraying of Citronella oil @2.0ml/l (T1) was effective in reducing the disease severity at Chiplima (DS - 30.00%) compared to control (47.03%) and increased the grain yield from 4711 kg/ha to 5578 kg/ha. At Maruteru spraying of Nirgundi oil @2.0ml/l (T4) reduced the disease severity from 76.59% to 28.95%. At IIRR and Raipur, T6 (Clove oil@ 2.0ml/l) treatment effectively reduced the disease severity compared to control treatment (IIRR = T6 - 49.52%; Control - 96.12%; RPR = T6 - 65.92%; Control - 75.55%). The disease reduction percentage was varied from 12.75% (RPR) to 48.48% (IIRR). With respect to grain yield, there was no significant difference among the treatments. At Moncompu spraying of Lemon grass oil @2.0ml/l (T5) effectively reduced the disease wherein percentage of disease reduction was 83.00% and grain yield was 3367 kg/ha. At Masodha, spraying of Cedar wood oil @2.0ml/l (T3) was effectively reduced the disease with 48.36% disease reduction and increased the grain yield from 2233 kg/ha to 3217 kg/ha (Table 104).

Effect of essential oils against brown spot and false smut disease at different locations

The trial for the management of brown spot was conducted at Sabour under natural disease pressure. The disease severity was moderate (31.39%). Among the tested oils, Citronella oil @2.0ml/l (T1) significantly reduced the disease severity from 31.39% to 11.37% with the percentage reduction of 63.78%. The same treatment increased the grain yield from 3983 kg/ha to 6200 kg/ha. At Maruteru and Pantnagar essential oils were tested against false smut disease. At Maruteru, spraying of Citronella oil @2.0ml/l (T1) significantly reduced the percentage from 16.31% to 9.93% and increased the yield from 3442 kg/ha to 4220 kg/ha. At Pantnagar, maximum of 11.20% disease reduction was recorded with Neem oil @2.0ml/l (T7) but there was no significant difference in the grain yield with respect to different treatments (Table 105).

Table 104: Effect of essential oils against sheath blight and grain yield - *Kharif*, 2019

T. No	Treatment	Sheath blight											
		CHN			CHP			IIRR			LDN		
		Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)
T 1	Citronella oil @2.0ml/l	64.71 (53.54)	8.03	4000	30.00 (33.06)	36.21	5578	53.21 (46.82)	44.64	2463	31.9 (34.38)	10.38	6522
T 2	Eucalyptus oil @2.0ml/l	68.00 (55.53)	3.35	4000	41.48 (40.06)	11.79	5089	69.89 (56.96)	27.29	2283	27.9 (31.86)	21.70	6911
T 3	Cedar wood oil @2.0ml/l	66.27 (54.47)	5.83	3900	35.56 (36.52)	24.40	5333	66.51 (54.62)	30.81	2497	30.4 (33.42)	14.59	7044
T 4	Nirgundi oil @2.0ml/l	66.67 (54.73)	5.26	3933	38.15 (38.08)	18.89	5311	69.95 (56.75)	27.22	2343	29.3 (32.76)	17.67	7156
T 5	Lemon grass oil @2.0ml/l	67.03 (54.94)	4.73	4167	41.85 (40.27)	11.01	5000	60.85 (51.26)	36.69	1970	34.9 (36.21)	1.96	6961
T 6	Clove oil @2.0ml/l	69.43 (56.41)	1.32	4100	40.74 (39.57)	13.37	5133	49.52 (44.72)	48.48	1923	32.1 (34.46)	10.00	6778
T 7	Neem oil @2.0ml/l	57.67 (49.39)	18.05	4900	37.78 (37.89)	19.68	5267	60.04 (50.85)	37.53	2057	27.2 (31.45)	23.57	7133
T 8	Emulsifier @2.0ml/l	70.63 (57.16)	-0.38	3433	44.07 (41.57)	6.29	4756	64.21 (53.25)	33.19	1980	26.6 (31.03)	25.34	7083
T 9	Carbendazim @0.6g/l	26.83 (31.17)	61.87	5767	24.81 (29.73)	47.24	6067	36.68 (46.82)	61.84	2463	15.2 (22.96)	57.25	8217
T10	Control	70.37 (57.00)	-	3517	47.03 (43.28)	-	4711	96.12 (56.96)	44.64	2283	35.6 (36.63)	-	6539
	C.V (%)	1.98	-	8.38	9.67	-	8.07	5.95	-	10.08	5.17	-	3.9
	LSD @ 5% *(P= 0.05)*	1.77	-	600	6.30	-	722	5.38	-	398	2.88	-	470
	Transformation	AT	-	-	AT	-	-	AT	-	-	AT	-	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

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Table 104: Effect of essential oils against sheath blight and grain yield - *Kharif*, 2019

T. No	Treatment	Sheath blight												
		MTU				MSD (FZB)			MNC			RPR		
		Disease Severity (%)	Disease Incidence (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)
T 1	Citronella oil @2.0ml/l	47.99 (48.65)	56.35 (44.21)	37.34	4220	37.5 (37.72)	47.33	3100	37.03 (37.19)	49.25	3367	69.62 (57.08)	7.85	8800
T 2	Eucalyptus oil @2.0ml/l	48.08 (47.49)	54.31 (43.53)	37.22	4200	41.8 (40.24)	41.28	2950	17.59 (24.65)	75.89	2833	70.73 (58.04)	6.38	8556
T 3	Cedar wood oil @2.0ml/l	51.81 (47.67)	54.64 (43.64)	32.35	3827	36. 7 (37.28)	48.36	3217	32.03 (33.99)	56.10	3067	70.36 (57.04)	6.87	8766
T 4	Nirgundi oil @2.0ml/l	28.95 (33.15)	32.00 (34.68)	62.20	4580	40.0 (39.21)	43.76	2833	40.55 (39.50)	44.42	3233	71.85 (59.04)	4.90	8850
T 5	Lemon grass oil @2.0ml/l	52.84 (55.04)	65.77 (47.97)	31.01	4210	41.3 (39.95)	41.98	2850	12.40 (20.05)	83.00	3367	72.59 (58.65)	3.92	8983
T 6	Clove oil @2.0ml/l	56.66 (55.71)	68.16 (48.27)	26.02	3763	45.2 (42.23)	36.45	2800	33.70 (35.37)	53.81	2700	65.92 (54.51)	12.75	8400
T 7	Neem oil @2.0ml/l	51.29 (46.00)	51.76 (42.68)	33.03	4015	46.8 (43.15)	34.20	2750	11.48 (19.59)	84.27	3400	69.62 (56.64)	7.85	8216
T 8	Emulsifier @2.0ml/l	41.57 (45.58)	51.27 (42.36)	45.72	4289	50.4 (45.23)	29.10	2633	29.07 (32.46)	60.16	2867	68.14 (55.65)	9.81	8366
T 9	Carbendazim @0.6g/l	46.15 (43.03)	46.61 (40.96)	39.74	4311	29.7 (32.99)	58.20	3667	15.18 (22.93)	79.19	2900	13.73 (21.93)	81.83	9006
T10	Control	76.59 (75.76)	91.15 (61.13)	-	3442	71.1 (57.53)	-	2233	72.96 (58.68)	-	2200	75.55 (60.73)	-	7150
	C.V (%)	15.19	19.32	-	15.23	4.01	-	5.68	17.32	-	11.89	11.52	-	3.59
	LSD @ 5% *(P= 0.05)*	11.77	16.50	-	715	2.85	-	283	9.63	-	610	10.65	-	524
	Transformation	AT	AT	-		AT	-		AT	-		AT	-	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation)

Table 105: Effect of essential oils against severity of Brown spot and False smut - *Kharif*, 2019

| T. No | Treatment | Brown spot | | | False smut | | | | | |
| | | SBR | | | MTU | | | PNT | | |
		Disease Severity (%)	% decrease over control	Grain Yield (Kg/ha)	% of infected panicles/m^2	% decrease over control	Grain Yield (Kg/ha)	% of infected panicles/m^2	% decrease over control	Grain Yield (Kg/ha)
T 1	Citronella oil @2.0ml/l	11.37 (19.67)	63.78	6200	9.93 (3.12)	39.12	4220	31.19 (33.94)	3.02	5525
T 2	Eucalyptus oil @2.0ml/l	14.77 (22.57)	52.94	5767	9.78 (3.10)	40.04	4200	30.20 (33.32)	6.10	5569
T 3	Cedar wood oil @2.0ml/l	18.72 (25.62)	40.34	5467	13.15 (3.61)	19.37	3827	30.80 (33.70)	4.22	5593
T 4	Nirgundi oil @2.0ml/l	20.74 (27.08)	33.89	5250	10.00 (3.14)	38.69	4580	30.53 (33.53)	5.06	5550
T 5	Lemon grass oil @2.0ml/l	13.39 (21.45)	57.33	6033	13.23 (3.56)	18.88	4210	30.01 (33.20)	6.70	5575
T 6	Clove oil @2.0ml/l	24.51 (29.65)	21.90	4783	13.40 (3.64)	17.84	3763	30.42 (33.46)	5.42	5530
T 7	Neem oil @2.0ml/l	25.51 (30.33)	18.70	4450	16.31 (4.02)	0.00	4015	28.56 (32.29)	11.20	5554
T 8	Emulsifier @2.0ml/l	27.43 (31.56)	12.58	4267	15.91 (3.98)	2.45	4289	30.01 (33.20)	6.69	5577
T 9	Carbendazim @0.6g/l	14.53 (22.39)	53.71	5683	6.97 (2.64)	57.27	4311	21.20 (27.40)	34.07	6095
T10	Control	31.39 (34.06)	-	3983	16.31 (4.04)	-	3442	32.16 (34.52)	-	5428
	C.V (%)	2.42	-	2.86	14.53	-	15.23	2.42	-	2.09
	LSD @ 5% *(P= 0.05)*	1.09	-	254	0.86	-	715	1.36	-	200
	Transformation	AT	-	-	ST	-	-	AT	-	-

(Figures in the parenthesis indicate transformed means; AT- Arc sine transformation; ST- Square root transformation)

Annexure I

Weather conditions at test locations where Plant Pathology Coordinated Trials were conducted, *Kharif*-2019

S. No	Location/ Details		Weather data from May-2019 to January-2020								
1	**Aduthurai**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		0	0	2	7	11	11	8	10	-
	Rainfall (mm)		0	0.8	21.2	92.8	251.2	226.7	286.7	247.3	-
	Temp. (^{0}C)	Maximum	37.2	36	34.5	34.8	51	32.0	31.6	29.5	-
		Minimum	27.3	26.7	25.2	24.6	35.9	23.9	22.9	21.2	-
	RH (%)	Morning	87	85	87	83	128	94.5	97	98	-
		Evening	51	57	51	53	86	73	100	92	-
2	**Almora**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	7	14	19	6	3	-	-	-
	Rainfall (mm)		-	53.45	114.25	252.95	46.25	16.5	-	-	-
	Temp. (^{0}C)	Maximum	-	30.225	29.32	28.62	29.05	27.3	-	-	-
		Minimum	-	16.34	19.15	20.26	19.075	11.1	-	-	-
	RH (%)	Morning	-	77.04	89.86	92.12	92.67	92.8	-	-	-
		Evening	-	47.86	64.08	70.38	60.7	48.52	-	-	-
3	**Arundhutinagar**	No Data									
4	**Bankura**	No Data									
5	**Chatha**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	4	11	8	7	3	3	-	-
	Rainfall (mm)		-	24.2	322.8	172.7	168.2	30.6	77.4	-	-
	Temp. (^{0}C)	Maximum	-	40.5	34.7	33.7	33	29.4	24	-	-
		Minimum	-	24.1	26.3	25.9	24.6	17.2	13	-	-
	RH (%)	Morning	-	50	81	87	89	87	90	-	-
		Evening	-	29	60	65	66	53	50	-	-
6	**Chinsurah**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		6	9	17	23	22	11	2	1	-
	Rainfall (mm)		124	74.4	183.6	285.6	162.2	121.3	87.3	9	-
	Temp. (^{0}C)	Maximum	37.38	37.21	35.7	34.63	34.31	32.27	30.26	26.09	-
		Minimum	27.26	25.13	24.45	24.31	24.37	21.69	11	11.17	-
	RH (%)	Morning	89.84	90.5	92.03	90.9	89.07	93.03	95.3	94.26	-
		Evening	58.1	65.63	71.42	71.97	72.47	70.62	59.63	54.16	-
7	**Chiplima**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		0	7	10	9	5	0	0	1	-
	Rainfall (mm)		0	217.8	241.3	357.9	116.5	0	0	0.4	-
	Temp. (^{0}C)	Maximum	39.7	34.9	31.9	31.6	33	32.3	28.8	30	-
		Minimum	23.2	24.6	24	24.7	23.5	20.4	14.3	9.5	-
	RH (%)	Morning	76	82	90	90	87	88	90	94	-
		Evening	48	66	73	78	69	62	69	42	-
8	**Coimbatore**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		6	0	1	6	9	13	5	6	-

S. No	Location/ Details		Weather data from May-2019 to January-2020								
	Rainfall (mm)		63	0	40	299.5	38.7	314.7	83.6	59.9	-
	Temp. (⁰C)	Maximum	35.1	33.1	31	28	29	30.5	29.6	29.3	-
		Minimum	21.8	22.3	21.4	21.2	21.4	21.9	21.5	22.3	-
	RH (%)	Morning	88.5	75.8	82.6	83	77.13	89.3	79.2	83.2	-
		Evening	-	-	-	-	-	-	-	-	-
9	**Cuttack**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		3	7	6	14	14	9	1	-	-
	Rainfall (mm)		190	197	488.3	522	529	746.8	6.4	-	-
	Temp. (⁰C)	Maximum	37.4	34.4	32.3	31.9	31.7	31.5	29.6	-	-
		Minimum	25.9	26.3	25.6	25.5	25.1	24.1	20.5	-	-
	RH (%)	Morning	89.1	83.9	88.7	89	93.8	92.8	90.5	-	-
		Evening	63.7	65.8	72.7	81.2	79.6	69.7	59.4	-	-
10	**Faizabad (Masodha)**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	1	6	5	6	4	-	-	-
	Rainfall (mm)		-	24.00	396.50	44.10	217.00	179.60	-	-	-
	Temp. (⁰C)	Maximum	-	38.9	33.6	32.8	32.6	28.9	-	-	-
		Minimum	-	26.8	26.0	26.3	25.8	22.5	-	-	-
	RH (%)	Morning	-	74.6	88.5	84.3	90.3	94.1	-	-	-
		Evening	-	42.2	75.0	77.9	78.5	83.1	-	-	-
11	**Gangavati**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		1	7	9	5	14	12	1	2	-
	Rainfall (mm)		7.60	45.20	57.00	37.90	251.40	160.90	6.10	6.3	-
	Temp. (⁰C)	Maximum	38.64	34.83	32.19	29.87	29.73	30.58	30.00	28.71	-
		Minimum	24.41	24.43	23.58	22.51	22.80	21.90	19.56	17.58	-
	RH (%)	Morning	49.77	60.58	66.93	70.32	77.36	90.08	82.62	87.98	-
		Evening	19.19	33.92	42.99	47.22	58.32	55.82	45.51	40.73	-
12	**Gerua**	No Data	**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
13	**Ghaghraghat**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		_	_	03	18	15	01	-	02	-
	Rainfall (mm)		_	_	53.4	250.40	424.4	5.6	-	24.00	-
	Temp. (⁰C)	Maximum	41.48	41.48	32.80	32.32	30.47	30.61	28.73	21.48	-
		Minimum	25.87	28.10	26.39	25.65	24.57	19.71	15.93	9.13	-
	RH (%)	Morning	-	-	-	-	-	-	-	-	-
		Evening	-	-	-	-	-	-	-	-	-
14	**Gudalur**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		19	21	30	26	17	15	6	3	-
	Rainfall (mm)		324	845	732	753	316	268	41	23	-
	Temp. (⁰C)	Maximum	28.5	23.2	21.9	22.3	25.7	26	25.6	25.2	-
		Minimum	18.3	16.8	17	16.8	16.9	16.5	15.1	14.3	-
	RH (%)	Morning	92.8	98.1	98.3	98.5	95.3	93.6	91.2	90.4	-
		Evening	81	91.3	92.5	91.7	78.5	74.7	68.2	65.8	-

S. No	Location/ Details		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
15	Hazaribagh		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
	Rainy days (No.)		4	8	19	19	15	17	0	2	-
	Rainfall (mm)		11.6	100.1	302	169.3	267.7	174.2	0	14.2	-
	Temp. (^{0}C)	Maximum	38.8	36.8	30.8	29.9	29.5	27.8	26.3	21.8	-
		Minimum	22.6	24.3	22.1	21.9	21.2	17.5	11.1	7.2	-
	RH (%)	Morning	49.7	65.5	83.3	82.8	85.4	83.4	81.8	86.1	-
		Evening	32.4	49.4	78.1	77.1	74	69.6	52.5	55.3	-
16	IIRR		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
	Rainy days (No.)		1	5	8	12	14	12	0	1	-
	Rainfall (mm)		9.0	85.0	60.6	190.8	318.8	129	0.0	8.8	-
	Temp. (^{0}C)	Maximum	41.2	36.8	32.0	29.8	29.7	30	29.9	27.8	-
		Minimum	21.3	20.0	18.3	17.4	16.7	16.6	17.7	15.8	-
	RH (%)	Morning	59.0	81.0	83.3	88.1	93.1	92.9	90.3	91.7	-
		Evening	29.0	48.0	58.1	68	69.9	70.5	49.4	52	-
17	Imphal		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
	Rainy days (No.)		17	20	26	16	21	13	6	2	-
	Rainfall (mm)		87.1	181.4	202.6	62.9	253.7	159.8	38.7	13.6	-
	Temp. (^{0}C)	Maximum	33.2	34	35	34.4	32.5	30.4	29.7	25	-
		Minimum	17.6	19	20.2	21.2	19.5	17.6	9.4	2.5	-
	RH (%)	Morning	81.2	87.4	89.4	87.1	90.6	93.8	93.5	92.6	-
		Evening	54.7	66.1	70.9	67.5	68	67.3	56.2	46.4	-
18	Jagadalpur		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
	Rainy days (No.)		5	9	21	22	16	11	0	0	-
	Rainfall (mm)		89.8	221	622.5	582.2	499	237.8	0.4	5.8	-
	Temp. (^{0}C)	Maximum	38.1	34.8	28.9	28.7	29.4	30.2	29.5	28.1	-
		Minimum	23.7	24.6	22.6	22.4	22.5	20.9	14.8	12.8	-
	RH (%)	Morning	72	80	93	94	94	96	97	97	-
		Evening	37	55	78	77	75	67	46	42	-
19	Jagtial	No Data	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
20	Karjat		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
	Rainy days (No.)		0	11	27	25	25	13	1	0	-
	Rainfall (mm)		0	536.80	1901.80	1075.50	1267.40	289.30	2.60	0	-
	Temp. (^{0}C)	Maximum	39.4	34.79	29.65	29.60	29.10	32.29	33.61	32.75	-
		Minimum	24.5	25.91	24.22	24.43	23.61	22.61	20.94	19.13	-
	RH (%)	Morning	74.8	81.23	91.37	90.70	92.20	90.53	90.13	88.81	-
		Evening	33.8	62.27	86.73	82.47	85.63	67.70	49.10	42.71	-
21	Kaul		May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20
	Rainy days (No.)		0	2	0	0	0	0	0	2	
	Rainfall (mm)		0	152.6	0	0	0	0	0	152.6	
	Temp. (^{0}C)	Maximum	39.6	32.4	32.3	31.1	26.7	17.2	39.6	32.4	
		Minimum	19.5	25	23.5	16.5	11.4	4.8	19.5	25	

S. No	Location/ Details		Weather data from May-2019 to January-2020								
	RH (%)	Morning	65	91	94	94	90	93	65	91	
		Evening	30	77	73	49	47	64	30	77	
22	**Khudwani**		**Apr -19**	**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**
	Rainy days (No.)		11	11	9	8	6	0	4	13	-
	Rainfall (mm)		44.8	89	104	104.8	117.8	0	32.6	300.9	-
	Temp. (^{0}C)	Maximum	21.88	23.2	26.03	30.46	29.36	30.75	21.93	8.95	-
		Minimum	7.11	8.19	10.72	16.46	16.2	12.2	5.95	2.21	-
	RH (%)	Morning	75.56	74.32	73.33	77.12	83.93	73.76	87.9	91.26	-
		Evening	52.6	54.54	57.76	50.41	58.83	44	54.61	57.23	-
23	**Lonavala**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	19	30	31	29	11	1	-	-
	Rainfall (mm)		-	60.1.2	2718	1762.8	1359	190	0.2	-	-
	Temp. (^{0}C)	Maximum	-	28.8	29	30	30.2	31	29.6	-	-
		Minimum	-	19.4	20	20	19	20	15.6	-	-
	RH (%)	Morning	-	94.8	95.7	94.7	90.4	83	79.8	-	-
		Evening	-	86.6	93.2	89.2	77.9	77.7	55	-	-
24	**Ludhiana**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		3	2	10	8	8	0	2	-	-
	Rainfall (mm)		20	29.9	218.4	331.4	264.8	0	35.2	-	-
	Temp. (^{0}C)	Maximum	38	40.4	34	33.8	33.1	30.6	25.6	-	-
		Minimum	22.1	26.8	26.7	26.1	25.5	18.4	13.4	-	-
	RH (%)	Morning	52	55	79	85	86	90	90	-	-
		Evening	22	30	64	67	68	46	47	-	-
25	**Malan**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		2	4	15	12	6	1	1	-	-
	Rainfall (mm)		33.4	25.6	438.5	407.1	203.7	18.4	8.4	-	-
	Temp. (^{0}C)	Maximum	33.1	35.3	31.1	30.2	30.1	24.8	23.5	-	-
		Minimum	15.9	18.2	18.6	16.2	15	13.9	13.8	-	-
	RH (%)	Morning	76.6	78.8	81.6	81.5	81.4	77.7	77.4	-	-
		Evening	70	75.3	74	77.5	75.8	69.5	70	-	-
26	**Mandya**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		7	3	2	13	6	15	1	0	-
	Rainfall (mm)		134.3	40.4	14.2	120.2	129.6	331.2	16.9	2	-
	Temp. (^{0}C)	Maximum	35.5	36	33	28.9	31.3	31.4	30.9	27.8	-
		Minimum	23.5	22.8	21.5	18.7	19	18.8	18.2	17.3	-
	RH (%)	Morning	81	88	86	88	91	93	90	91	-
		Evening	53	56	61	85	79	77	75	77	-
27	**Maruteru**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		Nil	4	12	11	12	12	Nil	Nil	-
	Rainfall (mm)		Nil	42.1	297.3	142.3	259.9	181.8	Nil	Nil	-
	Temp. (^{0}C)	Maximum	36.1	35	31.77	30.39	31.42	31.16	30.95	29.73	-

S. No	Location/ Details		Weather data from May-2019 to January-2020								
		Minimum	23.5	21.63	21.52	21.73	21.62	22.61	22.61	23.42	-
	RH (%)	Morning	85.7	82.8	86.84	86.39	88.07	86.94	83.29	82.26	-
		Evening	45.47	50.67	60.32	66.74	71.9	68.03	60.39	69.26	-
28	**Moncompu**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		3	19	19	22	21	23	14	2	-
	Rainfall (mm)		11.4	470.8	324.3	587.8	282	693.5	98.7	160	-
	Temp. (^{0}C)	Maximum	33.82	32.55	31.09	30.16	29.34	32.6	33.13	34	-
		Minimum	24.33	24.03	23.63	23.42	23.82	22.3	22.2	22.3	-
	RH (%)	Morning	78.9	83.73	84.32	92.1	91.77	89.1	90.9	87.3	-
		Evening	70.3	84.4	85.39	87.3	87.43	85.6	84.4	80.1	-
29	**Mugad**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		1	10	23	19	12	16	3	-	-
	Rainfall (mm)		19.4	168.2	369.2	811	124.6	455.4	105	-	-
30	**Navsari**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		0	7	15	17	20	4	3	0	-
	Rainfall (mm)		0	262	491	535	750	95	37	0	-
	Temp. (^{0}C)	Maximum	34.7	33.5	31.4	29.9	30.9	33.4	33.2	31	-
		Minimum	24.3	25.4	24.2	23.5	22.9	21.5	19.1	15.8	-
	RH (%)	Morning	85	91.5	94.4	96	95.9	87.8	91	85	-
		Evening	61.9	77	87.1	87.4	87.9	68.3	63.8	62.1	-
31	**Nawagam**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		0	4	5	15	15	2	0	0	-
	Rainfall (mm)		0	103.4	120.2	458.2	207.2	46	0	0	-
	Temp. (^{0}C)	Maximum	41.8	38.8	34.8	31.1	31.6	33.4	32.0	27.5	-
		Minimum	20.6	26.1	26.5	25.4	25.2	21.9	20.2	14.4	-
	RH (%)	Morning	65	73	76	90	89	82	79	75	-
		Evening	21	47	64	76	81	58	55	40	-
32	**Nellore**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	1	6	5	7	10	8	7	2
	Rainfall (mm)		-	6.4	15.2	81.9	185.4	330.2	166.8	158	29.6
	Temp. (^{0}C)	Maximum	-	38.9	37.2	33	33.2	31.7	30.1	28.5	29.1
		Minimum	-	28.9	28.8	25.9	25.2	24.2	24.5	22.7	21.8
	RH (%)	Morning	-	60.8	66.9	72.5	83.6	84.1	86.4	89.4	93.5
		Evening	-	45.5	54.2	57.3	62.7	72.8	71.2	71.3	73.4
33	**New Delhi**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		7	3	12	10	4	1	1	-	-
	Rainfall (mm)		45.4	31.2	283.3	246.1	17.6	41	4.8	-	-
	Temp. (^{0}C)	Maximum	40.1	54.2	35.7	33.4	34	31.7	27.28	-	-
		Minimum	23.9	28	27.5	26.5	25.6	18.3	14.5	-	-
	RH (%)	Morning	62.2	64.6	80.6	89.1	87.8	87	87	-	-
		Evening	36.3	40.9	66.2	68.1	63.1	50.3	64	-	-

S. No	Location/ Details		Weather data from May-2019 to January-2020								
			May-19	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
34	**Pantnagar**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		0	6	17	15	8	0	1	-	-
	Rainfall (mm)		0.00	257.00	239.50	332.30	290.60	0.00	29.20	-	-
	Temp. (°C)	Maximum	72.40	37.00	32.30	32.00	31.60	30.90	28.00	-	-
		Minimum	20.90	37.00	25.90	25.50	24.30	18.60	13.40	-	-
	RH (%)	Morning	56.00	69.90	85.20	88.20	89.30	89.40	90.20	-	-
		Evening	20.00	43.90	69.40	69.40	67.40	50.90	47.70	-	-
35	**Patna**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
36	**Pattambi**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		4	16	23	24	16	19	4	1	-
	Rainfall (mm)		82.5	342.6	560.9	1090.3	386.6	455.1	48.6	6	-
	Temp. (°C)	Maximum	34.9	31.7	29.8	29.3	30.7	31.6	32.3	31.9	-
		Minimum	23.4	22.3	21.5	21.1	21.8	21	21.1	20.8	-
	RH (%)	Morning	82.8	93.1	95.4	95.8	93.3	89.1	89.5	80.1	-
		Evening	55.4	72.3	77.1	79.9	70.4	70.5	60.6	53.7	-
37	**Ponnampet**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		5	17	25	24	20	16	0	1	-
	Rainfall (mm)		60.40	263.40	623.30	1795.90	496.70	229.40	0.00	33.00	
38	**Portblair**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
39	**Pusa**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	4.00	13.00	7.00	12.00	1.00	0.00	-	-
	Rainfall (mm)		-	35.00	354.00	171.70	403.00	6.60	0.00	-	-
	Temp. (°C)	Maximum	-	37.50	33.10	34.30	31.40	29.30	26.31	-	-
		Minimum	-	26.50	26.10	26.80	23.20	22.10	20.10	-	-
	RH (%)	Morning	-	80	88	89	91	92	93	-	-
		Evening	-	59	73	75	80	82	60	-	-
40	**Raipur**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		-	-	-	-	-	-	-	-	-
	Rainfall (mm)		10.6	75.8	211.5	301.6	451.1	81.6	0	0.8	-
	Temp. (°C)	Maximum	42.9	40.5	32.4	30.4	31	30.6	30.2	27.6	-
		Minimum	27,5	28.2	25.6	25.2	24.9	23	17.2	13.8	-
	RH (%)	Morning	46	67	86	91	91	91	90	86	-
		Evening	19	39	70	77	74	65	94	40	-
41	**Rajendranagar**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		1	5	8	12	14	12	0	1	-
	Rainfall (mm)		9.0	85.0	60.6	190.8	318.8	129	0.0	8.8	-
	Temp. (°C)	Maximum	41.2	36.8	32.0	29.8	29.7	30	29.9	27.8	-
		Minimum	21.3	20.0	18.3	17.4	16.7	16.6	17.7	15.8	-
	RH (%)	Morning	59.0	81.0	83.3	88.1	93.1	92.9	90.3	91.7	-
		Evening	29.0	48.0	58.1	68	69.9	70.5	49.4	52	-
42	**Ranchi**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**

S. No	Location/ Details		Weather data from May-2019 to January-2020								
			May-19	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
43	**Rewa**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		3	2	15	19	17	3	0	1	-
	Rainfall (mm)		6	40.6	364.4	517.2	335.6	42.8	0	30.6	-
	Temp. (^{0}C)	Maximum	43.3	42.3	34.9	33.2	32.7	30.9	30.5	22.7	-
		Minimum	22.4	26.9	25.5	25.8	24.9	20.1	14.4	9.8	-
	RH (%)	Morning	34	40	73	84	86	84	71	75	-
		Evening	17	25	57	71	77	67	55	59	-
44	**Sabour**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		4	4	18	12	16	4	0	2	-
	Rainfall (mm)		15.3	45.3	24.72	5.46	23.2	5.85	0	1.8	-
	Temp. (^{0}C)	Maximum	41.8	41.5	38.2	36.6	36.4	32.8	30.5	27.5	-
		Minimum	19.6	20	23.2	25	21.6	18.8	13.5	9.2	-
	RH (%)	Morning	89	87	98	92	92	100	92	94	-
		Evening	60.4	66	86	84	92	92	83	81	-
45	**Titabar**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		16.0	18.0	17.0	23.0	15.0	22.0	0.0	0.0	-
	Rainfall (mm)		357.7	266.4	397.8	182.8	348.4	167.6	0.0	0.0	-
	Temp. (^{0}C)	Maximum	28.8	33.1	32.4	34.0	32.1	30.1	28.4	23.8	-
		Minimum	20.8	24.0	24.1	23.9	22.3	20.1	15.4	8.6	-
	RH (%)	Morning	90.0	92.5	90.3	92.0	95.1	94.8	95.0	93.0	-
		Evening	81.0	76.1	80.0	72.0	75.6	78.5	71.5	63.0	-
46	**Umiam (Barapani)**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		14	18	19	14	23	11	4	3	-
	Rainfall (mm)		203.3	380.4	396.7	290.6	429.7	259.1	33.2	24.8	-
	Temp. (^{0}C)	Maximum	28.1	28.1	27.9	29.6	27.1	25.1	24.2	20.5	-
		Minimum	18	19.9	20.4	20.6	19.3	16.1	12.8	6.9	-
	RH (%)	Morning	83.5	87.3	89.2	84.4	92.7	92.4	87.2	85.9	-
		Evening	69	78.9	79.8	74.6	86.3	78.4	66.3	58.9	-
47	**Upper Shillong**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		20	25	28	17	25	16	5	-	-
	Rainfall (mm)		238	317.2	534.1	187.9	220	259.6	34.1	-	-
	Temp. (^{0}C)	Maximum	28.2	29.2	28.1	29.5	29.2	24.8	24.2	-	-
		Minimum	12.5	15	16.1	16.4	13.5	10.1	7.6	-	-
	RH (%)	Morning	100	100	100	98	98	100	100	-	-
		Evening	44	57	58	58	61	47	24	-	-
48	**Varanasi**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**
	Rainy days (No.)		0	4	11	14	13	3	0	2	-
	Rainfall (mm)		0	26.6	296.2	244.7	756	42.8	0	36.6	-
	Temp. (^{0}C)	Maximum	45	46.3	38.4	34.8	34.6	33.2	31.6	28	-
		Minimum	20.8	21.8	20.8	22.4	19.4	16	19	3.2	-
	RH (%)	Morning	73	71	98	97	98	97	96	97	-
		Evening	46	70	98	92	98	93	67	92	-
49	**Wangbal**		**May-19**	**Jun-19**	**Jul-19**	**Aug-19**	**Sep-19**	**Oct-19**	**Nov-19**	**Dec-19**	**Jan-20**

(No data indicates weather data was not received from the respective locations)

S. No.	Location	Latitude (North)	Longitude (East)	Elevation (m. from MSL)	Ecosystem	Sowing (Year, 2019)	Fertilizer Basal - NPK (Kg/ha)	Fertilizer top dressing (Kg/ha)
					lowland		60:50:50	
25	**Ludhiana**	30º90'N	75º 85'E	262 m	Irrigated	25-07-2019	Urea 37kg/Acre	Urea 74kg/acre
26	**Malan**	32º1'N	76.2ºE	950 m	Upland	07-08-2019	120:40:40 60:40:40	60N
27	**Mandya**	12°36'N	76º15'E	694.64 m	Irrigated	30-08-2019	150:50:50 75:50:50	75:0:0
28	**Maruteru**	16°38'N	81º44'E	5m	Irrigated	18-07-2019	150:40:40 50:40:20	50:0:0 (NPK) 50:0:20
29	**Moncompu**	9⁰51'N	76º5'E	10 m	Irrigated	09-09-2019	120:45:45 Kg/ha 1/2N,1/2P&K	15DAP-1/4N,1/4P&K, 40DAP-1/4N,1/4P&K
30	**Mugad**	50° 26' N	74°54'50"E	697 m	Rainfed drill sown low land	06-10-2019	63 : 50 : 50 NPK kg/ha	33 kg N/ha
31	**Navsari**	20º57'N	72º29'E	10 m	Irrigated	17-07-2019	75:50:0	75N
32	**Nawagam**	22º48'N	71º38'E	32.4 m	Irrigated	20-07-2019	120:30:0 60 N + 30 P_2O_5.	60 N + 20 ZnSO4
33	**Nellore**	14º27'N	79º59'E	20 m	Irrigated	21-09-2019	-	32 24 16 kg/acre NPK
34	**New Delhi**	28º08'N	77º12'E	216 m	Irrigated	17-07-2019	N:P:K 60:60:40 Kg per ha	20 kg N per ha
35	**Pantnagar**	29ºN	79⁰30'E	343.84 m	Irrigated	09-07-2019	60:60:40-15Kg (ZnSO4)	60N +5.0 (ZnSO4)
36	**Patna**	25⁰13.25ft	84⁰14.405ft.	77 m	Upland/Irrigated	27-07-2019	120:60:40	60N
37	**Pattambi**	10⁰48'N	76⁰12'E	25.35 m	Upland/Rainfed Lowland	25-07-2019	120:30:30 80:30:15	40:0:15 (NPK)
38	**Ponnampet**	12º29'N	75º56'E	856 m	Rainfed Lowland	31/07/2019	75:75:90 37.5:75:45	37.5 N:0:45
39	**Portblair**	6º14'N	92º94'E	5 m	Rainfed lowland	-	-	-
40	**Pusa**	25.98 N	85.67 E	51.8 m	Irrigated	23-07-2019	40:40:20	40N:40N
41	**Raipur**	21º16'N	81º36'E	681 m	Irrigated	20-07-2019	60Kg N	60N
42	**Rajendranagar**	17º 19'N	78º23'E	542 m	Irrigated	15-07-2019	180:60:40 45:60:40	135N IN 3 Splits
43	**Ranchi**							
44	**Rewa**	24º30'N	81º15'E	360 m	Upland Irrigated	23-07-2019	80:60:40	60N
45	**Sabour**	25º 23'N	87º07'E	37.19m	Rainfed lowland	18-07-2019	40:40:20	20N
46	**Titabar**	26ºN	93ºE	99 m	Lowland	29-07-2019	60:20:40	20 kg N 2
47	**Upper Shillong**	25º 30'122''N	91º 48'413'' E	1675 msl	Rainfed lowland	24-07-2019	120N:40P:40 60 kg N ,40 Kg P ,40 Kg K at Nursery	60 kg N at Nursery
48	**Varanasi**	25º20'N	23º03'E	75.7 m	Irrigated	30-07-2019	120:60:60	30N
49	**Wangbal**	24º8'N	94'E	781 m	Irrigated	-	-	-

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Annexure – III (Abbreviations)

Name of the centre	Code	Details	Code
Aduthurai	ADT	(-)	Data not available
Almora	ALM	A	Artificial Inoculation
Arundhatinagar	ARD	AVTs	Advanced variety trails
Bankura	BAN	BLB	Bacterial leaf blight
Chatha	CHT	BS	Brown spot
Chinsurah	CHN	CV	Co-efficient of variation
Chiplima	CHP	DSN	Donor Screening Nursery
Coimbatore	CBT	FS	False Smut
Cuttack (NRRI)	CTK	GD	Glume discoloration
Gangavati	GNV	GSN	Germplasm Screening Nursery
Gerua	GER	IC No.	Indigenous collection Number
Ghagraghat	GGT	IET No.	Initial Evaluation Trail Number
Gudalur	GDL	IVTs	Initial variety trails
Hazaribagh	HZB	LB	Leaf blast
Imphal	IMP	LSD	Least significant difference
Indian Institute of Rice Research	IIRR	LSI	Location Severity Index
Jagadalpur	JDP	MSL	Mean sea level
Jagtial	JGT	N	Natural Infection
Karjat	KJT	NB	Neck blast
Kaul	KUL	NdB	Node blast
Kudhwani	KHD	NHSN	National Hybrid Screening Nursery
Lonavala	LNV	NSN-1	National Screening Nursery 1
Ludhiana	LDN	NSN -2	National Screening Nursery 2
Malan	MLN	NSN-H	National Screening Nursery- Hills
Mandya	MND	PI	Promising index
Maruteru	MTU	RTD	Rice Tungro Disease
Masodha (Faizabad)	MSD	RTV	Rice Tungro Virus
Moncompu	MNC	SE	Standard error
Mugad	MGD	ShB	Sheath blight
Navsari	NVS	ShR	Sheath rot
Nawagam	NWG	SI	Susceptibility Index
Nellore	NLR	StR	Stem rot
New Delhi (IARI)	NDL		
Pantnagar	PNT		
Patna	PTN		
Pattambi	PTB		
Ponnampet	PNP		
Portblair	POB		
Pusa	PSA		
Raipur	RPR		
Rajendranagar	RNR		
Ranchi	RNC		
Rewa	REW		
Sabour	SBR		
Titabar	TTB		
Umiam (Barapani)	UMM		
Upper Shillong	USG		
Varanasi	VRN		
Wangbal	WGL		

Progress Report-2019 report was compiled by the following scientists of Department of Plant Pathology, ICAR-IIRR, Hyderabad.

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