2. ENTOMOLOGY
TRIALS
Kharif 2022

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TRIALS

Rabi 2021-22

SUMMARY

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***Kharif* 2022**

SUMMARY

All India Coordinated Entomology Programme was organized and conducted during *kharif* 2022 with seven major trials encompassing various aspects of rice Entomology involving 306 experiments (93.1%) that were conducted at 40 locations (ICAR-IIRR, 30 funded & 9 voluntary centres) in 22 states and one Union territory. Details of scientists involved in the program at head quarters, cooperating centres and the performance of centres is provided in Appendices I and II.

2.1. Host plant resistance studies

Host plant resistance studies at ICAR-IIRR comprised of six screening trials involving 1581 entries which included 1521 pre-breeding lines & varieties, 98 hybrids, 13 germplasm accessions and136 checks. These entries were evaluated against 15 insect pests in 209 valid tests (47 greenhouse reactions +162 field reactions). The results of these reactions identified **92 entries (5.81% of the tested) as promising** against various insect pests. Of these promising materials, **14 entries (15.21%)** are under **retesting**.

Planthopper screening trial (PHS): E*valuation of 176 entries against the two planthoppers BPH and WBPH in 12 greenhouse and 8 field tests at 16 locations indicated 16 entries (including 8 breeding lines, 1 local collection,* ***3 NILs viz.,*** **IR-187, IR-188 and IR-189 in the background of IR 24, two gene pyramided lines ISM 3 and ISMA 4 in the background of Improved Samba Mahsuri, two N22 mutant lines *viz.*, MH 4906 and MH 663** ***and 3 three checks PTB 33, RP2068-18-3-5 and MO1*** *as promising in 6 to 13 tests. Two breeding lines viz.,* ***RP-GP-3000-179-3-9-1, WGL 1533*** *and one local collection* ***IBT-BPH M 23*** *from IBT, PJTSAU performed better in the second year of* ***retesting****.*
In **Gall midge screening trial (GMS)** evaluation of 110 entries bred specifically for gall midge resistance were evaluated in 8 field tests and one greenhouse reaction against 9 populations of gall midge which helped in identification of 12 entries as most promising with nil damage in 5-6 tests of the 9 valid tests. **Of these, IBTWGL 3, RP 6614-102-11-3-3-1-1-1(FBL 19101), GM 5 (IBT) IBTWGL 2, IBTWGL 21** with known gall midge resistance genes in different varietal backgrounds were observed to be **promising** under retesting**.** Another 24 entries were promising in 4 tests.

Field evaluation of 25 entries replicated thrice at 18 locations in **Leaf Folder Screening Trial (LFST)** during Kharif 2022 revealed that 22 entries were promising in 2-6 tests out of 14 valid field tests. In the first year of testing, **RP5564 PTB 1-4-2 was found promising** in 6 of the 14 valid tests while four entries, viz., BPT **3182, RP5564 PTB 1-4-1-2, RP5564 PTB 2-4-1-5, and RP5564 PTB 1-4-1-1** were promising in 5 out of 14 valid field tests. **BPT 3068, RP5564 PTB 1-4-1** and **BPT 3085** were found promising in 4 valid field tests out of 14 while seven entries were promising in 3 valid field tests and the rest of the entries in 2 out of 14 valid field tests.

Stem borer screening trial (SBST) comprised of 55 entries which were evaluated in 16 valid field tests for dead heart and white ear damage identified 10 entries *viz.*, **BK 49-76, RP 6505-40, RP5564 PTB 2-4-2-1-2, RP5564 PTB 1-4-2, RP5564 PTB 2-4-2-1-1, BK 64-116, RP-6112-SM-92-R-293-2-2-4-4(a), RP5564 PTB 1-1-1-2, RP2068-18-3-5, W1263** as **promising** in 4 to 5 of the 16 tests in terms of low dead hearts (≤5% DH) and white ear damage ≤5% WE. These entries were also promising in 1 to 5 tests of the 8 valid tests with higher grain yield (≥15.0 g/hill) suggesting that recovery resistance and tolerance could be the mechanism in these entries as they have good grain yield despite damage. BK 49-76, BK 64-116 and RP 2068-18-3-5 were under retesting.

In Multiple resistance screening trial (MRST) trial, 40 entries were evaluated in 6 greenhouse and 45 field tests against 7 insect pests which helped in identification of 7 entries and 3 checks as promising in 5-8 tests against 2-4 insect pests with a PPR of 2.8-6.7. Of these, 4 entries viz., **PTB21, NND2, WGL1062** and **RNR37971** were in first year of testing; three entries viz., **RP 6461-248-1, RP Bio 4918-230** and **CRCPT 8** identified as promising were under second year of retesting. The check lines W1263, RP 2068-18-3-5 and PTB 33 were promising in 6-8 tests against 2-3 pests with a PPR of 3.9 -6.7.

IIRR-National Screening Nurseries (NSN) comprised of 4 trials *viz.,* National Screening Nursery 1(NSN1), National Screening Nursery 2 (NSN2), National Screening Nursery–Hills (NSN hills) and National Hybrid Screening Nursery (NHSN).

IIRR-**NSN1** constituted with 348 entries (326 AVT entries along with 10 insect checks and 12 disease checks) and evaluated at 18 locations against 10 insect pests identified 12 entries *viz.*, IET nos. **29749, 29743, 29935, 30233, 30261** as promising in 5 tests; **30097, 30078, 29235, 29238, 29875, 29203, 30106** in 4 tests of the 32 valid tests against 2 pests. PTB 33 was promising in 7 tests; Aganni and W1263 in 4 tests each.

IIRR-NSN 2 trial comprised of 581 entries (557 entries from IVT trials, 10 insect and 14 disease checks) and was evaluated at 17 locations against 8 insect pests. Evaluation of NSN 2 entries in 26 valid tests (8 greenhouse and 18 field tests) against 5 insect pests identified 9 entries as promising in 5-8 tests. **IET no 30838** was promising in 6 tests; **IET nos. 30831, 30845,**

30851, 30852, 30966, 30794 were promising in 5 tests. **RP 2068-18-3-5** and **PTB**-**33** were promising in 8 and 6 tests, respectively of the 26 valid tests.

IIRR NSN-Hills trial consisting of 124 entries (100 hill entries+10 insect check lines and 14 disease checks) was evaluated at 7 locations in 15 valid tests (6 greenhouse and 9 valid field tests) against 6 insect pests. Three test entries viz., **Vivekdhan 86 (NC), IET Nos 28887, 30518** along with check lines Nidhi, HR12 and RP 2068-18-3-5 were promising in 3 tests. Aganni and PTB33 were promising in 5 and 4 tests respectively of the 15 valid tests.

In **IIRR-NHSN** trial, 98 hybrids along with 24 checks were evaluated in 7 greenhouse and 11 field tests against 4 insect pests at 12 locations in 18 valid tests. The results identified **IET Nos. 30602, 30624 30594** and **RP 2068-18-3-5** as promising in 4 of the 18 tests. PTB33 was promising in 6 valid tests; IET Nos. **30609, 30620** and **30597** were promising in 3 tests.
NRRI screening nursery comprised of NRRI-NSN1 and NRRI- NSN2.

NRRI-NSN1: Evaluation of 51 entries in NSN-1 in 4 greenhouse and 13 field tests against 7 insect pests in 17 valid tests helped in identification of 4 entries *viz*., **IET Nos 31288, 29032, and CR Dhan 506** as promising in 4-5 tests against 2-3 insect pest damages.

NRRI- NSN2: Evaluation of 166 entries in NSN-2 in 4 greenhouse and 8 field tests against 5 insect pests in 12 valid tests helped in identification of 3 entries *viz*., **IET Nos 31232, 31221,31283** as promising in 2- 4 tests against 1-2 insect pest damages

INSECT BIOTYPE STUDIES comprising of four trials 1) Gall midge biotype monitoring trial (GMBT), 2) Planthopper special screening trial (PHSS) 3) Gall midge population monitoring (GMPM) and 4) Planthopper population monitoring trial (PHPM) were conducted to monitor the virulence pattern of gall midge and brown planthopper populations.

In **Gall midge biotype monitoring trial (GMBT)** 19 gene differentials were evaluated in one greenhouse and 11 field tests at 12 locations which identified **Aganni (*Gm8*), INRC 3021 (*Gm8*)** and **INRC17470** as promising in 9 -11 of the 12 valid tests. **INRC15888** and **INRC17470** were promising in 7 tests. W1263 (*Gm1*) was promising in 6 of the 12 valid tests. The results suggest that donors with *Gm8* and *Gm1* genes confer resistance to gall midge across the test locations.

Planthopper Special Screening Trial (PHSS) Among the 17 gene differentials evaluated, two gene differentials viz., **PTB 33 (with *bph2+Bph3+ Bph32*+unknown factors)** and **RP 2068- 18-3-5 (with *Bph33t* gene)** were promising in 12 and 13 tests respectively tested at 12 locations. **Swarnalatha** with ***Bph6*** gene performed better at 4 locations. Six gene differentials *viz*., **T12** (with *bph7* gene), **Rathu Heenati** (with *Bph3+Bph17* genes), **ASD 7** (with *bph2* gene), Babawee (with *bph 4* gene), **IR 36** (with *bph2* gene) and **IR 64** (with *Bph1+* gene) showed low damage at two locations each. Two gene differentials *viz*., **Chinasaba** (with bph8 gene) and **Milyang 63** (with unknown genetics) performed better at one location each.

Studies on virulence composition of gall midge populations in **Gall Midge Population Monitoring (GMPM**) trial conducted at six locations across four southern states in India through single female progeny testing suggest that Aganni (*Gm8*) holds promise at Jagtial, Warangal and Ragolu. Low virulence against W1263 (*Gm1*) was observed at Gangavathi, Pattambi and Warangal. Akshayadhan (with *Gm4* + *Gm8*) was promising at Jagtial and Warangal. However, a close monitoring of the virulence pattern in endemic areas is important.

In Planthopper Population Monitoring Trial (PHPM), the virulence monitoring studies of brown planthopper populations using the four gene differentials revealed that **at Ludhiana, brown planthopper population was more virulent than the other five BPH populations viz., IIRR-Rajendranagar, Coimbatore, New Delhi and Pantnagar** in terms of virulent females which laid eggs, egg period, number of nymphs hatched, nymphqal survival, and highest percentage of brachypterous adults. At all the locations, all the females were virulent except at Coimbatore.

Evaluation of granular insecticides for the management of gall midge (EIGM)

For gall midge, seed treatment with thiamethoxam followed by application of fipronil 3% GR at 20-25 DAT in the main field was most effective with significantly lower SS (8.27%) as compared to other treatments

In case of yellow stem borer, seed treatment with thiamethoxam followed by chlorantraniliprole 0.4 GR in the main field was most effective in preventing DH formation with 62.18 per reduction over control. Whereas, application of fipronil granules in nursery + chlorantraniliprole granules in main field was significantly superior in preventing white ear formation with 51.67 % reduction over control.

With respect to yield, treatment effects were significant and in all the treatments higher yield was recorded as compared to untreated control (3214.5 kg/ha). **Application of fipronil granules in nursery followed by**

chlorantraniliprole granules in main field was the best treatment with significantly higher yield (4496.4 kg/ha) as compared to remaining treatments. **Seed treatment with thiamethoxam followed by fipronil granules in main field (4468.2 kg/ha) and seed treatment with thiamethoxam followed by chlorantraniliprole granules in main field (4340.8 kg/ha) were second and third best** regarding yield and were at par with application of Fipronil 0.3 GR in the nursery + Chlorantraniliprole 0.4 GR in the main field. The best treatment resulted in 39.9% yield advantage over the untreated control.

Insecticide Botanicals Evaluation Trial (IBET) was carried out at 25 locations across the country to evaluate performance of various treatments having combinations of commercially available neem formulation, effective plant oils along with recommended insecticides against major insect pests of rice and consequent impact on natural enemies and grain yield during kharif, 2022. Based on the performance of the various treatment combinations in controlling the pest damage at various locations, all insecticides module was found to be superior in reducing stem borer damage at both vegetative and reproductive phases compared to other insecticide-botanical modules. Among combinations, lowest silver shoot damage was recorded in all insecticide treatment which was on par with other treatments. Combination of Neemazal, neem oil and triflumezopyrim treatment was found to effective against BPH. Against WBPH and GLH all insecticides combination was found to be the most effective treatment. Against leaf folder also insecticides module was effective in reducing leaf damage. All insecticide combination treatments were found moderately effective in reducing damage by whorl maggot, gundhibug and grasshopper pests. There was no significant difference in natural enemy (mirid, spider and coccinellid) populations among treatments, signifying that both insecticides and botanicals are safe to beneficial organisms. **Among various treatments, all insecticides treatment recorded highest mean yield of 4991.0 kg/ha followed by treatment consisting of neemazal, neem oil and triflumezopyrim giving yield of 4554.2 kg/ha.**

Optimum Pest Control Trial (OPCT) was initiated in kharif 2022 to evaluate the performance of the identified multiple pest resistant rice cultures under protected and unprotected conditions against the pest damages in a location. In this trial, 9 resistant cultures along with TN1 were evaluated at 9 locations. Silver shoot damage by gall midge was reported across 4 locations. Observations revealed that across locations the **damage** was **significantly lower** (1.7-3.03%SS) in **W1263 (*Gm1*), CUL M9, Suraksha (*Gm11*), Akshyadhan PYL, RP2068- 18- 3-5 (*gm3*)** as compared to other varieties (F val, 8.901 at 9 df P =0) where the damage ranged from 7.7-11.6% SS. Dead heart damage was reported from 7 locations and it was significantly lower in insecticide treatments at 4 locations as compared to unprotected control. **CUL M9, RP2068, RP5587-273-1-B-B-B** and **Suraksha recorded lower dead heart damage** across locations though statistically not significant (F val 0.426, P = 0.916). White ear damage was significantly lower in protected treatments at 3 locations of the 8 locations recorded. Though CulM9 had the least damage followed by KMR3, RP 2068-18-3-5, CR Dhan317, Akshaydhan PYL, W 1263 and RP5587-273-1-B-B-B, the reaction was statistically not significant (F val 0.098, P 1.0 at 9 df). Analysis of grain yield from 5 locations identified CR Dhan 317, KMR 3, RP2068-18-3-5, with higher yield (4 -4.5/ha) though statistically not significant (F val 1.563, P val 0.144).

Influence of crop establishment methods (IEMP), a collaborative trial with Agronomy, was conducted at 11 locations during Kharif 2022. Across the locations, the incidence of dead hearts caused by stem borer and leaf folder was significantly high in semi-dry rice followed by puddled direct-seeded rice while white ears were high in aerobic rice. Gall midge incidence was significantly high in puddled direct-seeded rice followed by the normal transplanting method. The incidence of whorl maggot, caseworm, and BPH was also significantly high in puddled direct-seeded rice**. Overall, the incidence of insect pests was significantly high in puddled direct-seeded rice followed by the normal transplanting method while the incidence was low in direct-seeded rice, semi-dry rice, mechanical transplanting, and aerobic rice.**

Cropping system influence on insect pest incidence (CSIP), a collaborative trial with Agronomy was conducted at two locations, Karjat and Titabar, during Kharif 2022. Low incidence of stem borer, leaf folder, whorl maggot, and case worm was observed in different main plots of crop establishment methods and sub-plots of straw incorporation techniques.

Evaluation of pheromone blends for insect pests of rice (EPBI) trial was conducted at 9 locations during Kharif 2022. The field trial was constituted with normal and slow-release formulations of yellow stem borer, rice leaf folder, and the multispecies blend of both RLF and YSB pheromone compounds. The slow-release formulations recorded maximum catches compared to the normal formulations in the case of yellow stem borer and leaf folder across locations. The peak mean catches of leaf folder per week were maximum at Ludhiana (89) followed by IIRR (66), while yellow stem borer, catches were maximum at Ludhiana (69). Similarly, adult catches were high in the slow-release formulation of multi-species lure at Ludhiana (45/week) with more stem borer species than leaf folders.

Evaluation of entomopathogens against sucking pests of rice (EESP) was taken up in nine locations to test the effectiveness of entomopathogens

Lecanicillium saksenae, *Beauveria bassiana* and *Metarhizium anisopliae* against sucking pests especially the ear head bug in rice. The results indicated ***L. saksenae*** **to be the most effective** of the three pathogens tested in seven locations with no detrimental impact on natural enemies.

Integrated Pest Management special (IPMs) trial was conducted with zone-wise practices at 19 locations in 40 farmers' fields during Kharif 2022. In Zone I (Hilly areas, dead hearts caused by black beetle was predominant in both IPM (24.2%) and FP plots (31.8%) followed by leaf folder in FP plots (16.9%). In Zone II (Northern areas), the incidence of stem borer, leaf folder, BPH, and WBPH was observed. Leaf folder incidence (> 20 % LFDL) was higher in FP plots at Kaul. In Zone III (Eastern areas) and Zone IV (North Eastern areas), stem borer, gall midge, leaf folder, whorl maggot, and BPH were observed but the incidence was low. In Zone V (Central areas), a high incidence of gall midge was observed in all the FP plots (15.3 – 37.2% SS) compared to IPM plots (9.9-11.3% SS) at Jagdalpur. Thrips damage was also high in FP plots at Jagdalpur (8.9-14.3% THDL) as against IPM plots (8.9-14.3% THDL). However, the incidence of stem borer, leaf folder, whorl maggot, and BPH was low. In Zone VI (Western areas), the incidence of stem borer, leaf folder, and WBPH was low in both IPM and FP plots across locations. In Zone VII (Southern areas), stem borer incidence was high in FP plots at Aduthurai (35.3-46.1% DH) compared to IPM plots (5.4 -15.6% DH). Similarly, gall midge and leaf folder incidence were high in FP plots and low in IPM plots in all three farmers' fields at Aduthurai.

IPM implemented plots resulted in mean grain yield advantage of 51.0, 25.0, 21.4, 10.9, 45.0 and 11.0% in Zone-I, III, IV, V, VI and VII, respectively over the farmer practices. In IPM adopted fields, the mean weed population reduction over the Zones ranged from 22.5 % in Zone-V (Central areas) to 66.7 % in Zone-VII at 30 DAT; and from 27.6 % in Zone-I (Hilly areas) to 56.1 % in Zone-I at 60 DAT. The dry weed biomass reported from 13 locations showed that, both at 30 and 60 DAT, biomass was reduced significantly by 15.7 % in Zone-V (Central areas) to 69.7% in Zone-VI (Western areas); 18.2 % in Zone-V (Central areas) to 54.1% in Zone-VI (Western areas).

Adoption of IPM practices effectively reduced the disease progression of leaf blast, neck blast, bacterial blight, sheath blight, and brown spot in Zone II (Northern areas), leaf blast, neck blast, bacterial blight and sheath blight in Zone III (Eastern areas). There was significant reduction in the disease development of leaf blast, neck blast and sheath blight in Zone V (central areas), sheath rot and glume discolouration in Zone VI (Western areas), bacterial blight, false smut and leaf blast in Zone VII (Southern areas) due to the adoption of IPM practices.

Grain yields were significantly high in IPM-implemented plots resulting in high gross returns. Overall, BC ratios of IPM plots were superior to that of FP mainly due to better yields, lower input costs, and better returns.

Assessment of insect populations through light trap data revealed that **yellow stem borer, leaf folder, and planthoppers continued to be the most important pests in terms of numbers as well as spread across the locations. Gall midge continues** to be an **endemic pest**. However, **case worm,** and **gundhi bug** showed an **increase** in the **spread** and **intensity** of incidence posing **concerns** for **future**. Patterns in seasonal incidence and population build up based on light trap data indicates that **the key pests are reaching their peak levels in the months of October and November** in the **kharif season**. Therefore, strategies are to be timed accordingly for the effective management of insect pests in rice.

***Kharif* 2022**

Pest Survey Report-2022

Rice dwarfing symptoms were prevalent in parts of **Kathua district**, **Jammu and Kashmir** in rice transplanted during the first fortnight of June. **Roots of majority of the dwarfed rice plants harboured low to moderate population of rice-root nematode, *Hirschmanniella* spp**. During reproductive stage **grain** discolouration was prominent. In Panchmahal and Mahisagar Districts of Gujarat, yellow stem borer, leaf folder and whitebacked planthopper showed moderate infestation.

Leaf mite caused 40-50 per cent leaf damage in parts of Sembanar Koil Block, Myiladuthurai District, Tamil Nadu in the month of June. Due to cloudy and rainy weather conditions in the month of December, gall midge gained severity (12-65 %) in Thiruvidaimarthur and Myiladuthurai areas. Whereas, in Kumbakonam area severe damage was inflicted by leaf folder. In parts of Mayiladuthurai, Nagapattinam, and Tanjavur Districts, brown planthopper caused heavy damage. In Palakkad and Pattambi Districts of Kerala, armyworm and thrips caused 20-30 per cent damage at vegetative stage. In Alathur, Palakkad, Chittur, Pattambi and Kuzhalmannam regions brown planthopper, leaf mites and leaf folder were prevalent. In certain parts, brown planthopper inflicted severe damage. At seedling stage thrips infested severely (>75% leaf damage) in Kuttanad Taluk, Alappuzha District. In Udupi and Dakshina Kannada Districts of Karnataka, caseworm infestation was severe (56% leaf damage). Case worm and brown planthopper caused extensive damage in parts of Malavalli Taluk, Mandya District. Hispa incidence was moderate in Rayaparthy mandal of Warangal District, Telanagana. In Hasanparthy area, Telangana brown planthopper occurred in moderate level

2.1 HOST PLANT RESISTANCE STUDIES

Host plant resistance trials were conducted with the main objective of identifying new sources of resistance to major insect pests, evaluation of performance of breeding lines and also characterization of insect pest populations from various hot spots. To achieve these objectives, six trials *viz*., i) Planthopper screening trial (PHS) ii) Gall midge screening trial (GMS), iii) Leaf folder screening trial (LFST), iv) Stem borer screening trial (SBST) v) Multiple resistance screening trial (MRST) and vi) National screening nurseries (NSN) were constituted and conducted. The results are summarized and discussed trial wise. **In all 1581 entries were evaluated at 39 locations against 14 pests and 92 (5.81%) entries were identified as promising**. The reaction of the entries to insect pests in each trial are tabulated in a separate volume **“Screening Nurseries: Vol. II – Insect Pests & Diseases”.** The results are discussed trial wise:

i) Planthopper Screening Trial (PHS)

The planthopper screening trial was constituted with 176 entries comprising of 10 breeding lines developed at RRU, ANGRAU, Bapatla; 15 breeding lines developed at APRRI, ANGRAU, Maruteru, 10 breeding lines developed at TNAU, Coimbatore; 3 breeding lines and 12 germplasm lines from RARS, PJTSAU, Jagtial; 12 breeding lines developed at Kunaram, PJTSAU; 2 breeding lines developed at ARI, PJTSAU; Rajendranagar, 1 breeding line developed at RARS, PJTSAU, Warangal; 1 local collection from IBT, PJTSAU, Rajendranagar; 16 NILs in the genetic background of IR 24, 3 mutant lines derived from BPT 5204, 7 mutant lines derived from N22, 4 breeding lines, 8 recombinant inbred lines, 51 gene pyramided lines of improved Samba Mahsuri and Improved Samba Mahsuri recurring parent developed at IIRR, Hyderabad along with three resistant checks PTB 33 (BPH), RP 2068-18-3-5 (BPH) and MO1 (WBPH) as well as one susceptible check TN1. Of these, eight entries were under retesting. The entries were evaluated at 16 locations in 20 tests against brown planthopper (BPH), whitebacked planthopper (WBPH) and mixed populations of planthoppers under both field and greenhouse conditions. Evaluation of entries in 10 greenhouse and 1 field test against brown planthopper, 2 greenhouse and 1 field test against whitebacked planthopper and 6 field tests against mixed populations of planthoppers revealed that 8 breeding lines *viz*., GPSS-RIL 86, RP-GP-3000-179-3-9-1*, BPT 3194, BPT 3217, BPT 3199, KNM 14382, RNR 31643, WGL 1533*, one local collection IBT-BPH M 23* from IBT, PJTSAU, 3 NILs *viz*., IR-187, IR-188 and IR-189 in the background of IR 24, two gene pyramided lines ISM 3 and ISMA 4 in the background of Improved Samba Mahsuri, two N22 mutant lines *viz*., MH 4906 and MH 663 as promising in 6-11 tests (Table 1). Two breeding lines *viz*., RP-GP-3000-179-3-9-1, WGL 1533 and one local collection IBT-BPH M 23 from IBT, PJTSAU performed better in the second year of retesting. The susceptible check, TN1 recorded damage score in the range of 5.6 to 9.0 in these valid tests. The universal checks *viz*., PTB 33 and MO1 performed well in 13 and 6 tests respectively. The breeding line, RP 2068-18-3-5 carrying BPH resistance gene Bph33t and identified as a donor check line for BPH performed better in 13 tests. Mixed populations of brown planthopper and whitebacked planthopper were present at Aduthurai, Gangavathi, Jagitial, Maruteru, Pantnagar, Raipur, Sakoli and Warangal. Data on BPH and WBPH populations during the field evaluation at Gangavathi (WBPH: BPH in 1.0:0.69 ratio) revealed predominance of WBPH over BPH. At Aduthurai, in the early stages, brown planthopper population was more compared to whitebacked planthopper (6BPH: 1WBPH) but gradually WBPH population increased (1BPH:1WBPH). At Nawagam, only WBPH was present. BPH was predominant throughout the crop season at Pantnagar (BPH is 6-10 times more than WBPH). At Raipur, BPH was in more numbers throughout the crop season (BPH is 3 to 24 times more than WBPH). At Rajendranagar, only BPH population was present. At Sakoli, brown planthopper dominated (2-5 times more) whitebacked planthopper throughout the crop season. At Warangal, brown planthopper was present in maximum numbers (16-24 times more) compared to whitebacked planthopper.

Evaluation of 176 entries against the two planthoppers BPH and WBPH in 12 greenhouse and 8 field tests at 16 locations indicated 16 entries (including 8 breeding lines, 1 local collection, ***3 NILs viz.,*** **IR-187, IR-188 and IR-189 in the background of IR 24, two gene pyramided lines ISM 3 and ISMA 4 in the background of Improved Samba Mahsuri, two N22 mutant lines** ***viz.*****, MH 4906 and MH 663** ***and 3 three checks PTB 33, RP2068-18-3-5 and MO1*** *as promising in 6 to 13 tests. Two breeding lines viz.,* ***RP-GP-3000-179-3-9-1, WGL 1533*** *and one local collection* ***IBT-BPH M 23*** *from IBT, PJTSAU performed better in the second year of* ***retesting****.*

Table 2.1.1 Performance of the most promising entries against planthoppers in PHS kharif 2022

Entry No	Designation	Brrown Planthopper											Whitebacked planthopper			Planthoppers						No of Promising tests					
		IIRR	ADT	CBT	CTC	LDN	MND	NDL	PNT	RPR	WGL	RNR	IIRR	CBT	NWG	GGV	JGL	MTU	PNT	RPR	SKL						
		Greenhouse Reaction										FR	Gr.h reaction		FR	Field reaction						BPH		WBPH		PH	Total NPT (20)
		Damage Score										No/10h	DS	DS	No/10h	DS	No/10 h	DS	No/10 h	No/10h	%DT	GH (10)	Field (1)	GH (2)	Field (1)	Field (6)	
7	GPSS-RIL 86	5.0	5	5.0	5.0	3.0	3	7.9	9.0	0.9	7.5	680	7.3	9.0	64	5	293	9	71	106	37	7				1	8
12	RP-GP-3000-179-3-9-1*	5.0	5	6.2	7.0	3.0	7	8.3	8.6	4.8	7.0	1040	4.1	6.8	35	3	321	7	77	148	39	3		1	1	1	6
16	IBT-BPHM23*	4.0	6	5.2	9.0	3.0	3	6.5	6.3	NG	4.8	780	3.4	6.5	131	9	262	9	75	148	46	4		1		1	6
24	IR-187	5.6	3	5.0	5.0	8.5	5	7.4	8.0	1.5	4.8	670	4.4	5.0	79	3	296	9	76	100	36	6		2		2	10
25	IR-188	4.5	3	5.2	3.0	7.6	5	7.4	4.4	1.0	8.8	830	4.0	9.0	66	3	330	3	96	66	34	6		1		3	10
26	IR-189	5.4	9	8.4	5.0	3.0	5	7.2	5.2	1.2	8.3	960	9.0	7.1	68	5	337	3	62	78	31	4				3	7
37	ISM-3	0.9	7	5.0	5.0	2.5	3	9.0	5.2	1.3	7.7	500	8.3	8.7	143	5	333	5	73	130	27	6				2	8
62	MH4906	3.6	9	5.7	9.0	8.0	9	7.7	4.1	NG	8.7	520	4.6	8.6	133	3	163	9	78	170	5	2		1		3	6
67	MH663	3.2	7	3.8	5.0	8.0	9	7.3	5.6	NG	8.7	580	4.4	6.2	65	9	301	9	72	162	9	4				2	6
95	ISMA-13	4.1	3	7.0	3.0	2.8	3	8.0	9.0	1.4	9.0	540	8.5	8.7	43	7	236	9	74	88	31	6				3	9
103	BPT 3194	1.8	7	4.8	5.0	8.0	5	2.0	8.0	1.8	4.5	420	3.4	8.2	37	1	361	5	77	104	22	7		1	1	2	11
105	BPT 3217	6.5	8	5.0	9.0	5.5	5	7.5	5.2	2.2	9.0	520	2.6	6.8	31	1	329	9	82	130	NG	3		1	1	1	6
108	BPT 3199	2.8	5	1.8	3.0	8.3	5	2.0	8.6	1.3	8.3	1160	4.1	3.0	83	5	280	7	93	144	NG	7		2		0	9
152	KNM 14382	4.1	8	8.6	9.0	5.5	5	2.8	5.5	3.0	6.7	540	9.0	5.0	127	3	328	9	100	140	34	4		1		1	6
172	RNR 31643	4.2	5	3.0	9.0	8.0	9	4.6	6.4	4.3	3.0	500	6.3	NG	63	3	286	9	96	128	41	5				1	6
174	WGL 1533*	2.2	3	3.0	9.0	8.3	1	1.6	7.5	1.2	6.8	320	5.0	NG	39	1	104	NG	120	186	43	6	1	1	1	2	11
40	RP2068-18-3-5	2.9	5	5.0	NG	2.5	3	4.8	6.0	NG	7.5	290	5.4	4.2	39	1	195	1	60	102	44	6	1	1	1	4	13
60	MO1	5.4	7	5.1	7.0	3.0	5	5.7	9.0	5.3	8.6	440	3.0	5.9	89	3	165	9	81	134	20	2		1		3	6
140	PTB33	1.7	7	4.0	9.0	4.0	3	1.0	3.5	2.0	3.1	310	4.0	3.0	45	1	130	NG	131	164	28	5	1	2		2	13
Promising level		5	5	5	5	5	5	5	5	3	5	400	5	5	40	3	250	5	75	100	20						
No. of promising entries		19	24	18	33	17	64	16	13	30	6	24	33	10	24	58	28	17	31	24	17						

ii) Gall Midge Screening Trial (GMS)

The objective of this trial was to evaluate the performance of the donors and breeding lines developed from known sources of gall midge resistance against various populations of gall midge. The trial was constituted with 110 entries (95 entries comprising of breeding lines, 3 varieties and 12 insect checks). Of these 28 entries were under retesting. The nominations included breeding lines that were developed from 34 crosses bred at 8 centres, *viz., ICAR*- IIRR; IBT PJTSAU; RARS Jagtial; ARS Kunaram; RARS Warangal; RRC Rajendranagar and RARS Pattambi where gall midge is an endemic pest. Of these breeding lines, 41 lines were already identified as marker positive for various gall midge resistance genes like *gm3, Gm4, Gm8*. The entries were evaluated at 12 locations across the country against the prevailing gall midge populations. The reaction of the entries to various populations of gall midge from different locations in 9 valid tests is discussed as under:

Twenty entries along with the check varieties Kavya, Aganni and W1263 recorded nil plant damage at **IIRR** (greenhouse reaction)**, Jagdalpur and Chiplima** (field reaction).

Field reaction at **Ambikapur** helped in identification of 15 entries *viz*., RP6290-22-59 (RMS-22-16), RP6290-22-71(RMS-22-22), RP6290-22-24 (RMS-22-30), GP 91, KNM 14282, KNM 14283, KNM 14382, RNR 35112, RNR 35123, WGL-1119, WGL 1782, RP6504-46, RP6505-30, RP6505-32, RP6505-89 with nil damage along with the resistant checks Kavya and W1263.

At **Jagtial**, field screening had identified 47 entries with nil damage along with the resistant check Aganni.

At **Maruteru**, 29 entries had nil damage. The check variety Kavya recorded nil damage and W1263 had 10 % plant damage.

KNM 11575, KNM 11579, JGL 38071, KNM 12392, APKS 82-75, GP 91, WGL 1512 and Kavya recorded nil damage in field screening at **Pattambi**.

RP 6614-102-11-3-3-1-1-1(FBL 19101), GM 4 (IBT), PTB18, PTB21, RP6290-22-72 (RMS-22-23), RP6290-22-12 (RMS-22-27), WGL-1119 and WGL 1789 recorded nil damage in field reaction at **Ranchi**, Jharkhand.

JGL 38071, WGL 1624, GM 5 (IBT), IBTWGL 2, IBTWGL 3, IBT WGL 31, RP 5923, PTB 10, Aganni, RP6290-22-11 (RMS-22-26), RP6503-3 and Aganni recorded nil damage at **Warangal** in the field evaluation.

The results reveal that there is a variation in the performance of the lines which could be attributed to the variation in the virulence of the populations as reported in the other gall midge trials.

Overall reaction: *Evaluation of 110 entries in 8 field tests and one greenhouse reaction against 9 populations of gall midge helped in identification of 12 entries as most promising with nil damage in 5-6 tests* of *the 9 valid tests* ***(Table 2.1.2)****. Of these* ***IBTWGL 3, RP 6614-102-11-3-3-1-1-1(FBL 19101), GM 5 (IBT) IBTWGL 2, IBTWGL 21*** *with known gall midge resistance genes in different varietal* *backgrounds were promising under retesting. Another 24 entries were promising in 4 tests.*

Table 2.1.2 Reaction of most promising entries to gall midge populations in GMS, *kharif* 2022

GMS No.	Designation	IIRR	JDP	CHP	ABP	JGT	MTU	PTB	RCI	WGL	GMS NPT
		GH	50DAT	50DAT	50DAT	50DAT	50DAT	50DAT	50DAT	52DAT	9
		%DP	%DP	%DP	%DP	%DP	%DP	%DP	%DP	%DP	
21	IBTWGL 3 *	0.0	0.0	0.0	40.0	0.0	0.0	14.3	25.0	0.0	**6**
32	PTB21	0.0	0.0	0.0	20.0	0.0	0.0	23.8	0.0	10.0	**6**
75	WGL-1119	NT	0.0	0.0	0.0	0.0	0.0	23.8	0.0	45.0	**6**
2	KNM 11579	0.0	0.0	0.0	80.0	100.0	0.0	0.0	15.0	55.0	**5**
3	JGL 38071	0.0	0.0	NT	60.0	100.0	0.0	0.0	20.0	0.0	**5**
11	RP 6614-102-11-3-3-1-1-1(FBL 19101)*	0.0	0.0	0.0	60.0	10.0	0.0	4.8	0.0	5.0	**5**
17	GM 5 (IBT)*	0.0	0.0	0.0	70.0	0.0	10.0	42.9	15.0	0.0	**5**
19	IBTWGL 2*	0.0	0.0	0.0	20.0	0.0	10.0	28.6	5.0	0.0	**5**
22	IBTWGL 21*	0.0	0.0	0.0	40.0	0.0	0.0	28.7	20.0	5.0	**5**
1	KNM 11575	0.0	0.0	0.0	60.0	100.0	0.0	0.0	15.0	45.0	**5**
59	RP6290-22-4 (RMS-22-24)	0.0	0.0	0.0	30.0	0.0	0.0	14.3	20.0	10.0	**5**
62	RP6290-22-11(RMS-22-26)	NT	0.0	0.0	10.0	0.0	0.0	9.5	20.0	0.0	**5**
	Checks										
70	Kavya	0.0	0.0	0.0	0.0	100.0	0.0	0.0	15.0	100.0	**6**
80	Aganni	0.0	0.0	0.0	10.0	0.0	25.0	9.5	25.0	0.0	**5**
90	W1263	0.0	0.0	0.0	0.0	100.0	10.0	4.8	20.0	85.0	**4**
	Total tested	64	110	109	110	109	106	108	110	110	
	Max. damage in the trial	40.0	100.0	70.0	100.0	100.0	80.0	47.6	45.0	100.0	
	Min. damage in the trial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Average in the trial	5.3	28.5	15.5	38.8	40.2	14.2	19.7	18.4	37.1	
	Damage in TN1	25.6	95.0	50.0	67.5	87.5	45.0	29.8	23.8	91.3	

*Entry under retesting

iii)Leaf Folder Screening Trial (LFST)

To identify novel sources of resistance to rice leaf folder, *Cnaphalocrocis medinalis,* the Leaf Folder Screening Trial (LFST) was constituted and conducted in the field. The trial comprised of 10 nominations from Bapatla, Rice section, Acharya NG Ranga Agricultural University; 10 nominations from Pattambi, Regional Agricultural Research Station (RARS); one nomination from Nawagam Main Rice Research Station, Anand Agricultural University; two back-cross inbred lines (BILs) of Swarna/*Oryza nivara* from IIRR along with a susceptible check (TN1) and resistant check (W 1263). During *Kharif* 2022, the trial was conducted at 18 locations using a randomised block design with 25 entries and 3 replications.

This is the first year of testing these entries across locations. The maximum damage in the entries ranged from 15.7 to 45.9% LFDL while the average damage in the trial varied between 8.7 and 36.1%. Data analysis revealed 22 entries as promising in 2-6 tests of 14 valid field tests (**Table 2.1.3**). Nominations from Pattambi were promising at many locations whose parentage is RP Bio226/IRGC 71598/MTU 1010. Nominations from Bapatla were also found promising at many locations.

RP5564 PTB 1-4-2 was promising in 6 out of 14 valid field tests. Four entries, *viz.*, BPT 3182, RP5564 PTB 1-4-1-2, RP5564 PTB 2-4-1-5, and RP5564 PTB 1-4-1-1 were promising in 5 out of 14 valid field tests. Three entries, i.e., BPT 3068, RP5564 PTB 1-4-1 and BPT 3085 were found promising in 4 out of 14 valid field tests. Seven entries, *viz.*, RP5564 PTB 1-3, BPT 3077, RP5564 PTB 1-1-1-2, RP5564 PTB 2-4-2-1-1, BPT 3130, RP5564 PTB 1-1-1-4 and NPK 46 were found promising in 3 valid field tests. The rest of the seven entries were promising in 2 out of 14 field tests except BPT 3239, which was found promising only at one location. W 1263, the resistant check was promising in 10 out of 14 valid field tests.

*Field evaluation of 25 entries replicated thrice at 18 locations in **Leaf Folder Screening Trial (LFST)** during Kharif 2022 revealed that 22 entries were promising in 2-6 tests out of 14 valid field tests. In the **first year** of **testing**, **RP5564 PTB 1-4-2** was found **promising** in 6 of the 14 valid tests while four entries, viz., **BPT 3182, RP5564 PTB 1-4-1-2, RP5564 PTB 2-4-1-5,** and **RP5564 PTB 1-4-1-1** were promising in 5 out of 14 valid field tests. **BPT 3068, RP5564 PTB 1-4-1** and **BPT 3085** were found promising in 4 valid field tests out of 14 while seven entries were promising in 3 valid field tests and the rest of the entries in 2 out of 14 valid field tests.*

Table 2.1.3 Performance of promising entries against leaf folder in LFST, *Kharif* 2022

Designation	Parentage	Leaf folder Damaged Leaves (%)														
		ADT	BPT	CHT	CHN	CTC	KKL	KUL	LDN	MLN	NVS	NWG	PTB	RNR	NLR	NPT
		80 DAT	80 DAT	47 DAT	84 DAT	60 DAT	80 DAT	60 DAT	60 DAT	98 DAT	60 DAT	60 DAT	60 DAT	87 DAT	50 DAT	14
RP5564 PTB 1-4-2	RP Bio226 x IRGC 71598 x MTU 1010	11.2	12.8	21.1	12.9	24.2	19.8	28.2	37.7	18.3	5.6	18.6	18.2	10.9	22.6	6
BPT 3182	BPT 2231/MTU 1075	25.8	14.1	21.7	9.2	17.2	29.8	27.0	44.2	18.1	0.0	17.9	23.9	16.6	9.6	5
RP5564 PTB 1-4-1-2	RP Bio226 x IRGC 71598 x MTU 1010	19.6	5.2	20.2	11.8	11.0	17.9	31.7	34.2	17.5	5.7	29.5	20.2	17.6	12.8	5
RP5564 PTB 2-4-1-5	RP Bio226 x IRGC 71598 x MTU 1010	15.8	5.7	21.7	13.8	9.7	25.3	26.1	32.8	16.6	0.0	34.3	23.5	8.0	15.9	5
RP5564 PTB 1-4-1-1	RP Bio226 x IRGC 71598 x MTU 1010	10.9	6.9	21.5	12.8	14.5	28.6	22.4	36.7	17.1	6.6	29.2	29.1	12.8	13.4	5
BPT 3068	NLR 34449/ Ramappa	21.7	10.8	19.8	10.8	11.3	29.5	18.8	37.5	20.1	6.4	28.2	31.6	22.9	8.5	4
RP5564 PTB 1-4-1	RP Bio226 x IRGC 71598 x MTU 1010	6.8	8.9	21.7	12.3	14.4	26.6	26.9	35.5	20.7	15.1	28.2	21.3	15.2	9.9	4
BPT 3085	BPT 5204/MTU 1075	29.2	17.0	22.7	15.2	8.7	20.9	19.7	32.9	16.5	26.3	17.7	25.5	31.7	26.3	4
RP5564 PTB 1-3	RP Bio226 x IRGC 71598 x MTU 1010	10.8	10.6	21.6	11.8	22.2	31.4	25.2	31.5	17.4	9.6	23.2	24.3	24.2	18.2	3
BPT 3077	BPT 5204/ MTU 1075	27.3	15.7	19.6	14.5	17.3	30.1	26.3	37.7	17.2	6.0	19.0	20.9	23.2	12.6	3
RP5564 PTB 1-1-1-2	RP Bio226 x IRGC 71598 x MTU 1010	33.6	7.5	20.3	13.8	21.4	26.7	28.0	32.7	15.5	5.8	28.2	23.0	15.1	13.9	3
RP5564 PTB 2-4-2-1-1	RP Bio226 x IRGC 71598 x MTU 1010	20.1	4.4	21.9	15.1	7.2	20.3	27.2	35.6	21.8	5.3	20.2	21.4	11.1	30.3	3
BPT 3130	BPT 5204/ MTU 1075	41.6	19.9	21.9	11.4	18.5	30.4	17.1	41.9	20.7	5.6	37.4	25.7	27.5	8.3	3
RP5564 PTB 1-1-1-4	RP Bio226 x IRGC 71598 x MTU 1010	44.1	16.9	21.5	13.9	24.1	36.8	17.5	34.7	17.9	10.3	30.4	23.2	22.7	10.3	3
NPK 46	Swarna/ *O nivara* BIL	32.2	28.4	19.1	15.7	21.7	32.1	29.0	36.4	17.5	0.1	37.8	25.4	24.4	7.6	3
BPT 3135	BPT 5204/ MTU 1001	27.6	18.0	20.6	14.6	27.5	26.8	24.3	40.7	19.8	6.7	30.6	24.5	26.1	17.6	2
BPT 3148	RP Bio 226/IRGC 23385// Nidhi/MTU 1081	26.8	20.6	22.9	10.9	19.9	18.3	24.4	33.5	17.6	19.3	30.1	20.8	26.7	10.9	2
NWGR 16032	Gurjari/ NWGR 3015	45.9	39.7	22.5	11.4	24.7	20.1	30.7	35.9	18.2	4.1	24.9	25.1	20.6	13.8	2
RP5564 PTB 2-4-2-1-2	RP Bio226 x IRGC 71598 x MTU 1010	21.1	4.7	20.9	11.8	20.1	28.4	32.1	35.6	14.0	18.1	25.9	24.8	15.3	12.7	2
NPK 24	Swarna/ *O nivara* BIL	8.3	18.2	21.7	10.2	17.7	29.9	18.9	38.0	20.0	15.3	40.0	20.8	14.0	12.8	2
BPT 3113	BPT 2270/ NLR 145	33.3	11.3	19.9	11.6	26.2	28.9	26.2	39.6	19.9	14.6	34.4	26.2	22.1	14.5	2
BPT 3192	BPT 5204/ MTU 1075	32.9	12.0	22.0	15.6	30.6	25.9	24.3	34.8	17.9	13.8	25.5	26.1	25.8	11.1	2
BPT 3239	BPT 5204/ MTU 1075	27.8	11.8	19.4	12.5	37.6	35.6	23.5	36.9	25.6	7.3	29.7	21.7	21.9	11.5	1
W 1263	Resistant check	7.9	9.5	10.3	10.3	11.8	18.2	17.8	29.2	15.0	0.1	14.7	21.7	13.5	9.3	10
TN 1	Susceptible check	40.3	33.5	20.5	15.5	22.2	27.6	27.8	46.8	17.1	31.3	42.6	22.8	30.8	15.7	
Minimum damage		6.8	4.4	10.3	9.2	7.2	17.9	17.1	29.2	14.0	0.0	14.7	18.2	8.0	7.6	
Maximum damage		45.9	39.7	22.9	15.7	37.6	36.8	32.1	44.2	25.6	26.3	40.0	31.6	31.7	30.3	
Average damage in trial		24.3	13.8	20.7	12.7	19.1	26.6	24.7	36.1	18.4	8.7	27.3	23.7	19.6	13.9	
Promising level		15	10	15	10	15	20	20	20	20	15	20	20	10	10	
Number Promising		6	8	1	1	8	4	6	0	18	19	5	1	1	6	
Data from Arundhutinagar, Jagdalpur, Karjat and Masodha was not considered for analysis due to the low pest pressure																

iv) Stem Borer Screening Trial (SBST)

To identify novel sources of tolerance to stem borer damage in rice, **Stem borer Screening trial** (SBST) was conductedduring kharif 2022 with 55 entries which included 37 nominations from IIRR (one BPT mutant and its derivatives, ILs derived from *O. nivara; O. rufipogon* and *O. glaberrima*); 10 nominations from IIRR-PTB; one each from Cuttack, Jagtial, and Rudrur; along with the checks, PB1, TN1, W 1263, Sasyasree and TKM6. Of these, 15 entries were under retesting. The entries were evaluated at 15 locations. For effective screening, two staggered sowings were taken up in most of the locations. At IIRR and Coimbatore, infestation was supplemented through pinning of yellow stem borer egg mass. At each location, observations were recorded on dead heart damage in vegetative phase and white ear damage in reproductive phase, grain yield in the infested plant and the larval survival in the stubbles at harvest. In all the locations tested, damage by yellow stem borer was observed though it was pink stem borer at Ghaghraghat. Traces of pink stem borer were observed in stubbles at ARS, Rajendranagar farm. The results of the evaluation from the valid tests are discussed below.

Dead heart damage: The dead heart damage in the trial varied from 0.0 to 54.3% with an average damage of 18.6% DH across 6 locations in 7 valid tests. Evaluation of entries for dead heart damage at 30, 50 DAT and at 74 DAT in two staggered sowings helped in identification of four entries- **RP 6505-40, RP 6505-50, RP-6112-SM-92-R-293-2-2-4-4(a)** and **W1263** in 3 to 5 tests of 7 valid tests with ≤5% DH (DS1.0). **BK 49-76, BK 64-116, RP 6505-1,** and **CGR-19-68** were promising in 2 of the 7 valid tests.

White ear damage: The white ear damage across 7 locations in 9 valid tests varied from 0.0 to 87.8% with a mean of 19.9% WE in the trial. Evaluation of entries identified, **RP5564 PTB 2-4-2-1-2** and **RP5564 PTB 1-4-2** as promising in 5 tests with ≤5% WE (DS1.0). RP2068-18-3-5 was promising in 4 tests; and **BK 49-76, RP5564 PTB 1-4-1, RP5564 PTB 1-4-1-1, RP5564 PTB 1-4-1-2, RP5564 PTB 2-4-2-1-1** were promising in 3 tests each.

The larval survival per entry across 7 locations in 10 tests varied from 0 to 5.6 larvae/hill in the stubbles with a mean of 1.6 larvae/hill.

Grain yield: CR Dhan 308 and **NSR 10 (RP BIO 4919)** were promising in 7 and 6 tests, respectively of the 8 valid tests with grain yield of ≥15g/hill despite white ear damage. **RDR-1930, RP 6505-1, RP 6505-50, RP 6505-82, BK 49-76, KMR3, NSR 88 (RP BIO 4919), RP-6112-SM-92-MS-M-R-41-7-55-3-11-6-2, RP-6112-SM-92-MS-M-R-279-3-6-2-10-5-8, SM-92, RP-6112-SM-92-R-159-6-6-14-14, RP-6112-SM-92-R-293-1-1-3-3, RP-6112-SM-92-R-273-3-3-11-11, CGR-4, RP 6505-40** were **promising** in 5 of the 8 tests with grain yield of ≥15g/hill. Of these 8 entries were under retesting.

Overall reaction: Evaluation of entries in 16 valid field tests for dead hearts and white ear damage identified 10 entries as promising in 4 to 5 of the 16 tests in terms of low dead heart (≤5% DH) and white ear damage ≤5% WE. They were also promising in 1 to 5 tests of the 8 valid tests with higher grain yield (≥15.0 g/hill) suggesting that recovery resistance and tolerance could be the mechanism in these entries as they have good grain yield despite damage. The mean no. of larvae in the stubbles in these entries varied from 0.9-2.4/hill **(Table 2.1.4)**. BK 49-76, BK 64-116 and RP 2068-18-3-5 were under retesting.

Table 2.1.4 Reaction of most promising cultures to stem borer in SBST, *kharif* 2022.

SBST No.	Entries	No.of promising tests (NPT)					
		SBDH	SBWE	SBDH+ SBWE	SBGY	DH+WE+GY	Mean larvae/hill
		7	9	16	8	24	
11	BK 49-76*	2	3	5	5	10	1.7
5	RP 6505-40	5	0	5	4	9	2.4
47	RP5564 PTB 2-4-2-1-2	0	5	5	4	9	1.0
52	RP5564 PTB 1-4-2	0	5	5	3	8	1.1
53	RP5564 PTB 2-4-2-1-1	0	5	5	2	7	0.9
12	BK 64-116*	2	2	4	3	7	1.6
28	RP-6112-SM-92-R-293-2-2-4-4(a)	3	1	4	3	7	1.7
49	RP5564 PTB 1-1-1-2	1	3	4	1	5	1.3
54	RP2068-18-3-5*	0	4	4	4	8	1.1
	Check						
50	**W1263**	4	1	5	4	9	1.9

*Entry under retesting

Data on dead heart damage from ABP, ANR, GGT, NVS, MNC, NLR; RNR,TTB white ear damage from ADT, GGT, ABK, ARN, MNC, NVS and NLR not considered for analysis due to low pest pressure.

Valid data considered for analysis

Parameters	Locations									Total Tests
Dead heart damage	ADT	CBT	PNT-2	PNT-2	PTB	PSA	RPR			7
White head damage	IIRR	PNT-1	PNT-2	PTB	PSA	RNR-1	RNR-2	RPR	TTB	9
Grain yield (g/hill)	IIRR	PNT-1	PNT-2	PTB	PSA	RNR-1	RNR-2	RPR		8

v) Multiple Resistance Screening Trial (MRST)

This trial was constituted with a view to identify the reaction of entries found promising in pest specific trials to other pests and also to evaluate the reaction of advanced breeding lines to insect pests. The trial included evaluation of 40 entries consisting of 8 lines promoted from SBST trial, one entry from PHS trial, 4 nominations from ARS Rajendranagar; four N22 EMS mutants tolerant to heat, 6 wild rice introgressed lines from IIRR; 10 entries under retesting along with five resistant and one susceptible check. The entries were evaluated against 11 insect pests at 26 locations. Some of the introgressed lines possessing disease resistance have been included in this trial to evaluate their reaction to insect pests. The details of the reaction of entries for valid data is available in **Screening Nurseries-Diseases and Insect pests Vol II.**

The valid data pertaining to reaction of entries from various locations are discussed pest wise.

BPH: Entries were evaluated in six greenhouse and two field tests against BPH. Field screening was augmented by releasing insect periodically to ensure population build – up at RNR. RP Bio 4918-230 was promising in 3 of the 8 valid tests. CRCPT 8, RPBio4918 (DBNPK13), NND-2, RNR 37998, RNR 37971, PTB 33, RP 2068-18-3-5 were promising in only 2 of the 8 tests against BPH with a DS ≤3.0. The resistant checks, PTB33 and RP2068-18-3-5 recorded a DS of ≤3.0 in 4 valid tests. PTB21, RP Bio 4918(NPK 77-3) and WGL 1062 exhibited field tolerance against BPH with ≤DS 3.0.

WBPH: RP Bio 5477-NH363 was the only entry which recorded a DS of 2.4 in greenhouse reaction at IIRR but at CBT it had recorded a DS of 7.0.

Gall midge: Entries were evaluated in one greenhouse and 7 field tests and identified 4 entries as promising in 2 of the 8 valid tests with nil damage. The resistant check W1263 recorded nil damage in 3 tests. WGL 1062, HWR20 and RNR 37964 recorded nil damage at IIRR and Ambikapur. RNR 37971 recorded nil damage at IIRR and Pattambi.

Stem borer: Entries were evaluated against stem borer at vegetative phase for dead heart damage in 8 valid tests. At IIRR infestation was augmented through release of neonate larvae/ egg mass. RP Bio 4918-224* recorded nil damage in 3 of the 8 valid tests. At reproductive phase, of the 9 valid tests with ≤5 % WE damage, RP 6461-248-1* was promising in 3 tests and RPBio4918-DB-NPK55, WGL 1062, KMR3, NND-2 were promising in 2 tests each.

Foliage feeders: Incidence of leaf folder, whorl maggot, case worm and rice hispa were observed at various locations. RP Bio 4918-269, RP 6461-248-1*, PTB21 and RP 5587-B-B-B-267 recorded ≤5 % DL at against leaf folder at Nellore where the average damage in the trial was 11.7 % DL. Incidence of whorl maggot was recorded at 5 locations. RP Bio 4918-224 and CRCPT 8 recorded nil damage at Nellore of the 5 valid tests against whorl maggot. Case worm damage was reported from Brahmavar (mean damage 26.9% DL) and Pattambi (mean damage7.9 % DL). The population was 5.1 larvae per hill at 45 DAT at Brahmavar.

Overall reaction: *Evaluation of 40 entries in 6 greenhouse and 45 field tests against 7 insect pests helped in identification of 7 entries and 3 checks as promising in 5-8 tests against 2-4 insect pests with a PPR of 2.8-6.7* ***(Table 2.1.5)****. Of these 4 entries were in the first year of testing viz.,* ***PTB21, NND2, WGL1062 and RNR37971****; three entries viz.,* ***RP 6461-248-1, RP Bio 4918-230*** *and* ***CRCPT 8*** *identified as* ***promising*** *were under second year of retesting. The check lines W1263, RP 2068-18-3-5and PTB 33 were promising in 6-8 tests against 2-3 pests with a PPR of 3.9 - 6.7.*

Valid reaction to insect pests considered for analysis in MRST, kharif 2022

Insect pests	Reaction	Locations/ Tests									Total tests
BPH	GH	IIRR	LDN	MTU	MND	CBT	PNT				6
BPH	FR	RNR*	RNR*								2
WBPH	GH	IIRR	CBT								2
BPH+ WBPH		MTU	GNV	GNV							3
GM	FR	IIRR	ABP	CHP	JDP	WGL	PTB	ADT	GNV		8
SBDH	FR	ADT	CHN	MSD	NVS	PNT	PTB	PSA	RPR		8
SBWE	FR	IIRR*	MLN	PSA	LDN	CHN	MTU	NWG	PNT	RPR	9
LF	FR	CHT	MLN	NWG	NLR	PTB	PSA				6
WM	FR	ADT	CHN	JDP	NLR	PTB					**5**
CW	FR	BRH	PTB								2

*Augmented Insect infestation

Data on BPH from JDP, RPR, WGL; WBPH from WGL,PNR; GLH from JDP& RPR; GM from RCI, NLR, TTB; SBDH from BRH, CHP, JDP,MTU, NWG; SBWE from PTB, ADT, BRH, CHP, GNV, MSD, NLR, RNR, RCI,TTB, WGL,ABP; LF from ADT, GNV, JDP, LDN, RNR, RPR, RCI, TTB, WGL, MSD, NVS, TTB ; RH from NLR& RPR; were not included due to low pest pressure.

Table 2.1.5 Reaction of most promising entries against insect pests during kharif 2022.

MRST No.	Designation	No. of promising tests (NPT)										No. of Promising	MRI	
		BPH	WBPH	BPH+ WBPH	GM	SBDH	SBWE	LF	WM	CW	Tests	Pests	T*P	PPR
		8	**2**	**3**	**8**	**8**	**9**	**6**	**5**	**2**	**51**	**7**	**357**	
5	RP 6461-248-1*	1	0	0	0	1	3	1	0	0	6	**3**	18	5
16	PTB21	1	0	1	1	1	1	1	0	0	6	**4**	24	6.7
31	NND-2	2	0	0	0	1	3	0	0	0	6	**2**	12	3.4
4	RP Bio 4918-230*	3	0	0	0	1	1	0	0	0	5	**2**	10	2.8
9	CRCPT 8*	2	0	1	0	0	1	0	1	0	5	**2**	10	2.8
26	WGL 1062	1	0	0	2	0	2	0	0	0	5	**2**	10	2.8
38	RNR 37971	2	0	0	2	0	1	0	0	0	5	**2**	10	2.8
	Checks													
10	PTB 33	4	0	2	1	1	0	0	0	0	8	**3**	24	6.7
15	W 1263	0	0	0	3	1	1	1	0	0	6	**3**	18	5
25	RP 2068-18-3-5*	4	0	1	0	1	1	0	0	0	7	**2**	14	3.9

*Entry under retesting; Percent promising reaction (PPR)= MRI of individual entry*100/Total MRI

vi. National Screening Nurseries (NSN)

a) IIRR- National Screening Nurseries (NSN)

IIRR-National Screening Nurseries (NSN) comprised of 4 trials -National Screening Nursery 1 (NSN1), National Screening Nursery 2 (NSN2), National Screening Nursery – Hills (NSN hills) and National Hybrid Screening Nursery (NHSN). **IIRR-NSN1** was constituted with 348 entries (326 AVT entries along with 10 insect checks and 12 disease checks) and evaluated at 18 locations against 10 insect pests. **IIRR-NSN 2** trial comprised of 581 entries (557 entries from IVT trials, 10 insect and 14 disease checks) was evaluated at 17 locations against 8 insect pests. **IIRR NSN- Hills** trial consisting of 124 entries (100 hill entries + 10 insect check lines and 14 disease checks) was evaluated at 7 locations against 7 insect pests. **IIRR**-**NHSN** trial constituted with 122 entries (98 hybrids + 10 insect checks +14 disease checks) was evaluated at 12 locations against 8 insect pests. The valid data in each trial are discussed pest wise:

Brown planthopper

IIRR-NSN1: Entries were evaluated against BPH under greenhouse conditions at IIRR, CBT, LDN and MND. IET Nos. 29749 and 30261 recorded a damage score (DS) of ≤3.0 and <10 % hopper burn in 4 of the 5 valid tests; IET Nos 29743, 30233, 30282 and 29203 recorded a damage score (DS) of ≤3.0 in 3 of the 5 tests in greenhouse evaluations. PTB-33 and RP 2068-18-3-5 were resistant (DS of ≤3.0) in 4 and 3 tests, respectively.

IIRR-NSN2: Entries were evaluated against BPH under greenhouse conditions at IIRR, CBT, LDN and MND. **IET No 30815** was **resistant** in 4 of the 5 tests and was at par with PTB33 and RP 2068-18-3-5. **IET Nos 30835, 30845, 30852, 30859, 31068, 31119, 31128, 31129, 31131, 30780, 30794, 30665** were **promising** in 2 of the 5 valid tests with a DS of ≤3.0.

IIRR-NSN hills: Entries were evaluated against BPH under greenhouse conditions at IIRR, CBT, LDN and PNT. **IET 28882** exhibited a DS ≤ 3.0 at CBT and LDN out of 4 tests and was at par with the reaction of RP2068-18-3-5. The resistant check, PTB33 had a DS ≤ 3.0 at IIRR, LDN, & CBT.

IIRR-NHSN: **IET Nos 30594** and PTB 33 were promising in 4 of the 5 valid tests against BPH in greenhouse reaction with a DS of ≤3.0. **IET No 30597** and RP 2068-18-3-5 were promising in 3 and 2 tests, respectively.

White-backed planthopper

IIRR-NSN1: Entries were evaluated in greenhouse conditions against WBPH at both IIRR and Coimbatore. None of the test entries were observed to be promising for WBPH except MO1 at IIRR. At Coimbatore, 2 entries *viz.*, **IET nos 29446** and **29235** were found promising with a DS≤ 3.0 but MO1 recorded DS 5.0.

IIRR_NSN2: Entries were evaluated in greenhouse conditions at IIRR and CBT. **IET nos. 30866** and **31003** recorded a DS≤ 3.0 at Coimbatore.

*IIRR-NSN hills***:** Entries were evaluated under greenhouse conditions at IIRR and CBT. **IET 30528** at **IIRR** and **IET 30518** at CBT recorded a DS ≤ 3.0 in greenhouse reaction. MO1 recorded resistant reaction (DS ≤ 3.0) at IIRR only.

IIRR-NHSN: Entries were evaluated in greenhouse conditions against WBPH at both IIRR and Coimbatore. None of the test entries were observed to be promising for WBPH except MO1 (DS 1.5) at IIRR. At Coimbatore, MO1 recorded DS 5.2 and PTB 33 recorded 2.8.

Mixed population of Planthoppers

IIRR-NSN1: Entries were evaluated in field against mixed population of planthoppers at Gangavathi (at 68 DT) and Maruteru (90 DT). **IET Nos 30106, 30078, 29238, 29214, 29935, 28524**, Gontra Bidhan-3 (NC), and PTB33 were identified as promising (DS ≤ 3.0) at both locations to mixed populations of planthoppers. The average infestation at Gangavathi was 256 planthoppers /10 hills at 68DAT. The ratio of BPH to WBPH was 1:1.15 whereas at Maruteru it was 9:1.

IIRR-NSN2: All the entries were evaluated in field against a mixed population of BPH and WBPH at Gangavathi, Kaul and Maruteru. The ratio of BPH to WBPH was 1: 1.16 at 60-90 DAT at GNV: 10BPH: 1WBPH at Kaul and 9BPH: 1WBPH at MTU. At Gangavathi and Kaul all the entries had a population of >50 insects /10 hills. However, at Maruteru, 42 entries scored a DS ≤3. **IET Nos 30851, 30873, 30874, 30875, 30879, 30880, 30881, 30889, 30971, 30978, 31120**, Swarna scored DS1.0 and was at par with the resistant check RP2068-18-3-5.

IIRR- NSN hills: All the entries were susceptible at Maruteru when evaluated against mixed population of BPH and WBPH (9:1) under field conditions at 90DT except PTB33 and RP2068-18-3-5 (DS 3.0).

IIRR-NHSN: None of the test entries were promising in field reaction at Maruteru. PTB 33 and RP 2068-18-3-5 recorded a DS of 3.0.

Gall midge:

IIRR-NSN1: Evaluation of NSN1 entries under field conditions in 6 valid tests revealed that **IET No 30097** recorded nil damage in four tests (ABK, CHP, SKL & TTB). **IET nos 30093** and **29742** recoded nil damage in 3 tests and were at par with Aganni. WGL 32100 (RP) and IET 30632 recorded nil damage in 2 of the 6 tests and were at par with Suraksha and W 1263.

IIRR-NSN2: **IET Nos 30841** and **30667** were promising with nil damage in two field tests of the 4 valid tests and were at par with Aganni.

Stem borer:

IIRR NSN1: **IET Nos 30013, 30028, 30021, 30083, 28489**, US 312 (HC), 29875 and W1263 were promising with <10% DH (DS 3.0) in 2 of the 7 valid field tests for dead heart damage. **IET Nos 30003, 29409, 30106, 30078** and **29935** were promising in 2 of the 7 valid field tests with ≤ 5% (DS 1.0) white ear damage. However, the reaction needs to be further confirmed under greenhouse conditions.

IIRR NSN2: I**ET 30831, 30849, 30880, 31077, 31001,31122,30794,30745, 30755, 31151, 30649** had nil dead heart damage in 2 of the 5 valid tests. 27 entries recorded ≤ 5% WE damage in 2 of the 4 valid tests.

IIRR NSN hills: Only one entry, Vivekdhan 65 (NC) had recorded <10% dead heart damage (DS <3.0) in field reaction at Pantnagar. Valid data for stem borer white ear damage was recorded from 3 locations, LDN, MLN and PNT. **IET nos 28880, 28893, 30487, 30492, 30499, 30500,** VL Dhan 158 (ZC for North and South), and Vivekdhan 86 (NC), Nidhi and Aganni recorded <5% white ear damage (DS 1.0) in field reaction at Pantnagar and Ludhiana.

IIRR NHSN: **IET Nos 30621, 30624, 30576** and MTU-1010 recorded nil damage in field reaction at Chinsurah at 50 DAT. However, IET Nos 30621, 30624, recorded a DS of 5.0 and 3.0 respectively at Pantnagar at 70 DAT. IET No 30576 and MTU-1010 were early maturing.

IET Nos 30609, 30624 and HR-12 were promising in 3 of the 6 valid tests with <5 % WE damage (DS <1.0).

However, these lines need to be further tested under greenhouse conditions for validation of the reactions and to check that they are not escapes as it is more common in very short and long duration varieties.

Leaffolder:

*IIRR-NSN1***:** None of the entries were promising against leaffolder in the field evaluation at Nawagam and Pusa at 30 and 41 DAT, respectively

IIRR NSN2: Entries were evaluated in field for leaffolder damage at Kaul and Malan. However, none of the entries were promising.

*IIRR NHSN***:** None of the entries were promising against leaffolder at Nawagam and Pattambi. Average damage in the trial was 22.7 and 9 % DL, respectively.

IIRR NSN Hills: Vikramarya was the only variety which recorded <15% damaged leaves from both Malan and Chatha.

Other insect pests: Some of the damages by other minor pests observed in the trials are detailed below:

Green leafhopper:

Low incidence of GLH @10.1 insects/10 hills was recorded at Jagdalpur (68DT).

Whorl maggot

IIRR NSN1: **IET No 29700** and US 312 (HC) recorded nil damage at Jagdalpur (68 DT). **IET Nos 29715, 30230, 30247, 29546** had nil damage at Rajendranagar at 30 DAT.

IIRR NSN2: Incidence was observed at Aduthurai (48 DAT), Chinsurah (45 DAT) and Jagdalpur (78 DAT). The average damage varied from 3.1-4.7 % DL.

IIRR-NHSN: Low incidence was observed with average damage of 8.2% DL at 30 DAT at Pattambi.

Rice hispa

IIRR-NSN1: Average leaf damage by rice hispa in the trial was 6.9 % DL at Raipur. One entry, IET 29246 had nil damage.

Case worm

IIRR- NSN1: Field incidence was observed at Titabar and the average damage was only 3.3 % DL.

IIRR-NHSN: The average damage in the trial at PTB was 10.4 % DL and IET 30603 had nil damage for case worm.

Gundhi bug

IIRR- NSN1: **IET No 30022** was the only entry which recorded nil grain damage by gundhi bug at Masodha in field evaluation at 90 DAT when the average damage in the trial was only 5.3 % damaged grain (DG).

IIRR- NSN2: At GGT, the average damage was 7.5% DG.

IIRR-NSN Hills: Incidence of Gundhi bug at Chatha was recorded with an average of 42.8% DG.

Grasshopper

In NSN hill entries, grasshoppers (*Oxya nitidula, Hieroglyphus* spp. *Attractomorpha pscittacina* & Long-horned grasshopper caused leaf damage of 8.9 % at Khudwani and rice skipper (*Paranara guttata*) was also observed.

Overall reaction

IIRR-NSN1: *Evaluation of 348 entries at 18 locations in 7 greenhouse and 25 field tests against 5 insect pests identified 12 entries viz.,* ***IET nos 29749, 29743, 29935, 30233, 30261 as promising in 5 tests; 30097, 30078, 29235, 29238, 29875, 29203, 30106 in 4 tests*** *of the 32 valid tests against 2 pests. PTB 33 was promising in 7 tests; Aganni and W1263 in 4 tests each* ***(Table 2.1.6)****.*

IIRR-NSN2: *Evaluation of 557 entries along with 24 checks in 26 valid tests (8 greenhouse and 18 field tests) against 5 insect pests identified 9 entries as promising in 5-8 tests. IET no 30838 was promising in 6 tests;* ***IET nos 30831, 30845, 30851, 30852, 30966, 30794 were promising in 5 tests****. RP 2068-18-3-5 and PTB-33 were promising in 8 and 6 tests, respectively of the 26 valid tests* ***(Table 2.1.7)****.*

IIRR- NSN hills*: Entries were evaluated at 7 locations in 15 valid tests (6 greenhouse and 9 valid field tests) against 6 insect pests (Table 2.XXX). Three test entries viz., Vivekdhan 86 (NC),* ***IET Nos 28887, 30518*** *along with check lines Nidhi, HR12 and RP 2068-18-3-5 were promising in 3 tests. Aganni and PTB 33 were promising in 5 and 4 tests respectively of the 15 valid tests* ***(Table 2. 1.8)****.*

IIRR-NHSN: *In this trial, 98 hybrids along with 24 checks were evaluated in 7 greenhouse and 11 field tests against 4 insect pests at 12 locations in 18 valid tests. The results identified* ***IET Nos 30602, 30624 30594*** *and RP 2068-18-3-5 as promising in 4 of the 18 tests. PTB33 was promising in 6 valid tests;* ***IET Nos 30609, 30620*** *and* ***30597*** *were promising in 3 tests* ***(Table 2. 1.9)****.*

It is pertinent to note that since most of the breeding lines in these nurseries were not specifically bred for insect resistance, the number of promising tests is very low in all the identified promising entries in the nurseries. So, these entries need to be further tested, verified and validated for one or two seasons under suitable pest pressure situations for use in pest resistance breeding programs.

Table 2.1.6 Performance of the most promising cultures against insect pests in IIRR- NSN1, *kharif* 2022

Br. No.	NSN No.	IET No.	Designation	Cross	IIRR BPH GH DS	CBT BPH GH DS	LDN BPH GH DS	MND BPH GH DS	MND BPH GH %HB	**BPH NPT 5**	IIRR WBPH GH DS	CBT WBPH GH DS	**WBPH NPT 2**	GNV PH 68DT No. /10h	GNV PH 68DT DS	MTU PH 90DT DS	**BPH+ WBPH NPT 3**	ABK GMB1 50 DT %DP	CHP GMB1 50DT %DP	SKL GMB4 50DT %DP	WGL GMB4M 58-70DT % DP	GNV GMB 30DT %SS	TTB GMB 50DT %SS	**GM NPT 6**	MSD SBDH 76DT %DT	PNT SBDH 56DT %DH	PNT SBDH 76DT %DH	PSA SBDH 41DT %DH	RPR SBDH 66DT %DH	SKL SBDH 50DT %DH	TTB SDBH 46DT %DH	**SBDH NPT 7**	PSA SBWE 90DT %WE	MSD SBWE 90DT %WE	MNC SBWE Pr. H %WE	NWG SBWE Pr. H % WE	PNT SBWE 114DT %WE	RPR SBWE 92DT %WE	SKL SBWE Pr. H %WE	**SBWE NPT 7**	NWG LF 30DT % DL	PSA LF 41DT %DL	**LF NPT 2**	**Overall NPT 32**
4123	191	29749	VNR-230 (Hybrid)	-	1.0	3.0	3.3	3.0	5.0	**4.0**	8.4	6.4	**0.0**	113	1.0	7	**1.0**	90.0	80.0	NG	95.0	20.9	8.0	**0.0**	8.0	4.7	23.3	16.7	13.5	NG	4.0	**0.0**	17.3	9.6	NT	10.0	12.7	53.2	NG	**0.0**	22.4	14.1	**0.0**	**5**
4128	196	29743	HRI-211 (Hybrid)	-	0.7	8.6	3.0	3.0	15.4	**3.0**	7.0	5.0	**0.0**	271	5.0	5	**0.0**	100.0	80.0	100.0	90.0	56.3	4.8	**0.0**	12.2	5.9	20.5	12.6	4.0	8.8	0.0	**1.0**	15.5	11.3	NT	1.9	0.0	40.9	30.3	**1.0**	24.1	12.2	**0.0**	**5**
4305	208	29935	MTU 1377	MTU 1075 /	9.0	5.2	8.4	5.0	52.4	**0.0**	6.4	6.0	**0.0**	207	1.0	3	**2.0**	80.0	90.0	100.0	45.0	2.5	3.8	**0.0**	9.1	7.1	32.0	15.7	5.9	6.9	0.0	**1.0**	16.7	9.5	NT	8.5	0.0	9.1	3.5	**2.0**	16.2	11.6	**0.0**	**5**
5802	233	30233	WGL 1495	MTU 1121*2	1.0	5.2	3.0	3.0	14.3	**3.0**	8.0	3.8	**0.0**	226	1.0	7	**1.0**	60.0	70.0	100.0	85.0	8.6	4.8	**0.0**	7.5	8.4	18.4	17.6	0.0	8.7	4.8	**1.0**	14.5	9.1	NT	9.3	35.7	10.0	15.7	**0.0**	22.4	11.7	**0.0**	**5**
6012	264	30261	RP 6317-RMS-S35-BC2F4	MTU 1121 *	0.4	3.0	3.3	3.0	8.7	**4.0**	7.0	4.8	**0.0**	167	5.0	5	**0.0**	60.0	40.0	100.0	70.0	16.7	8.3	**0.0**	13.0	0.0	29.2	13.8	14.0	9.4	4.2	**1.0**	15.9	13.8	NT	10.0	62.9	17.6	30.2	**0.0**	16.9	14.2	**0.0**	**5**
4911	60	30097	NWGR 16050	NWGR-3119	9.0	8.0	8.4	7.0	65.2	**0.0**	6.8	9.0	**0.0**	225	3.0	9	**0.0**	0.0	0.0	0.0	65.0	19.0	0.0	**4.0**	10.5	6.5	29.0	14.7	1.9	17.0	3.7	**0.0**	14.1	11.0	8.6	10.9	7.9	57.8	27.1	**0.0**	13.1	11.7	**0.0**	**4**
4917	66	30078	MTU 1382	MTU 1075 /	8.4	5.4	8.1	5.0	39.3	**0.0**	7.8	6.8	**0.0**	182	1.0	3	**2.0**	80.0	70.0	100.0	70.0	18.8	7.1	**0.0**	10.1	5.8	20.9	15.7	20.0	0.6	7.1	**0.0**	13.2	5.9	NT	9.4	0.0	1.8	6.3	**2.0**	7.0	12.4	**0.0**	**4**
3703	92	29235	PNPK 7106	PNP 3 / SR	8.4	5.8	7.9	7.0	66.7	**0.0**	9.0	3.0	**1.0**	209	1.0	9	**1.0**	60.0	80.0	NG	90.0	9.1	0.0	**1.0**	9.1	10.3	25.3	12.2	0.0	NG	8.3	**1.0**	16.4	5.8	3.1	10.3	3.1	40.4	NG	**0.0**	9.5	14.8	**0.0**	**4**
3707	96	29238	ORJ 1351 (TP 30600)	IRRI 154 / M	8.6	5.0	8.1	9.0	80.6	**0.0**	9.0	5.2	**0.0**	189	1.0	3	**2.0**	50.0	60.0	100.0	85.0	9.7	0.0	**1.0**	12.3	6.7	28.4	12.6	0.0	10.8	7.7	**1.0**	15.5	11.1	4.2	8.9	11.5	5.9	27.4	**0.0**	21.2	13.3	**0.0**	**4**
4111	180	29875	BRR 2074	IR 11 A 257-	9.0	5.4	8.1	7.0	73.5	**0.0**	9.0	8.0	**0.0**	301	7.0	9	**0.0**	90.0	100.0	100.0	80.0	13.5	3.8	**0.0**	9.2	9.1	35.3	6.7	0.0	8.4	0.0	**3.0**	4.3	6.5	NT	12.0	4.1	11.1	27.8	**1.0**	20.3	6.4	**0.0**	**4**
3836	323	29203	CR 4331-85-1-1-1	Naveen*3 / (	2.1	3.4	3.0	3.0	12.5	**3.0**	5.3	5.0	**0.0**	125	1.0	9	**1.0**	80.0	40.0	100.0	60.0	14.3	5.0	**0.0**	12.0	8.5	NA	17.1	15.4	6.3	10.0	**0.0**	17.5	11.0	NT	16.0	16.9	36.4	22.3	**0.0**	11.7	13.3	**0.0**	**4**
4906	55	30106	MTU 1358	MTU 1061 /	9.0	7.0	8.1	7.0	65.2	**0.0**	9.0	5.2	**0.0**	187	1.0	3	**2.0**	100.0	50.0	100.0	100.0	17.9	9.5	**0.0**	10.2	8.5	27.7	14.9	10.0	9.0	4.8	**0.0**	15.5	8.3	NT	5.2	0.0	0.0	11.1	**2.0**	15.6	11.4	**0.0**	**4**
		Check																																										
	343	PTB 33			1.7	3.0	3.0	3.0	34.8	**4.0**	4.7	5.0	**0.0**	108	1.0	1	**2.0**	80.0	50.0	65.0	10.0	33.3	4.8	**0.0**	10.9	12.9	87.3	17.4	30.2	5.3	4.8	**0.0**	15.3	13.1	NT	15.6	53.4	0.0	26.4	**1.0**	8.3	12.9	**0.0**	**7**
	340	Aganni			8.3	NG	8.1	9.0	100.0	**0.0**	6.7	NG	**0.0**	Rat dama	NG	9	**0.0**	10.0	0.0	0.0	0.0	67.7	8.7	**3.0**	12.1	13.6	80.0	14.3	25.5	22.5	8.7	**0.0**	14.9	14.1	NT	12.8	74.1	25.9	2.9	**1.0**	12.6	14.1	**0.0**	**4**
	348	W 1263			9.0	9.0	8.1	5.0	42.1	**0.0**	9.0	6.0	**0.0**	149	3.0	9	**0.0**	60.0	0.0	0.0	45.0	9.1	NG	**2.0**	13.3	0.0	5.8	15.1	14.5	11.8	NG	**2.0**	14.5	15.5	NG	13.7	6.9	57.4	22.7	**0.0**	9.1	13.3	**0.0**	**4**
				Total Tested	340	337	344	342	342		348	337		317	317	343		347	342	312	339	347	343		345	343	205	348	345	312	343		348	345	95	343	343	344	312		343	348		
				Max. in the tr	9	9	9	9	100		9	9		497	9	9		100	100	100	100	68	15		17	21	87	20	40	26	23		18	150	22	35	90	88	72		43	17		
				Min. in the tri	0	3	3	3	5		2	3		86	1	1		0	0	0	0	2	0		3	0	6	5	0	0	0		4	3	0	2	0	0	3		6	5		
				Ave. damage	8	7	7	7	65		8	7		256	4	8		70	49	95	75	21	5		10	8	28	15	13	8	6		15	11	6	10	20	36	26		16.8	12.7		
				Damage in T	9	8	8	9	100		9	5		402	9	9		25	30	85	85	43	NG		13	9	37	16	11	9	NG		13	13	NG	13	50	32	33		16.7	12.7		
				Promising lev	3	3	3	3	10		3	3		50	1	3		0	0	0	0	0	0		3	0	10	10	0	0	0		5	5	0	0	0	5	5		0	0		
				No. promisin	12	4	22	23	4		1	2		0	67	13		10	10	8	3	0	25		2	3	2	12	28	6	19		4	4	2	0	12	10	2		0	0		

Data from JDP, WGL, PNT for BPH; PNT; WGL for WBPH; MNC, for GM; MNC,CHP,GNV, JDP,RNR, NWG,SKL, WGL for SBDH; CHP,GNV, RNR, MNC, WGL, TTB for SBWE; GNV, MSD, JDP, MNC,TTB for LF; JDP for GLH; JDP for WM;GGT for GB; RNR & JDP for WM;TTB for CW ; RPR for RH - not considered for analysis due to low pest pressure.

Valid insect pest considered for analysis in NSN1, *kharif* 2022

Insect pests	Reaction	Locations							Total
BPH	GH	IIRR	CBT	LDN	MND(DS)	MND(HB)			5
WBPH	GH	IIRR	CBT						2
BPH+WBPH		GNV	GNV	MTU					3
GM	FR	ABK	CHP	SKL	WGL	GNV	TTB		6
SBDH	FR	MSD	PNT	PNT	PSA	RPR	SKL	TTB	7

SBWE	FR	PSA	MSD	MNC	NWG	PNT	RPR	SKL	7
LF		PSA	NWG						2

Table 2.1.7 Performance of most promising cultures against insect pests in IIRR- NSN2, kharif 2022.

						IIRR	CBT	LDN	PNT	MND	MND		IIRR	CBT		GNV	MTU	KUL		CHP	JDP	ADT	GNV		GGT	MLN	NVS	PNT	PNT		CHN	GGT	NVS	PNT		KUL	MLN		
						GH	GH	GH	GH	GH	30DT	**BPH**	GH	GH	**WBPH**	63DT	90DT	60DT	**PH***	30DT	75DT	48DT	30DT	**GM**	30DT	90DT	50DT	55DT	77DT	**SBDH**	89DT	68DT	Pr.h	120	**SBWE**	30DT	90DT	**LF**	Overall
						BPH	BPH	BPH	BPH	BPH	BPH	**NPT**	WBPH	WBPH	**NPT**	PH	PH	PH	**NPT**	GMB1	GMB1	GMB	GMB	**NPT**	SBDH	SBDH	SBDH	SBDH	SBDH	**NPT**	SBWE	SBWE	SBWE	SBWE	NPT	LF	LF	**NPT**	**NPT**
Entry No.	**Br. No.**	**IET No.**	**Designation**	**Cross Comb**	**GT**	BPH	DS	DS	DS	DS	%HB	**6**	DS	DS	**2**	No./10h	DS	No./10h	**3**	%SS	%SS	%SS	% SS	**4**	%DT	%DT	%DH	%DH	%DH	**5**	%WE	%WE	%WE	%WE	**4**	%DL	%DL	**2**	**26**
8	**4408**	30838	KNM 12469	BPT 5204 / F	MS	8.2	6.8	8.0	2.7	7.0	75.0	**1**	8.1	8.4	**0**	348	3.0	150	**1**	8.7	19.0	0.0	33.3	**1**	20.8	7.1	0.0	10.9	32.26	**1**	3.3	10.9	0.0	2.0	**2**	8.7	25.7	**0**	**6**
1	**4401**	30831	AD 18158	CR 1009 / IE	SB	4.9	5.2	8.3	2.5	7.0	72.7	**1**	9.0	5.8	**0**	339	5.0	153	**0**	5.2	12.3	0.8	19.4	**0**	21.8	0.0	0.0	6.8	35.63	**2**	9.8	13.2	0.0	0.0	**2**	13.2	21.2	**0**	**5**
15	**4415**	30845	CR 4206-17-4-2-2	MTU 1010 /	LB	2.5	4.2	8.3	9.0	3.0	26.3	**2**	9.0	5.3	**0**	291	GF	187	**0**	15.1	25.0	0.0	25.0	**1**	29.3	21.1	0.0	5.3	*	**1**	31.9	20.5	0.0	18.3	**1**	9.9	18.9	**0**	**5**
21	**4421**	30851	CN 1317-557-5-6-BNKR 42-2-5-1	Vikramarya /	LS	3.9	6.8	8.3	9.0	9.0	93.8	**0**	5.2	7.4	**0**	230	1.0	128	**1**	11.4	0.0	1.0	58.1	**1**	20.8	11.8	0.0	3.7	31.76	**1**	4.1	2.2	0.0	11.5	**2**	13.5	12.9	**0**	**5**
22	**4422**	30852	MTU1400 (MTU 2374-93-1-1-1)	BPT 2231 / N	MS	3.0	4.8	8.3	9.0	3.0	19.0	**2**	5.3	4.2	**0**	151	3.0	121	**1**	3.2	21.5	0.0	5.3	**1**	35.4	4.2	13.3	2.1	39.33	**0**	10.7	19.6	8.3	4.5	**1**	10.6	13.3	**0**	**5**
271	**5024**	30966	RP 6686-CGR 22	Samba Mahs	MS	6.9	8.6	3.0	9.0	7.0	66.7	**1**	7.4	5.1	**0**	259	3.0	149	**1**	17.0	16.3	0.8	24.4	**0**	24.4	23.5	0.0	2.9	*	**1**	2.5	20.0	0.0	0.9	**2**	17.7	20.0	**0**	**5**
368	**4235**	30794	PRNP 10027	PRNP 101 /	SB	2.6	5.0	3.0	9.0	7.0	66.7	**2**	7.4	5.0	**0**	275	7.0	167	**0**	9.4	42.7	0.8	16.7	**0**	25.0	0.0	0.0	3.8	27.06	**2**	9.4	6.5	0.0	18.5	**1**	15.0	28.0	**0**	**5**
	Checks																																						
576	**PTB 33**					1.5	4.8	2.7	7.1	3.0	8.3	**4**	4.3	5.8	**0**	375	5.0	126	**0**	4.8	12.2	1.4	42.9	**0**	50.0	12.5	0.0	7.8	31.01	**1**	3.4	7.5	0.0	33.6	**1**	12.9	10.0	**0**	**6**
578	**RP 2068-18-3-5**					1.7	5.0	2.7	2.8	3.0	25.0	**4**	5.8	5.6	**0**	331	1.0	142	**1**	4.7	0.0	1.7	30.8	**1**	21.1	0.0	5.9	13.0	16.81	**1**	6.7	7.3	8.3	0.0	**1**	16.0	22.7	**0**	**8**

*PH- mixed population of BPH &WBPH; Kul- 10BPH:1WBPH, GNV- 1BPH: 1.6 WBPH; MTU 9BPH: 1 WBPH.
Data from PNT for BPH & WBPH; MNC for GM; MNC,CHP,GNV, ADT, CHN, CHP,JDP,KJT, NVS, for SBDH; ADT, JDP,KJT,GNV, MNC, NVS, for SBWE;ADT, JDP,KJT,MNC, NVS,GNV, for LF; JDP for GLH; JDP for WM;GGT for GB; RNR & JDP, ADT, CHN for WM; - not considered for analysis due to low pest pressure

Valid insect pest reaction considered for analysis in NSN 2, kharif 2022

Insect pest	Reaction	Location						Total test
BPH	GH	IIRR	CBT	LDN	PNT	MND	MND	6
WBPH	GH	IIRR	CBT					2
PH*	Field	GNV	MTU	KUL				3
GM	Field	CHP	JDP	ADT	GNV			4
SBDH	Field	GGT	MLN	NVS	PNT	PNT		5
SBWE	Field	CHN	GGT	NVS	PNT			4
LF	Field	KUL	MLN					2

Table 2.1.8 Performance of most promising cultures to insect pests in NSN Hills, Kharif 2022

Entry No.	IET No.	Designation	Cross	IIRR	PNT	CBT	LDN	BPH	IIRR	CBT	WBPH	MTU	PH	PNT	SBDH	LDN	MLN	PNT	SBWE	MLN	CHT	LF	CHT	GB	KHD	Grh	Overall	Overall
				GH	GH	GH	GH	NPT	GH	GH	NPT	91DT	NPT	68DT	NPT	90DT	97DT	113DT	NPT	97DT	80DT	NPT	74DT	NPT	45DT	NPT	NPT	NPT
				BPH	BPH	BPH	BPH	4	WBPH	WBPH	2	BPH + WBPH	1	SBDH	1	SBWE	SB	SBWE	3	LF	LF	2	GB	1	Gr.H	1	15	15
				DS	DS	DS	DS		DS	DS		DS		%DH		%WE	%DT	%WE		%DL	% DL (Mean)		%DG		%DL			
21	Vivekdhan 86 (NC)			1.9	5.7	6.6	8.3	1	6.2	8.8	0	9.0	0	NA	0	3.4	9.6	4.7	2	21.2	19.4	0	60.0	0	6.5	0	3	3
30	28887	VL 32558	VL 31329 / Anjali	1.5	7.8	5.2	3.2	1	6.7	7.2	0	9.0	0	NA	0	3.4	18.5	6.3	1	14.8	17.5	1	30.0	0	7.4	0	3	3
85	30518	VL 32850	VL Dhan 87 / VL 32056	5.7	9.0	5.2	8.4	0	8.9	3.0	1	9.0	0	26.7	0	3.5	0.0	24.1	2	18.2	33.2	0	30.0	0	10.6	0	3	3
116	Aganni			9.0	2.0	8.0	3.2	1	9.0	5.0	0	GF	0	9.6	1	9.8	0.0	2.1	2	18.5	13.7	1	NF	0	10.0	0	5	5
119	PTB 33			1.2	8.6	3.0	2.8	3	4.4	5.3	0	3.0	1	29.2	0	9.4	6.3	32.7	0	18.8	15.3	0	NF	0	10.6	0	4	4
101	HR 12			2.1	8.0	8.9	7.8	1	6.4	8.0	0	9.0	0	26.5	0	3.4	8.3	11.0	1	24.0	13.3	1	NF	0	9.6	0	3	3
104	Nidhi			6.1	9.0	7.4	8.3	0	9.0	8.2	0	9.0	0	29.5	0	11.9	0.0	4.5	2	18.2	13.3	1	40.0	0	9.8	0	3	3
121	RP 2068-18-3-5			1.6	NT	3.2	2.8	2	6.2	3.7	0	9.0	0	31.2	0	6.9	18.2	6.3	0	16.4	12.6	1	NF	0	10.3	0	3	3
	Total entries tested			124	124	123	122		124	123		121		55		124	124	124		124	123		94		124			
	Ave. damage in the trial			7.2	7.7	7.0	7.4		7.7	7.1		9.0		26.1		7.5	13.4	14.2		19.7	22.2		42.8		8.9			
	Damage in TN1			9.0	7.3	8.8	7.6		9.0	9.0		9.0		30.6		13.6	7.1	26.8		19.8	13.8		NF		9.8			
	Promising level			3	3	3	3		3	3		3		10		5	0	5		15	15		10		5			

Data from PNT for BPH & WBPH; LDN for SBDH : GLH from CHT; rice skippers from KDW skipper from Khudwani not considered for analysis due to low pest pressure

Valid insect pest reaction considered for analysis in NSN hills, kharif 2022

Insect pests	Reaction	Locations/ Tests				Tests
BPH	GH	IIRR	PNT	CBT	LDN	**4**
WBPH	GH	IIRR	CBT			**2**
BPH+ WBPH	GH	MTU				1
SBDH	FR	PNT				1
SBWE	FR	LDN	MLN	PNT		3
LF	FR	MLN	CHT			2
GB	FR	CHT				1
Grh	FR	KHD				1

Table 2.1.9 Performance of the most promising cultures against insect pests in NHSN, kharif 2022

			IIRR	CBT	LDN	MND	MND	**BPH**	IIRR	CBT	**WBPH**	MTU	**PH**	CHN	PNT	**SBDH**	CHN	GGT	LDN	NWG	PNT	PTB	**SBWE**	NWG	PTB	**LF**	**Overall**
			BPH	BPH	BPH	BPH	BPH	**NPT**	WBPH	WBPH	**NPT**	PH	**NPT**	SBDH	SBDH	**NPT**	SBWE	SBWE	SBWE	SBWE	SBWE	SBWE	**NPT**	LF	LF	**NPT**	**NPT**
			GH	GH	GH	GH	63DT	**5**	GH	GH	**2**	90DT	**1**	50DT	70DT	**2**	Pr.h	96DT	90DT	Pr.h	106	90DT	**6**	70DT	75DT	**2**	**18**
S.No.	Br. No.	IET No.	DS	DS	DS	DS	%HB		DS	DS		DS		DH%	%DH		WE%	%WE	%WE	% WE	%WE	%WE		% DL	%DL		
5	IHRT-M-3205	30602	7.3	3.8	3.0	3.0	17.2	**2**	5.6	4.8	**0**	7.0	**0**	10.2	23.7	**0**	11.3	10.4	13.2	15.4	3.9	0.0	**2**	20.7	8.6	**0**	**4**
31	IHRT-MS-3305	30624	9	9.0	8.6	7.0	62.5	**0**	8.3	6.2	**0**	9.0	**0**	0.0	17.9	**1**	2.6	9.4	7.7	4.3	13.7	1.5	**3**	21.6	7.2	**0**	**4**
92	IHRT-ME-3125	30594	2.3	2.8	3.0	3.0	25.0	**4**	9.0	3.8	**0**	7.0	**0**	18.6	28.4	**0**	10.8	13.3	6.9	14.0	13.1	10.1	**0**	29.1	10.9	**0**	**4**
13	IHRT-M-3213	30609	4.7	8.7	9.0	5.0	38.1	**0**	8.0	5.2	**0**	9.0	**0**	8.8	30.6	**0**	9.5	3.7	13.6	5.8	4.7	4.6	**3**	17.0	5.2	**0**	**3**
26	IHRT-M-3226	30620	5.4	5.2	8.3	1.0	5.0	**1**	9.0	5.4	**0**	9.0	**0**	8.5	10.0	**0**	0.0	8.1	13.6	11.8	7.8	2.2	**2**	17.0	8.7	**0**	**3**
96	IHRT-ME-3129	30597	2.2	5.0	3.0	3.0	25.0	**3**	9.0	4.6	**0**	9.0	**0**	22.3	35.4	**0**	12.0	12.9	12.5	5.8	22.5	11.8	**0**	31.9	12.9	**0**	**3**
99	HR-12	HR-12	8.4	7.2	9.0	7.0	70.6	**0**	9.0	7.8	**0**	9.0	**0**	23.5	28.1	**0**	9.6	6.8	3.8	11.8	12.3	0.0	**3**	18.4	12.6	**0**	**3**
		Checks																									
117		PTB 33	1.9	2.9	3.0	3.0	29.6	**4**	4.5	2.8	**1**	3.0	**1**	12.0	26.4	**0**	19.0	21.6	10.4	11.7	33.9	NT	**0**	25.4	9.6	**0**	**6**
119		RP 2068-18-3-5	2.8	4.3	7.4	1.0	13.5	**2**	6.2	5.8	**0**	3.0	**1**	1.8	37.0	**0**	11.1	22.2	6.1	12.1	3.1	NT	**1**	22.4	13.1	**0**	**4**
	Total tested		120	119	120	121	121		120	119		121		122	88		122	122	122	121	121	119		121	122		
	Max damage in the trial		9	9	9	9	100		9	9		9.0		24.2	77.9		21.0	32.1	17.4	34.0	100.0	43.8		45.1	23.8		
	Min. damage in the trial		0.9	2.0	3.0	1.0	5.0		1.5	2.8		3.0		0.0	8.7		0.0	0.0	3.6	1.9	0.0	0.0		12.6	3.3		
	Ave. damage in the trial		7.3	6.9	7.9	7.0	68.7		7.8	6.5		8.9		10.2	27.1		10.0	15.3	10.4	11.4	14.8	12.7		22.7	9.0		
	Damage in TN1		8.8	8.3	8.2	9.0	91.7		9.0	9.0		9.0		12.3	44.2		10.6	21.8	9.2	14.5	36.5	32.9		24.2	12.0		
	Promising level		3	3	3	3	3		3	3		3		0	0		5	5	5	5	5	5		5	0		
	No. promising		8	3	7	11	0		1	1		2		4	0		8	1	0	0	11	31		0	0		

*PH- mixed population of BPH and WBPH ; Field reaction of BPH& WBPH from PNT; GM from PTB; SBDH from CHN, MNC, NWG, PTB,GGT, LDN, SBWE from MNC: LF damage from CHN,GGTLDN,MNC; WM , BB & CW damage from PTB were not considered due to low pest pressure.

Valid insect pest reaction considered for analysis in NHSN, kharif 2022

Insect pests	Reaction	Locations / tests						Total tests
BPH	GH	IIRR	CBT	LDN	MND	MND		**5**
WBPH	GH	IIRR	CBT					**2**
PH	FR	MTU						**1**
SBDH	FR	CHN	PNT					**2**
SBWE	FR	CHN	GGT	LDN	NWG	PNT	PTB	**6**
LF	FR	NWG	PTB					**2**

b) NRRI-National Screening Nurseries

AT NRRI Cuttack, National Screening Nurseries (NSN) consisting of two trials *viz.*, National Screening Nursery-1 (NSN1) and National Screening Nursery-2 (NSN2) were constituted this year with entries from Early Direct Seeded, Rainfed Shallow Lowland, Semi Deep Water and Deepwater rices. NSN1 trial constituted with 51 entries (41 AVT entries along with 10 insect checks) was evaluated at 18 locations. NSN2 trial comprised of 156 entries (146 IVT entries plus 10 insect checks) was evaluated at 16 locations. The valid data of the reaction of entries in the above said trials are presented insect pest wise:

Brown Planthopper:

NRRI-NSN1: IET29032 and IET31288 were found promising for brown planthopper in 1 test in greenhouse reaction at LDN of the 3 valid tests. PTB-33 and RP2068-18-3-5 exhibited resistant reaction (damage score ≤3 on SES scale) in 2 tests each.

NRRI-NSN2: IET31232 and IET31221 were promising in 2 locations out of the 3 tests. RP2068-18-3-5and PTB-33 exhibited resistant reaction in all three 3 tests.

White-backed Planthopper:

NRRI-NSN1: None of the entries were found promising at CBT including the resistant checks PTB-33 and RP2068-18-3-5.

NRRI-NSN2: The following IET lines *viz.*, 31280, 31221, and 31281 were found promising in one glasshouse screening test at CBT including the resistant checks PTB-33 and RP2068-18-3-5.

Mixed population of Planthoppers:

NRRI-NSN1: None of the entries were found promising in field evaluation at GNV including the resistant checks PTB-33 and RP2068-18-3-5. The average population in the trial was 289 hoppers/10 hills.

NRRI-NSN2: None of the entries were found promising in field evaluation including the resistant checks PTB-33 and RP2068-18-3-5 in both the locations tested. The average population in the trial was 289 hoppers/10 hills at GNV and 196 hoppers/ 10 hills at Kaul.

Gall Midge:

NRRI-NSN1: IET27538 and CR Dhan 506 recorded nil damage against gall midge at Sakoli. Aganni and W-1263 recorded nil damage in at Sakoli.

NRRI-NSN2: The following IET lines *viz.*,31272, 26741(R), 31206, Swarna Sub 1, 31229, 31190 and 31192 were found promising in one field reaction at JDP where average damage was 11.0% SS. Whereas in GNV average damage was 19.0% SS and IET lines 31260, 31214, 31218, 31233, and 31176 were found promising at promising level of 5% SS.

Stem borer:

NRRI-NSN1: CR Dhan 506 was promising against stem borer during vegetative and reproductive phase in 2 out of the 3 tests.

NRRI-NSN2: IET31283 had nil white ear damage at Aduthurai during reproductive phase; however, it requires glasshouse study for confirmation.

Leaf folder:

NRRI-NSN1: Leaffolder incidence was low at the evaluating centers (PUSA and Nawagam) and the damage level was <10% DL.

NRRI-NSN2: IET31161 and IET31200 were promising against leaf folder in Aduthurai and Kaul, respectively. Average leaffolder damage was 44% and 19% DL at Aduthurai and Kaul, respectively.

Hispa:

NRRI-NSN1: In the field evaluation at Raipur, hispa incidence at 70 DAT was recorded and the average damage in the trial was 7.0% DL.

Note: Since all these breeding lines have not been specifically developed for insect pest resistance; all these identified promising entries need to be further tested and validated for their resistance against individual pests in specific screening program under suitable pest pressure for further use in the resistant breeding program.

Overall reaction:

NRRI-NSN1: Evaluation of 51 entries in NSN-1 in 4 greenhouse and 13 field tests against 7 insect pests in 17 valid tests helped in identification of 4 entries as promising in 4-5 tests against 2-3 insect pest damages **(Table 2.1.8.1)**. Resistant checks PTB 33 and RP 2068-18-3-5 were resistant to BPH in the valid tests. W1263 and Aganni were promising against gall midge.

NRRI- NSN2: Evaluation of 166 entries in NSN-2 in 4 greenhouse and 8 field tests against 5 insect pests in 12 valid tests helped in identification of 3 entries as promising in 2- 4 tests against 1-2 insect pest damages (Table 2). Resistant checks PTB 33 and RP 2068-18-3-5 were resistant to BPH in the valid tests. W1263 and Kavya were promising against gall midge.

Table 2.1.10 Performance of most promising culture against insect pests in NRRI-NSN1, *Kharif* 2022

Sl. No	IET No.	Number of promising tests (NPT)							
		BPH	WBPH	PH	GM	SBDH	SBWE	Hispa	Overall NPT
		3	1	1	4	3	4	1	17
1	31288	1	0	0	1	1	1	0	4
2	29032	1	0	0	1	1	1	0	4
3	29026	0	0	0	1	1	1	1	4
4	CR Dhan 506	0	0	0	1	2	2	0	5
Resistant checks									
PTB-33		2	0	0	1	1	0	0	4
RP2068-18-3-5		2	0	0	0	1	0	0	3
Aganni		0	0	0	2	1	0	0	3
W-1263		1	0	0	1	0	1	0	3

* JDP, PSA, WGL for BPH; WGL for WBPH; CHP, JDP for BPH; CHP, TTB for GM; GNV, MSD, LDN, JDP, RNR, WGL, TTB, RPR, PSA, NWG, MNC for LF; GNV, CHP, JDP, LDN, MSD, MNC, NWG, RNR, WGL, TTB for SBDH; GNV, CHP, LDN, RNR, PSA, WGL for SBWE; TTB for CW; RNR for WM; MSD for GB; JDP for GLH not considered for analysis due to low insect pest pressure.

Valid NSN1 data from locations considered for analysis

Insect pest	Locations			
BPH	CBT	GNV	MND	LDN
WBPH	CBT	-	-	-
PH	-	GNV		
Gall midge	JDP	GNV	SKL	WGL
SBDH	RPR	PSA	SKL	-
SBWE	RPR	MSD	SKL	TTB
Hispa	RPR	-	-	-

Table 2.1.11 Performance of most promising culture against insect pests in NRRI-NSN2, *Kharif* 2022

Sl. No	IET No.	Number of promising tests (NPT)						
		BPH	WBPH	PH	GM	SBWE	LF	Overall NPT
		3	1	2	2	2	2	12
1	31232	2	1	0	0	0	0	3
2	31221	2	1	0	0	0	0	3
3	31283	0	0	0	0	1	0	1
Resistant checks								
PTB-33		3	1	0	0	0	1	5
RP2068-18-3-5		3	1	0	1	0	0	5
Aganni		2	0	0	1	0	0	3
W-1263		0	1	0	0	0	1	2

*JDP for BPH; CHP for GM; ADT, GNV, CHP, JDP, GHT, MNC for SBDH; CHP, NVS, MNC, GNV, GGT for SBDH; GNV, JDP, GGT, NVS, MNC for LF; ADT for WM, JDP for GLH; GGT for GB not considered for analysis due to low insect pest pressure

Valid NSN2 data from locations considered for analysis

Insect pest	Locations		
BPH	CBT	LDN	MND
WBPH	CBT	-	-
PH	-	GNV	KUL
Gall midge	JDP	GNV	-
LF	ADT	-	KUL
SBWE	ADT	GGT	-

2.2. INSECT BIOTYPE STUDIES

Variation in the response of host plant/gene differentials to different pest populations in endemic areas were monitored for two major insect pests *viz.,* planthoppers and gall midge through Insect biotype studies comprising of four trials a) Gall midge biotype monitoring trial (GMBT) b) Planthopper Special Screening trial (PHSS) c) Gall midge population monitoring trial (GMPM) and d) Planthopper population Monitoring trial (PHPM).

The results of the observed virulence pattern of gall midge populations during *kharif* 2022 in GMBT trial are discussed below:

a) Gall midge biotype monitoring trial (GMBT)

Gall midge biotype trial was constituted with a set of 15 gene differentials categorized into 4 groups, along with the susceptible check TN1 in the fifth group and three lines with *Gm4*, *Gm8* and *gm3* genes in the background of Improved Samba Mahsuri and INRC 17470 in the 6^{th} group. The trial was conducted at 18 locations. The reaction of the differentials was observed at both 30 DAT and /or 50 DAT in terms of percent plant damage and silver shoot (%). Data with >50 % plant damage in TN1 at a location was considered as valid. Though gall midge incidence was recorded at Brahmavar, Maruteru, Nellore, Titabar, Pattambi, Ranchi, and Raipur, the severity was low. At Pattambi the trial was also conducted in farmer's field at Ongallur and observations were recorded at both 30 and 50 DAT. No data was received from Cuttack. The results of the evaluation from the valid data from research stations at 11 locations in 12 tests are summarized in **(Table 2.2.1)** and discussed as under.

Telangana state

IIRR: The populations at **IIRR** collected from Medchal were maintained in greenhouse on TN1. All the differentials were promising with 0-10 % DP except Abhaya.

Jagtial: Earlier the populations at **Jagtial** conformed to the typical pattern of R-S-R-R-S for biotype 3 but this year, only differentials with *Gm8* gene (Aganni, INRC 3021) were promising.

Warangal: Aganni and INRC 3021(with *Gm8*), RP5923 (*gm3*) and the new donor INRC 17470 exhibited ≤10% DP at Warangal research station and also in the farmer's field which is 30 km away from research farm. But Abhaya was promising only at the research station. It is interesting to note that the virulence on *Gm11* and *gm3* is less in farmers' field as compared to the reaction in the research station.

Andhra Pradesh

Ragolu: Differentials of Group 3 and 4 showed resistance to gall midge at this location which is typical reaction pattern (S-S-R-R-S) of biotype 4.

Maharashtra:

Sakoli: This year only Aganni and INRC 3021 (both with *Gm8*) and INRC 17470 recorded nil damage at this location.

Karnataka

Gangavathi: Only INRC 3021 recorded nil damage while ARC 6605, and Aganni recorded very low silver shoot damage.

Chattishgarh

Ambikapur: Kavya and W1263 (*Gm1*)**;** *Aganni and INRC15888 (Gm8)* recorded <10%DP in the field reaction at this location.

Jagdalpur: Reaction at Jagdalpur were grouped as R-S-S-R-S-S with exceptions of Madhuri L9 in Group 2 and RP 5022-21 in group 4 differentials.

Odisha

*Chiplima***:** All differentials showed susceptibility except W1263 (*Gm1*), RP 2068-18-3-5, RP5923 (*gm3*); Aganni, INRC 3021, INRC15888 and RP5925-24 (*Gm8*), Madhuri L9 (*Gm9*) and INRC17470 which had<10 % plant damage. Variation in the reaction of the other donors was observed within the groups.

Tamil Nadu

Aduthurai: The field reaction at this location conforms to the pattern of R-R-R-R-S of biotype 1 with low damage (20% DP) in ARC5984 and Madhuri L9.

Kerala

Moncompu; All the differentials except *Kavya, RP5922-21(Gm1); RP2068-18-3-5 & RP5923-22 (gm3), MR1523 (Gm11)* recorded nil damage.

Overall reaction: *Evaluation of the gene differentials in one greenhouse and 11 field tests at 12 locations identified* ***Aganni (Gm8), INRC 3021(Gm8)*** *and* ***INRC17470*** *as* ***promising*** *in 9 -11 of the 12 valid tests.* ***INRC15888*** *and* ***INRC17470*** *were* ***promising*** *in 7 tests.* ***W1263 (Gm1)*** *was promising in 6 of 12 valid tests. The results also suggest that* ***donors*** *with* ***Gm8*** *and* ***Gm1*** *genes confer resistance to gall midge across the test locations.*

b) Planthopper Special Screening Trial (PHSS)

A set of 17 primary sources of BPH resistance with some sources having known resistance gene(s) was evaluated at thirteen locations *viz.*, IIRR, Aduthurai, Coimbatore, Cuttack, Gangavathi, Ludhiana, Mandya, Maruteru, New Delhi, Pantnagar, Raipur, Rajendranagar, Warangal in 13 tests in the greenhouse in Standard Seed box Screening Test (SSST) with 1 to 4 replications. At Coimbatore, the sources were screened for both brown planthopper and whitebacked planthopper reaction. The special screening tests such as days to wilt to know the tolerance mechanism, feeding preference test by measuring honeydew excretion and nymphal survival were conducted at Pantnagar, Coimbatore and Maruteru. Based on SSST results presented in **(Table. 2.2.1)**. It was observed that two gene differentials *viz.*, **PTB 33 (with *bph2* + *Bph3* + *Bph32* + unknown factors)** and **RP 2068-18-3-5 (with *Bph33t*** gene) were **promising** in 12 and 13 tests respectively out of 13 tests at 12 locations. Babawee with *bph*4 gene performed better at 5 locations while T12 (with *bph7* gene) gene performed better in 4 locations. Three gene differentials *viz.*, ARC 10550 with *bph5* gene, Rathu Heenati (with *Bph3*+*Bph17* genes) and Swarnalatha with *Bph6* showed low damage at three locations each. One gene differential *viz.*, ASD7 with *bph2* gene performed better at two locations only. Five gene differentials *viz.*, IR-65482-7-2-216-1-2-B with *Bph18*(t)) gene, MUTNS 1, OM 4498, Milyang 63 with unknown genetics and Pokkali with *bph9* gene showed promising reaction at one location each. Four gene differentials *viz.*, Chinasaba with *bph8* gene, IR 36 (with *bph2* gene), IR 64 (with *Bph1*+ gene) and IR-71033-121-15 with *Bph20/21* genes showed susceptible reaction at all test locations.

At Pantnagar, lowest nymphal survival was observed in PTB33 followed by IR 64, ASD7, ARC10554 and IR 36 and highest nymphal survival was observed in RP2068-18-3-5 followed by OM 4498. T12 took more days to wilt followed by Swarnalatha and IR-71033-121-15. Honeydew excretion was the lowest in PTB33 followed by Chinsaba and ASD 7 and it was highest in T12 followed by Swarnalatha and IR-71033-121-15. In TN1 the average honeydew excretion was 175.9 mm2. At Coimbatore, lowest honeydew excretion was observed in ARC 10550 followed by RP 2068-18-3-5, PTB 33 and Pokkali whereas highest honeydew excretion was observed in TN1 followed by ASD7. At Maruteru, highest honeydew excretion was observed in IR-71033-121-15 followed by ASD7 and MUTNS1 while lowest honeydew excretion was observed in RP 2068-18-3-5 followed by PTB33 and Ratu Heenati. Nymphal survival data from Maruteru was not considered as the values were very low.

Among the 17 gene differentials evaluated, two differentials viz., **PTB 33 (with *bph2* + *Bph3* + *Bph32*+unknown factors)** and **RP 2068- 18-3-5 (with *Bph33t* gene)** were promising in 12 and 13 tests respectively at 12 test locations. Swarnalatha with Bph 6 gene performed better in 4 locations. Six gene differentials *viz.*, T12 (with *bph7* gene), Rathu Heenati (with *Bph3*+*Bph17* genes) ASD 7 with *bph2*, Babawee with *bph 4* gene, IR 36 (with *bph2* gene) and IR 64 (with *Bph1* gene) showed low damage at two locations each. Two gene differentials *viz.*, Chinasaba with *bph8* gene and Milyang 63 with unknown genetics performed better at one location each **(Table.2.2.2).**

Table 2.2.1 Reaction of gene differentials to gall midge populations in GMBT, kharif 2022

Group	Entry No.	Differential	Gene	IIRR	ADT	ABK	CHP	JDP	GNV	JGT	MNC	RGL	SKL	WGL	WGL$	Overall NPT
				GR	50DT	50DT	50DT	50DT	50DT	50DT	50DT	50DT	50DT	51DT	50DT	12
				% DP	%DP	%DP	%DP	%DP	%SS	%DP	%DP	%DP	%DP	%DP	%DP	
I	**1**	**KAVYA**	***Gm 1***	0	10.0	0	20.0	0.0	35.8	100.0	33.3	40.0	20.0	95.0	50.0	**4**
	2	**W 1263**	***Gm 1***	0	0.0	0	0.0	0.0	15.3	95.0	0.0	60.0	30.0	90.0	95.0	**6**
	3	**ARC 6605**	***(?)***	0	0.0	80	30.0	40.0	1.6	95.0	0.0	30.0	100.0	85.0	50.0	**3**
II	**4**	**PHALGUNA**	***Gm 2***	0	0.0	100	60.0	80.0	16.4	100.0	0.0	30.0	100.0	95.0	50.0	**3**
	5	**ARC 5984**	***Gm 5***	0	20.0	70	20.0	90.0	19.4	100.0	0.0	30.0	100.0	100.0	40.0	**2**
	6	**DUKONG 1**	***Gm 6***	0	0.0	70	50.0	80.0	68.5	100.0	0.0	20.0	100.0	100.0	95.0	**3**
	7	**RP 2333-156-8**	***Gm 7***	5	0.0	60	40.0	30.0	52.3	100.0	0.0	30.0	100.0	75.0	55.0	**3**
	8	**MADHURI L 9**	***Gm 9***	7	20.0	60	10.0	0.0	35.3	100.0	0.0	20.0	100.0	100.0	65.0	**4**
	9	**BG 380-2**	***Gm 10***	0	0.0	60	30.0	90.0	48.5	100.0	0.0	50.0	100.0	78.9	68.4	**3**
III	**10**	**CR-MR 1523**	***Gm 11***	0	0.0	50	70.0	10.0	50.1	75.0	13.3	0.0	100.0	50.0	5.0	**5**
IV	**11**	**RP 2068-18-3-5**	***gm 3***	0	0.0	50	10.0	10.0	40.1	80.0	26.7	0.0	38.5	60.0	5.0	**6**
	12	**ABHAYA**	***Gm 4***	30	10.0	50	30.0	10.0	45.8	40.0	0.0	0.0	100.0	55.0	35.0	**4**
	13	**INRC 3021**	***Gm 8***	0	0.0	20	10.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	**11**
	14	**AGANNI**	***Gm 8***	0	0.0	10	0.0	0.0	3.9	0.0	0.0	0.0	0.0	5.0	0.0	**11**
	15	**INRC 15888**	***Gm 8***	0	0.0	0	0.0	0.0	38.4	100	0.0	0.0	26.3	80.0	50.0	**7**
	16	**RP 5925-24**	***Gm 8***	0	0.0	40	0.0	0.0	34.6	100	0.0	0.0	40.0	50.0	5.6	**7**
	17	**RP 5922-21**	***Gm 1***	0	0.0	40	40.0	80.0	36.6	100	13.3	0.0	89.5	85.0	33.3	**3**
	18	**RP 5923**	***gm 3***	0	0.0	30	0.0	20.0	34.5	20.0	6.7	0.0	63.2	25.0	15.0	**5**
	19	**INRC 17470**	**?**	0	0.0	40	0.0	0.0	24.3	30.0	0.0	0.0	0.0	5.0	0.0	**9**
V	**20**	**TN1**	***none***	*70*	50.0	90	90.0	100	57.4	100	53.3	60.0	90.0	95.0	78.9	**0**
Total Tested				20	20	20	20	20	20	20	20	20	20	20	20	
Max. in the trial				70	50	100	90	100	68.5	100.	53.3	60.0	100	100	95.0	
Min. damage in the trial				0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	
Ave. damage in the trial				5.6	5.5	46	25.5	32	32.9	76.8	7.3	18.5	64.9	66.9	39.8	
Damage in TN1				70	50	90	90	100	57.4	100.	53.3	60.0	90.0	95.0	78.9	
Promising level				10	10	10	10	10	1	10	10	10	10	10	10	
No. promising				18	17	4	9	11	1	2	15	10	3	3	6	

$ farmers field

Table 2.2.2 Performance of promising gene differentials in (PHSS) -kharif 2022

Entry No.	**Designation**	**Gene**	**Reaction of gene differentials against planthopper**														**Total NPT (14)**
			Brown planthopper													**Whitebacked planthopper**	
			IIRR	ADT	CBT	CTC	GNV	LDN	MND	MTU	NDL	PNT	RPR	RNR	WGL	CBT	
1	ASD7 (Acc 6303)	*bph2*	8.1	8.3	6.4	9.0	3.7	**7.7**	7.0	3.0	7.6	8.3	**1.6**	**8.6**	8.2	8.2	2
2	Babawee	*bph4*	6.7	6.3	5.2	7.8	1.0	**6.0**	5.0	1.7	6.4	8.6	**-**	**4.8**	8.4	2.8	5
5	ARC 10550	*bph5*	5.6	9.0	4.3	4.4	4.3	**8.0**	7.0	9.0	6.0	7.4	**1.8**	**7.9**	6.5	6.8	3
16	Ratu Heenati	*Bph3+Bph17*	7.2	8.3	7.2	9.0	3.7	**5.6**	5.0	9.0	5.5	7.4	**-**	**4.8**	6.7	4.6	3
17	RP 2068-18-3-5	*Bph33(t)*	2.2	3.0	1.3	3.0	3.5	**2.8**	3.0	2.9	2.3	2.5	**1.0**	**4.6**	4.1	3.8	13
18	Swarnalatha (Acc33964)	*Bph6*	6.5	8.3	5.8	9.0	3.7	**6.9**	5.0	9.0	6.7	6.6	**1.9**	**7.8**	8.3	5.0	3
19	T12	*bph7*	8.1	8.3	7.2	9.0	1.7	**5.9**	5.0	7.7	3.5	7.5	**1.6**	**8.7**	7.7	9.0	4
22	PTB33	*bph2+Bph3+*	1.7	3.3	5.0	2.8	1.7	**NG**	1.0	3.1	3.2	3.8	1.6	**4.3**	3.1	9.0	12
Promising level			5.0	5.0	5.0	5.0	3.0	5.0	5.0	5.0	5.0	5.0	3.0	5.0	5.0	5.0	
No. of promising entries			3.0	3.0	4.0	3.0	8.0	2.0	7.0	5.0	4.0	3.0	6.0	5.0	3.0	5.0	

c) Gall midge population monitoring (GMPM)

This trial has been designed to complement the study on characterization of gall midge biotypes. Reaction of single gall midge female to a set of three gene differentials *viz.*, W1263 (*Gm1*), Aganni(*Gm8*), Akshayadhan (*Gm4* + *Gm8*) and Purple variety (no resistance gene but highly susceptible) would generate information on the virulence pattern of the gall midge population. This year the trial was conducted at six locations *viz.*, Gangavathi, Moncompu, Pattambi, Jagtial, Ragolu and Warangal and the results are presented in Table **2.2.3** and discussed location wise.

Gangavathi: Of the 250 female insects tested, 92% were virulent. Of these, 86.95% were virulent on Purple (no gene), 26.98% on W1263 (*Gm1*), 35.22% on Aganni (*Gm8*) and 15.22% on Akshayadhan (*Gm4*+*Gm8*). The sex ratio was very much skewed towards females in all the test entries and male progeny percentage was very high in W1263 as compared to other entries. These results support the reaction of these differentials at Gangavathi in GMBT trial except for recording of high virulence on Aganni in this test.

Moncompu: Single female progeny test was done with 50 females of which 92 % were virulent. Of the virulent insects, only 8.7% were virulent on purple (no gene), 28.3% on W1263 (*Gm1*), 73.9% on Aganni (*Gm8*) and 76.09 % on Akshayadhan (*Gm4*+*Gm8*). Though the severity of pest was low in GMBT trial, it can be deduced that under favourable conditions there can be an upsurge in the gall midge infestation at this location.

Pattambi: At this location, 207 insects were tested and all were virulent. Low virulence (22.7%) was observed on W1263 (*Gm1*) with 11.9 %SS. The other two differentials and purple were highly susceptible with more than 65 % of the females being virulent. High percentage of male progeny was recorded in all the differentials (30.5-35.2%). This is in line with the results of the GMBT trial where *Gm1* gene holds promise but virulence on other differentials need to be monitored with caution.

Jagtial: Of the 210 female insects tested, only 71.4% were virulent. on Purple (no resistance gene) 77.3% were virulent, 23.2% on W1263 (*Gm1*), and none were virulent on Aganni (*Gm8*) and Akshayadhan (*Gm4*+ *Gm8*). The sex ratio was favorable in all the differentials. Male progeny was 33.74 % on W1263 as compared to 40.4% on purple. These results support the reaction of these differentials at Jagtial in GMBT trial suggesting Aganni and Akshayadhan (*Gm4*+*Gm8*) as promising donors at this location.

Ragolu: At this location, 250 single females were tested and the results suggest that the population was highly virulent 60.96% on the purple variety and the two gene differentials, W1263 (20.91%) and Akshyadhan (*Gm4*+ *Gm8*). None were virulent on Aganni. In all the test entries, the sex ratio was 1:1.

Warangal: At this location, 250 insects were tested. Low virulence of tested females was recorded on Aganni (6.7%). Sex ratio was skewed towards females in all the test entries. Damage was <10% SS in Aganni and Akshayadhan (*Gm4*+ *Gm8*). Male progeny (%) was very high in Aganni (41.7%). The results are similar to the reaction pattern observed in GMBT trial conducted this year at this location.

Studies on virulence composition of gall midge populations in GMPM trial conducted at six locations across four southern states in India suggest ***that Aganni (Gm8) holds promise at Jagtial, Warangal and Ragolu. Low virulence against W1263 (Gm1) was observed at Gangavathi, Pattambi and Warangal*****.** ***Akshayadhan (with Gm4 + Gm8) was promising at Jagtial and Warangal.*** *However, a close monitoring of the virulence pattern in endemic areas is important.*

d) Planthopper Population Monitoring Trial (PHPM)

The planthopper population monitoring trial (PHPM) was conducted to monitor the virulence pattern of brown planthopper populations against selected donors by releasing a single brown planthopper female and testing its progeny. This trial was conducted at six locations *viz.*, IIRR-Rajendranagar, Coimbatore, Gangavathi, Ludhiana, New Delhi and Pantnagar. Four gene differentials *viz.*, PTB 33 (*bph 2, 3 and 32 genes*), RP 2068-18-3-5 (*bph 33t* gene), RP Bio4918-230S (*bph 39 and 40* genes) and Salkathi (two QTLs *qBph4.3* and *qBph4.4)* were tested along with susceptible variety TN1. The number of nymphs hatched from each gene differential, number of adults emerged, their sex and macroptery were recorded on each gene differential and the results are presented here. The data from Gangavathi is not considered.

IIRR: The females laid eggs on all the gene differentials and the total number of nymphs hatched /female were 137 and the egg period was 9 days. Number of nymphs hatched were more on TN1. Nymphal duration was the lowest on TN1 (12.74 days) and in PTB33, it was the highest (17.96 days). The sex ratio was in favour of males in all gene differentials except in TN1 which had more females. The winged insects (66.0%) outnumbered the wingless insects (34.0%) in all the gene differentials except in TN1.

Coimbatore: All the females laid eggs on TN1 whereas 40.0-60.0% females laid eggs on RP Bio4918-230S, RP 2068-18-3-5 and PTB 33. The total number of nymphs hatched /female were 63.2. The nymphs hatched were highest on TN1 and lowest on RP 2068-18-3-5. The incubation period was 14.8 days, the nymphal survival ranged from 54.5-100% and was highest on RP Bio4918-230S.

Ludhiana: All the females laid eggs on all the gene differentials and nymphs hatched were highest on TN1 and lowest on PTB33. The total number of nymphs hatched /female were 205.7. The egg period ranged from 9 days (TN1 and Salkathi) to 10 days (PTB33, RPBio4918-230S and RP2068-18-3-5). The nymphal survival was highest (99.0%) and nymphal duration was shortest on TN1 (17 days) and vice versa in PTB33

(93.0% and 21 days respectively). Males were lowest in TN1 and sex ratio was in favour of males except in TN1. The macropterous adults were more (67.1%) than wingless adults and were more on RP 2068-18-3-5.

New Delhi: All the females laid eggs on all the gene differentials and nymphs hatched were highest on TN1 and lowest on Salkathi. The total number of nymphs hatched /female were 262. The egg period ranged from 7.5 days (TN1) to 9 days (PTB33, Salkathi). The nymphal survival was highest (76.6%) on TN1 and lowest on Salkathi (32.9%). Males were lowest in TN1 and sex ratio was in favour of females.

Pantnagar: All the females laid eggs on all the gene differentials and nymphs hatched were highest on TN1 and lowest on PTB33. The total number of nymphs hatched /female were 147. The egg period was 9 days. The nymphal survival was highest on TN1 (77.4%) and lowest in PTB33 (37.2%) and nymphal duration was 15 days. Males were lowest in RP2068-18-3-5 and sex ratio was in favour of females.

The virulence monitoring studies of brown planthopper populations using the four gene differentials revealed that ***at Ludhiana, brown planthopper population was more virulent than the other five BPH populations viz., IIRR-Rajendranagar, Coimbatore, New Delhi and Pantnagar*** *in terms of virulent females which laid eggs, egg period, number of nymphs hatched, nymphal survival, and highest percentage of brachypterous adults. At all the locations, all the females were virulent except at Coimbatore.*

Table 2.2.3 Virulence composition of gall midge populations in GMPM, kharif 2022

Sl. No.	Location	No of females tested	Virulent females (%)	Variety	Virulent females (%) of total females virulent	%SS damage	Sex ratio of the progeny Male : Female	% Male progeny
1	Gangavathi	250	92	Purple	86.95	28	1:5.1	19.1
				W1263 (*Gm1*)	27	24.8	1:4.2	37.5
				Aganni (*Gm8*)	15.22	11.8	1:3.0	16.3
				Akshayadhan(*Gm4*+*Gm8*)	35.22	3.28	1:4.2	19.4
2	Jagtial	210	71.4	Purple	77.3	10.8	1:1.5	40.4
				W1263 (*Gm1*)	38.7	5.4	1:1.96	33.7
				Aganni (*Gm8*)	Not virulent	0	NA	NA
				Akshayadhan(*Gm4*+*Gm8*)	Not virulent	0	NA	NA
3	Moncompu	50	92	Purple	8.7	2	0: 4	0
				W1263 (*Gm1*)	28.3	8	1: 3	25.0
				Aganni (*Gm8*)	73.9	22	1: 1.4	41.4
				Akshayadhan (*Gm4*+*Gm8*)	76.09	29.5	1: 1.8	35.9
4	Pattambi	207	100	Purple	81.16	59.2	1:2.03	30.5
				W1263 (*Gm1*)	22.71	11.9	1:2.28	35.2
				Aganni (*Gm8*)	65.22	41.4	1:1.84	33.0
				Akshayadhan(*Gm4*+*Gm8*)	68.12	47.7	1:2.28	30.5
5	Ragolu	250	100	Purple	60.96	53.2	1:1.0	49.8
				W1263 (*Gm1*)	20.91	17.6	1:1.34	42.7
				Aganni (*Gm8*)	Not virulent	0	-	0
				Akshayadhan (*Gm4*+*Gm8*)	37.74	24.4	1:1.02	48.6
6	Warangal	250	67.6	Purple	89.9	46.2	1:2.9	25.8
				W1263 (*Gm1*)	82.3	36.0	1:2.4	29.3
				Aganni (*Gm8*)	7.1	1.97	1:1.4	41.7
				Akshayadhan (*Gm4*+*Gm8*)	6.5	3.27	1:3.3	21.4

Table 2.2.4 Virulence monitoring of brown planthopper populations in PHPM, kharif 2022

Locations	IIRR				Coimbatore					Gangavathi			
Gene differential	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**TN1**	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**Sal-kathi**	**TN1**	**PTB 33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**TN1**
No. females released	25				10								
Virulent females (%)	100				60	50	40		100				
No nymphs hatched/female	15.0	25.0	27.0	70.0	3.8	2.1	2.9		54.4				
Total nymphs/female	137				63.2								
Egg period	8	8	10	10	14.8	14.8	14.8		14.8				
Nymphal surival (%)	40.00	42.22	44.44	91.11	54.5	65.3	100	77.4	84.5				
Nymphal duration	17.96	16.81	16.38	12.74									
Males (%)	64.29	63.49	60.32	34.19	NR	NR	NR		NR				
Sex ratio	0.56F:1.0M	0.58F:1.0M	0.66F:1.0M	1.92F:1.0M	NR	NR	NR		NR				
winged females(%)	17.86	26.98	24.60	21.71	NR	NR	NR		NR				
Winged males (%)	50.00	47.62	50.00	24.27	NR	NR	NR		NR				
wingless females(%)	17.86	9.52	15.08	44.10	NR	NR	NR		NR				
Wingless males (%)	14.29	15.87	10.32	9.91	NR	NR	NR		NR				

Table 2.2.4 (Contd…) Virulence monitoring of brown planthopper population in PHPM, kharif 2022 Contd…

Locations	**Ludhiana**					**New Delhi**					**Pantnagar**				
Gene differential	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**Salkathi**	**TN1**	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**Salkathi**	**TN1**	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**Sal kathi**	**TN1**
No. females released	**20**					**10**	**10**	**10**	**5**	**10**	**25**				
Virulent females (%)	**100**					**100**					**100**				
No nymphs hatched/female	23.25	26.3	33.65	34.95	87.5	43.2	42	63.3	30.7	83.1	20.5	23.1	30.4	22.3	50.8
Total nymphs/female	**205.7**					**262.3**					**147**				
Egg period	10	10	10	9	9	9	8	8	9	7.5	12	12	12	12	12
Nymphal surival (%)	93	94	97.5	96.5	99	58.4	61.3	63.6	32.9	76.6	37.6	37.2	49.2		77.4
Nymphal duration	21	20	**19**	**19**	17						15	15	**15**		15
Males (%)	53.2	52.3	51.2	52.4	42.9	44.5	47.9	43.4	47.3	44.3	31.5	30.1	38.3		38.2
Sex ratio	0.88F:1.0M	0.91F:1.0M	0.95F:1.0M	0.91F:1.0M	1.33F:1.0M	1.25F:1.0M	1.09F:1.0M	1.31F:1.0M	1.11F:1.0M	1.26F:1.0M	2.2F:1.0M	2.32F:1.0M	1.6F:1.0M		1.61F:1.0M
winged females(%)	29.1	29.7	28.2	23.3	24.7										
Winged males (%)	39.8	41.2	42.5	43.0	33.8										
wingless females(%)	17.7	18.0	20.6	24.3	32.3										
Wingless males (%)	13.4	11.1	8.7	9.3	9.1										

2.3 Chemical Control Studies

i) Evaluation of granular insecticides for the management of gall midge (EIGM)

Asian gall midge, *Orseolia oryzae* (Wood-Mason) is one of the key pests of rice at vegetative stage of crop growth particularly in the rainy season. Of late, there is an uptrend in its incidence in many areas leading to severe yield losses. In order to identify the effective granular insecticides/ combination of granular insecticides for the management of gall midge a field trial was conducted at 12 locations (RGL, BPT, MTU, NLR, WGL, GVT, ADT, PTB, JDP, ABP, SKL and CHP) during 2022 *Kharif* season.

Treatments:

Crop Stage	Trt. No.	Insecticide	Dosage (formulation)
Seed Treatment alone	T_1	Thiamethoxam 25% WG	4 g/kg seed
Nursery alone (15 DAS/one week before transplantation)	T_2	Carbofuran 3% CG (Check1)	33 Kg per ha (3.3 g/m$^{2)}$
	T_3	Fipronil 0.3 GR	25 Kg per ha (2.5 g/m^2)
	T_4	Chlorantraniliprole 0.4 GR	10 Kg per ha (1.0 g/m^2)
Main field alone (20-25 DAT)	T_5	Carbofuran 3% CG (Check2)	33 Kg per ha (3.3 g/m^2)
	T_6	Fipronil 0.3 GR	25 Kg per ha (2.5 g/m^2)
	T_7	Chlorantraniliprole 0.4 GR	10 Kg per ha (1.0 g/m^2)
	T_8	Cartap hydrochloride 4% GR	18.75 kg per ha(1.9g/m^2)
Seed Treatment + Main field	T_9	$T_1 + T_6$	
	T_{10}	$T_1 + T_7$	
	T_{11}	$T_1 + T_8$	
Nursery + Main field	T_{12}	$T_3 + T_7$	
	T_{13}	$T_3 + T_8$	
Untreated control	T_{14}	Untreated Control	

Statistical analysis: Data were subjected to appropriate transformations and to two-way ANOVA. Treatment effects across the locations (treatment*location interaction) were estimated to draw overall conclusions. Means were separated by LSD at five per cent level of significance.

Results:

Effect of granules on gall midge damage at different locations:

Data from nine locations were considered for analysis and at all the locations percent SS crossed the ETL of 5% in the untreated plot. Percent silver shoots (SS) ranged from 1.97 (CHP) to 35.04 (JDP). Treatment effects compared to untreated control were significant at all the locations except SKL. Location wise results are described below based on the mean of 35, 50, and 65 DAT Table 2.3.1.1).

ADT: T13 (5.72 %SS), T9 (5.82 %SS), and T10 (5.85 %SS) were most effective as compared to the remaining treatments.

AMB: T13 (8.51 %SS) was most effective along with T12 (9.27 %SS) which were significantly superior as compared to the remaining treatments. In untreated plot 20.16 %SS were recorded.

CHP: All the treatments were significantly effective as compared to the untreated control (T14) (20.11 %SS) and T9 (1.97 %SS) was significantly superior to all the remaining treatments.

GVT: All the treatments were significantly effective as compared to the untreated control (T14) (32.04 %SS). Significantly lower SS were recorded in T10 (5.73 %) and T9 (6.35%) as compared to rest of the treatments.

JDP: All the treatments were significantly effective as compared to the untreated control (T14) (35.04 %SS). T12 was the most effective (5.54 %SS) treatment. T13 (8.41 %SS) was comparable to the best performing treatment.

MTU: Though T8 (17.93 %SS) and T3 (19.26 %SS) were effective in suppressing gall midge damage, treatment means were not significant as compared to untreated control (22.27 % SS).

PTB: Treatments T12 and T4 (4.56 5 SS), t9 (5.12 %SS), T3 (5.17 %SS) and T2 (5.26 %SS) were significantly superior to untreated control (8.61 %SS) but were similar to rest of the treatments.

SKL: Treatment effects were not significant and all were at par.

WGL: Treatment effects were significant and in all the treatments significantly lower damage was recorded as compared to the untreated control (10.05 %SS). T5 was most effective with significantly lower %SS (2.49).

Effect of granules on the gall midge damage across the locations (locationXtreatment):

In order to arrive at treatment effects across the locations (treatment x locations) interaction effects were worked out. ***T9 (seed treatment with thiamethoxam 25% WG followed by application of fipronil 3% GR at 20-25 DAT in the main field)* was most effective** with significantly lower SS (8.27%) as compared to rest of the treatments.

Stem borer:

Effect of granules on stem borer damage at different locations:

Data from eight locations were considered for analysis. Only at three locations (ADT, ABP, and GNV) DH damage crossed ETL of 10 per cent. Percent silver shoots (SS) ranged from 1.97 (CHP) to 35.04 (JDP). Treatment effects were significant at all the locations compared to untreated control treatment. Location wise results are described below based on the mean of 35, 50, and 65 DAT (2.3.1.2).

ABP: All the treatments were effective and resulted in lower percent dead hearts (DH) as compared to the untreated control (9.9 %). In T8 and T10 significantly lower DH

(5.51 and 5.35 per cent respectively) were recorded compared to rest of the treatments. With respect to white ears, T13 was the best treatment (4.91 %WE). In untreated control treatment 18.39 %WE were recorded.

ADT: Except T8 and T5 (12.5 % and 14.05 % DH) all the treatments were significantly superior to untreated check (16.48 %DH). With respect to WE all the treatments were significantly effective as compared to untreated control and at par each other (11.07 %WE).

CHP: DH were too low to be analysed. Whereas, WE damage was considerable with 13.62 per cent in the untreated control. T12, T10, T7 and T6 were most effective with significantly lower DH as compared to remaining treatments.

GVT: T10 and T9 were most effective with significantly lower DH (2.61% and 3.27% respectively). In untreated control (T14) 17.02 % DH were recorded.

JDP: T12 was most effective with significantly lower percent DH (2.65) as compared to rest of the treatments. For WE, T12 and T13 were most effective with significantly lower %DH (7.42 and 7.92 respectively).

MTU: Except T4, all the treatments were significantly superior to untreated check (3.39 % DH). For WE, in T3 comparatively lower percent WE (6.29) were recorded as compared to the rest of the treatments.

NLR: DH damage was low and not considered. Whereas, for WE in T1 significantly lower damage was recorded (0.66 %WE) as compared to rest of the treatments.

PTB: Treatments T8 (1.18%DH) and T9 (1.54 %DH) were significantly superior to T7 (4.87 %DH) and T14 (6.36 %DH) and were comparable to rest of the treatments. With respect to WE, T10 was the best treatment and significantly superior to T9 and T5 and was at par with rest of the treatments.

RGL: All the treatments were significantly superior to the untreated control (15.26 %WE) but were at par to each other, though in T1 comparatively lower percent WE were recorded.

SKL: Treatment T7 (4.29 %DH) was superior to rest of the treatments in preventing DH formation. In T12, lower WE (6.88%) recorded as compared to remaining treatments.

WGL: All the treatments were significantly superior to untreated control (7.69 %DH) and T10 (Thiamethoxam 25% WG + Chlorantraniliprole 0.4 GR) was the most effective one (0.68 %DH). Whereas, in preventing the WE damage all the treatments were significantly effective as compared to the untreated control (9.69%) and T11 was the best treatment (1.42 %WE).

Effect on stem borer damage across the locations (location X treatment):

For dead hearts (DH), **T10 (seed treatment with thiamethoxam 25% WG + chlorantraniliprole 0.4 GR in the main field**) was most effective with 62.18 per reduction over control. Similar trend observed with WE also, wherein combination treatments were effective in preventing WE damage. T12 (fipronil 0.3 GR in nursery + chlorantraniliprole 0.4 GR in the main field) (7.46 %) was significantly superior and was at par with T7, T10, T11, and T13. In the untreated control 15.42 % WE recorded (Table 2.3.1.1).

Effect on leaf folder damage across the locations (location X treatment):

In all the treatments, significantly lower damage was recorded as compared to the untreated control and were similar in their efficacy except T1, T2, and T11 that were comparatively less effective.

Effect on spiders and mirids across the locations (location X treatment):

Data revealed that all the treatments were safe to spiders and mirids and the treatment mean differences were insignificant (Tables 2.3.1.4).

Effect on yield at different locations:

In general, treatments involving two rounds of application *i.e.*, ST + main field and nursery + main field resulted in higher yields as compared to untreated control and single application treatments.

AMB: In T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) significantly higher yield was recorded (4261.7 kg/ha) as compared to the untreated control (T14) (2981.7 kg/ha) and was at par with remaining treatments except T3 (3518.3 kg/ha).

ADT: T12 (fipronil granules at nursery + chlorantraniliprole granule in main field) resulted in better yield (2966.7 kg/ha) as compared to the untreated control (T14) (1766.7 kg/ha) and T1 (2261.7 kg/ha), but was at par with the remaining treatments.

CHP: Significantly higher yield (44683.3 kg/ha) was recorded in T10 (seed treatment + chlorantraniliprole granules in main field) as compared to remaining treatments.

GVT: In T10 (seed treatment with thiamethoxam + chlorantraniliprole granule in main field) significantly higher yield (7565.3 kg/ha) followed by T9 (7328 kg/ha).

JDP: Significantly higher yield was recorded in T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) (4240 kg/ha) as compared to remaining treatments except T7, T8, and T13.

MTU: In T9 (seed treatment + fipronil at main field) gave highest yield (2712.3 kg/ha) and was at par with others except T10, T8, and T1.

NLR: Significantly higher yield (7263.3 kg/ha) was recorded in T9 as compared to untreated control (4926.7 kg/ha) and was at par with rest of the treatments.

PTB: T5 (carbofuran 3% CG in main field) gave higher yield (4626.7 kg/ha) compared to remaining treatments and was at par with T7 and T12.

RGL: Though not significant, the yield was comparatively higher in T9 ((5906.7 kg/ha).

SKL: T7 (chlorantraniliprole granule in main field) gave significantly higher yield 92728.3 kg/ha) among all the treatments.

WGL: T9 was superior and gave highest yield (4375.5 kg/ha amongst the treatments.

Effect on yield across the locations (location X treatment):

Treatment effects were significant and in all the treatments higher yield was recorded as compared to the untreated control (T14) (3214.5 kg/ha). T12 (fipronil granules in nursery + chlorantraniliprole granules in main field) was the best treatment with significantly higher yield (4496.4 kg/ha) as compared to remaining treatments. T9 (seed treatment with thiamethoxam + fipronil granules in main field) (4468.2 kg/ha) and T10 (seed treatment with thiamethoxam + chlorantraniliprole granules in main field) (4340.8 kg/ha) were second and third best and were at par with T12. The best treatment resulted in 39.9% yield advantage over the untreated control (Table 10).

Conclusions:

For gall midge, T9 (seed treatment with thiamethoxam followed by application of fipronil 3% GR at 20-25 DAT in the main field) **was most effective** with significantly lower SS (8.27%) as compared to rest of the treatments

In case of yellow stem borer T10 (seed treatment with thiamethoxam followed by chlorantraniliprole 0.4 GR in the main field) was most effective *in preventing DH formation with 62.18 per reduction over control. Whereas, T12 (fipronil granules in nursery + chlorantraniliprole granules in main field) was significantly superior in preventing white ear formation with 51.67 % reduction over control.*

With respect to yield, treatment effects were significant and in all the treatments higher yield was recorded as compared to untreated control (T14) (3214.5 kg/ha). T12 (fipronil granules in nursery followed by chlorantraniliprole granules in main field) was the best treatment with significantly higher yield (4496.4 kg/ha) as compared to remaining treatments. T9 (seed treatment with thiamethoxam followed by fipronil granules in main field) (4468.2 kg/ha) and T10 (seed treatment with thiamethoxam followed by chlorantraniliprole granules in main field) (4340.8 kg/ha) were second and third best and were at par with T12. The best treatment resulted in 39.9% yield advantage over the untreated control.

Table 2.3.1.1 Field efficacy of granular insecticides against rice gall midge at different locations

Crop Stage	Treatment		Dose	ADT	ABP	CHP	GNV	JDP	MTU	PTB	SKL	WGL	Mean
Seed Treatment alone	T_1	Thiamethoxam 25% WG	4 g/kg seed	8.03 (4.62) ^{cd}	13.73 (7.94) ^{bc}	5.55 (3.19) ^{ef}	22.66 (13.16) ^{b}	21.95 (12.77) ^{b}	21.88 (12.81) ^{abc}	7.19 (4.18) ^{ab}	5.81 (3.35) ^{a}	7.47 (4.29) ^{cd}	12.70 (6.52) ^{b}
Nursery alone (15 DAS/one week before transplantation)	T_2	Carbofuran 3% CG (Check1)	33 Kg per ha (3.3 g/m^{2})	17.75 (10.26) ^{a}	15.75 (9.12) ^{b}	7.80 (4.48) ^{d}	16.41 (9.46) ^{d}	15.80 (9.15) ^{c}	23.32 (13.61) ^{ab}	5.26 (3.04) ^{b}	6.14 (3.53) ^{a}	3.89 (2.23) ^{ef}	12.46 (6.16) ^{c}
	T_3	Fipronil 0.3 GR	25 Kg per ha (2.5 g/m^{2})	8.91 (5.12) ^{cd}	11.76 (6.79) ^{c}	5.99 (3.44) ^{e}	19.95 (11.54) ^{c}	16.15 (9.42) ^{c}	19.26 (11.20) ^{bc}	5.17 (2.98) ^{b}	6.31 (3.63) ^{a}	5.45 (3.14) ^{cde}	10.99 (5.82) ^{a}
	T_4	Chlorantraniliprole 0.4 GR	10 Kg per ha (1.0 g/m^{2})	6.74 (3.87)^{def}	13.28 (7.69) ^{c}	8.86 (5.09) ^{cd}	17.09 (9.87) ^{d}	15.80 (9.14) ^{c}	24.44 (14.48) ^{a}	4.64 (2.68) ^{b}	5.80 (3.35) ^{a}	6.09 (3.50) ^{bcd}	11.42 (5.60) ^{de}
Main field alone (20-25 DAT)	T_5	Carbofuran 3% CG (Check2)	33 Kg per ha (3.3 g/m^{2})	14.08 (8.12) ^{b}	11.85 (6.90) ^{c}	5.22 (3.00) ^{ef}	13.58 (7.82) ^{e}	14.12 (8.19) ^{cd}	18.00 (10.55) ^{c}	5.93 (3.44) ^{ab}	5.39 (3.12) ^{a}	2.49 (1.43) ^{f}	10.07 (4.97) ^{f}
	T_6	Fipronil 0.3 GR	25 Kg per ha (2.5 g/m^{2})	7.62 (4.37) ^{cde}	12.04 (6.97) ^{c}	5.31 (3.05) ^{ef}	11.78 (6.77) ^{g}	15.17 (8.77) ^{c}	20.73 (12.13) ^{abc}	9.16 (5.33) ^{a}	4.74^{a} (2.72)	3.55 (2.04) ^{ef}	10.01 (4.45) ^{g}
	T_7	Chlorantraniliprole 0.4 GR	10 Kg per ha (1.0 g/m^{2})	7.57 (4.35) ^{cde}	11.42 (6.61) ^{c}	9.99 (5.74) ^{cd}	11.13 (6.40) ^{g}	15.02 (8.71) ^{c}	24.97 (14.66) ^{a}	4.56 (2.63) ^{b}	6.02 (3.47) ^{a}	5.24 (3.01) ^{de}	10.66 (4.88) ^{f}
	T_8	Cartap hydrochloride 4% GR	18.75 kg per ha(1.9g/m^{2})	8.57 (4.92) ^{c}	14.17 (8.22) ^{c}	13.32 (7.66) ^{b}	12.72 (7.32) ^{f}	13.03 (7.54) ^{cd}	17.93 (10.50) ^{c}	6.81 (3.95) ^{ab}	4.70 (2.71) ^{a}	7.38 (4.24) ^{bc}	10.96 (5.37) ^{e}
Seed Treatment + Main field	T_9	$T_1 + T_6$		5.82 (3.34) ^{f}	12.22 (7.05) ^{c}	1.97 (1.13) ^{h}	6.35 (3.64) ^{j}	12.93 (7.49) ^{cd}	21.45 (12.55) ^{abc}	5.12 (2.95) ^{b}	4.86 (2.80) ^{a}	3.70 (2.12) ^{ef}	8.27 (3.08) ^{k}
	T_{10}	$T_1 + T_7$		5.85 (3.36) ^{f}	12.47 (7.29) ^{c}	3.49 (2.00) ^{g}	5.73 (3.29) ^{j}	14.12 (8.19) ^{cd}	21.29 (12.43) ^{abc}	7.46 (4.32) ^{ab}	4.54 (2.61) ^{a}	7.85 (4.52) ^{b}	9.20 (3.47) ^{j}
	T_{11}	$T_1 + T_8$		6.11 (3.51) ^{ef}	11.58 (6.68) ^{c}	4.43 (2.54) ^{fg}	10.14 (5.83) ^{h}	11.37 (6.58) ^{de}	21.98 (12.91) ^{abc}	7.23 (4.18) ^{ab}	5.47 (3.15) ^{a}	6.38 (3.67) ^{bcd}	9.41 (4.06) ^{hi}
Nursery + Main field	T_{12}	$T_3 + T_7$		7.93c^{d} (4.56)	9.27^{e} (5.34)	5.79^{e} (3.32)	8.53^{i} (5.02)	5.54 (3.18) ^{f}	23.86 (13.94) ^{ab}	4.56 (2.63) ^{b}	5.30 (3.05) ^{a}	5.28 (3.03) ^{de}	8.45 (3.80)^{i}
	T_{13}	$T_3 + T_8$		5.72^{f} (3.28)	8.51^{e} (4.91)	8.38^{d} (4.81)	9.46^{ih} (5.43)	8.41 (4.84) ^{ef}	21.92 (12.85) ^{abc}	7.32 (4.30) ^{ab}	4.73 (2.72) ^{a}	6.55 (3.76) ^{bcd}	9.00 (4.16) ^{gh}
Untreated control	T_{14}	Untreated Control		18.11^{a} (10.50)	20.16^{a} (11.75)	20.11^{a} (11.71)	32.04^{a} (18.93)	35.04 (20.73) ^{a}	22.27 (13.01) ^{abc}	8.61 (5.15) ^{a}	5.08^{a} (2.92)	10.05 (5.80) ^{a}	19.05 (10.66) ^{a}
LSD (P=0.05)				0.8961	1.6147	0.7555	0.4919	1.929	3.1314	2.1083	1.1352	1.1796	0.3273

Note: Figures in parentheses are square root transformed values. Means within a column followed by same alphabet are not significantly different from one another (LSD, P<0.05).

Table 2.3.1.2 Field efficacy of granular insecticides on stem borer in terms of dead hearts at different locations

											DH	
Crop Stage	**Trt. No.**	**Insecticide**	**ADT**	**AMB**	**GNV**	**JDP**	**MTU**	**PTB**	**SKL**	**WGL**	Mean	%ROC
Seed Treatment alone	T_1	Thiamethoxam 25% WG	5.80 (3.33)^{c}	8.50 (4.92)^{ab}	15.42 (8.88)^{ab}	6.01^{b} (3.47)	1.74 (1.0)^{b}	1.57 (0.90)^{ab}	8.65 (5.02)^{bc}	2.77 (1.59)^{cd}	6.31 (2.27)^{b}	30.62
Nursery alone (15 DAS/one week before transplantation)	T_2	Carbofuran 3% CG (Check1)	5.93 (7.30)^{c}	5.72 (3.30)^{cdefg}	14.32 (8.27)^{bc}	4.64^{bc} (2.67)	1.15 (0.66)^{b}	1.42 (0.81)^{ab}	7.87 (4.55)^{bcd}	4.20 (2.41)^{b}	5.66 (2.38)^{b}	37.78
	T_3	Fipronil 0.3 GR	5.98 (3.43)^{c}	7.89 (4.59)^{abc}	13.20 (7.60)^{bcd}	4.43^{bc} (2.54)	1.81 (1.04)^{b}	1.27 (0.73)^{b}	6.50 (3.76)^{cde}	4.43 (2.56)^{b}	5.69 (2.16)^{b}	37.42
	T_4	Chlorantraniliprole 0.4 GR	5.96 (3.42)^{c}	6.27 (3.63)^{bcdefg}	11.43 (6.58)^{de}	6.31 (3.66)^{ab}	3.38 (1.96)^{a}	2.10 (1.23)^{ab}	5.20 (3.0)^{de}	3.73 (2.14)^{bc}	5.55 (2.20)^{b}	38.95
Main field alone (20-25 DAT)	T_5	Carbofuran 3% CG (Check2)	14.05 (8.10)^{a}	7.74 (4.48)^{abcd}	9.69 (5.57)^{ef}	4.63 (2.67)^{bc}	2.58 (1.49)^{ab}	2.41 (1.40)^{ab}	9.91 (5.77)^{ab}	1.98 (1.13)^{def}	6.63 (2.16)^{b}	27.15
	T_6	Fipronil 0.3 GR	7.86 (4.51)^{bc}	7.57 (4.40)^{bcde}	8.40 (4.87)^{fg}	5.62 (3.25)^{b}	1.89 (1.08)^{ab}	1.50 (0.88)^{ab}	6.81 (3.93)^{cde}	2.07 (1.19)^{def}	5.22 (1.74)^{cd}	42.61
	T_7	Chlorantraniliprole 0.4 GR	5.83 (3.34)^{c}	5.69 (3.28)^{cdefg}	7.14 (4.10)^{g}	5.13 (3.0)^{bc}	1.24 (0.71)^{b}	2.42 (1.40)^{ab}	4.28 (2.46)^{e}	1.0 (0.57)^{fg}	4.09 (1.36)^{ef}	54.99
	T_8	Cartap hydrochloride 4% GR	12.49 (7.19)^{ab}	4.508 (2.59)^{g}	12.17 (7.01)^{cd}	4.51 (2.60)^{bc}	2.43 (1.40)^{ab}	1.67 (0.96)^{ab}	6.42 (3.72)^{cde}	2.29 (1.32)^{de}	5.81 (2.09)^{bc}	36.08
Seed Treatment + Main field	T_9	**T_1 + T_6**	6.57 (3.77)^{c}	7.07 (4.14)^{bcdef}	3.27 (1.87)^{h}	4.88 (2.81)^{bc}	1.03 (0.60)^{b}	1.83 (1.06)^{ab}	12.07 (7.07)^{ab}	2.16 (1.24)^{de}	4.86 (1.56)^{de}	46.52
	T_{10}	**T_1 + T_7**	4.43 (2.54)^{c}	5.35 (3.09)^{efg}	2.61 (1.50)^{h}	4.78 (2.74)^{bc}	1.31 (0.76)^{b}	1.03 (0.59)^{b}	7.31 (4.22)^{bcde}	0.68 (0.39)^{g}	3.44 (1.05)^{f}	62.18
	T_{11}	**T_1 + T_8**	5.85 (3.36)^{c}	5.17 (2.98)^{fg}	7.46 (4.66)^{fg}	3.86 (2.21)^{bc}	1.23 (0.70)^{b}	1.89 (1.10)^{ab}	5.97 (3.43)^{cde}	1.89 (1.08)^{def}	4.16 (1.50)^{de}	54.23
Nursery + Main field	T_{12}	**T_3 + T_7**	6.53 (3.75)^{c}	5.50 (3.16)^{defg}	6.81 (4.19)^{g}	2.64 (1.51)^{c}	1.33 (0.76)^{b}	2.36 (1.43)^{ab}	6.05 (3.48)^{cde}	1.30 (0.74)^{efg}	4.07 (1.40)^{def}	55.27
	T_{13}	**T_3 + T_8**	4.67 (2.68)^{c}	5.30 (3.05)^{fg}	7.99 (4.92)^{fg}	4.24 (2.43)^{bc}	1.59 (0.91)^{b}	2.28 (1.31)^{ab}	6.89 (3.98)^{bcde}	1.86 (1.07)^{def}	4.35^{de} (1.61)	52.20
Untreated control	T_{14}	Untreated Control	16.48 (9.57)^{a}	9.93 (5.74)^{a}	17.02 (9.83)^{a}	9.05 (5.22)^{a}	2.34 (1.35)^{ab}	3.23 (1.87)^{a}	7.01 (4.05)^{bcde}	7.68 (4.41)^{a}	9.09 (3.45)^{a}	0
LSD (P=0.05)											0.35	

Note: Figures in parentheses are square root transformed values. Means within a column followed by same alphabet are not significantly different from one another (LSD, $P<0.05$).

Table 2.3.1.3 Field efficacy of granular insecticides on stem borer in terms of white ears at different locations

Crop Stage	Treatment		ADT	ABP	CHP	JDP	MTU	NLR	PTB	RGL	SKL	WGL	WE	
													Mean	%ROC
Seed Treatment alone	T_1	Thiamethoxam 25% WG	5.31 (3.04)^{b}	11.50 (6.63)^{b}	7.82 (4.50)^{bc}	19.37 (11.19)^{b}	7.94 (4.57)^{c}	0.66 (0.38)^{c}	19.56 (11.35)^{abc}	2.99 (1.71)^{b}	28.66 (17.18)^{a}	3.90 (2.24)^{cde}	10.77 (2.21) ^{bcdef}	30.18
Nursery alone (15 DAS/one week before Transplan-tation)	T_2	Carbofuran 3% CG (Check1)	6.80 (3.90)^{b}	11.83 (6.88)^{b}	8.12 (4.68)^{b}	16.0 (9.23)^{cd}	9.54 (5.50)^{bc}	5.16 (2.98)^{bc}	23.58 (13.71)^{abc}	4.77 (2.73)^{b}	11.38 (6.60)^{cd}	7.01 (4.05)^{b}	10.42 (2.45)^{bcdef}	32.45
	T_3	Fipronil 0.3 GR	4.92 (2.82)^{b}	14.30 (9.34)^{a}	7.39 (4.26)^{bcd}	19.43 (11.29)^{b}	6.29 (3.61)^{c}	6.38 (3.68)^{bc}	23.70 13.86)^{abc}	3.370 (1.93)^{b}	9.78 (5.63)^{cd}	3.39 (1.94)^{cde}	9.90 (2.13)^{bcdefg}	35.85
	T_4	Chlorantraniliprole 0.4 GR	5.82 (3.34)^{b}	8.88 (5.1)^{bcd}	6.40 (3.69)^{bcde}	15.54 (8.97)^{cde}	15.62 (9.07)^{b}	10.10 (5.83)^{ab}	17.79 (10.38)^{abc}	3.98 (2.28)^{b}	12.88 (7.60)^{bcd}	4.03 (2.32)^{cd}	10.10 (2.32)^{bcd}	34.50
Main field alone (20-25 DAT)	T_5	Carbofuran 3% CG (Check2)	7.19 (4.13)^{b}	9.64 (5.60)^{bcd}	5.90 (3.40)^{cdef}	12.89 (7.40)^{def}	13.03 (7.72)^{bc}	6.52 (3.76)^{bc}	23.22 (14.56)^{ab}	4.02 (2.30)^{b}	19.64 (11.58)^{abc}	3.20 (1.84)^{cde}	10.53 (2.38)^{bc}	31.78
	T_6	Fipronil 0.3 GR	7.24 (4.16)^{b}	10.63 (6.13)^{bc}	4.42 (2.54)^{fg}	16.28 (9.43)^{bc}	6.80 (3.92)^{c}	12.90 (7.44)^{ab}	19.39 (11.21)^{abc}	4.73 (2.70)^{b}	22.82 (13.457)^{ab}	2.96 (1.70)^{cde}	10.82 (2.39)^{b}	29.87
	T_7	Chlorantraniliprole 0.4 GR	6.21 (3.60)^{b}	9.63 (5.54)^{bcd}	3.08 (1.77)^{g}	12.37 (7.13)^{ef}	8.97 (5.16)^{bc}	10.37 (6.0)^{ab}	17.42 (10.09)^{bc}	5.04 (2.89)^{b}	8.16 (4.77)^{d}	2.25 (1.29)^{cde}	8.35 (1.91)^{efg}	45.87
	T_8	Cartap hydrochloride 4% GR	6.30 (3.62)^{b}	9.60 (5.53)^{bcd}	6.29 (3.62)^{bcdef}	11.75 (6.77)^{f}	20.92 (13.60)^{a}	7.77 (4.47)^{ab}	20.15 (11.73)^{abc}	4.62 (2.64)^{b}	5.57 (3.21)^{d}	2.74 (1.57)^{cde}	9.57 (2.26)^{bcde}	37.95
Seed Treatment + Main field	T_9	$T_1 + T_6$	6.30 (3.62)^{b}	9.35 (5.40)^{bcd}	4.47 (2.57)^{efg}	15.34 (8.86)^{cde}	10.05 (5.78)^{bc}	9.11 (5.26)^{ab}	26.22 (15.40)^{a}	3.94 (2.26)^{b}	14.40 (8.34)^{bcd}	3.49 (2.0)^{cde}	10.27 (2.30)^{bcd}	33.44
	T_{10}	$T_1 + T_7$	6.50 (3.53)^{b}	8.94 (5.15)^{bcd}	3.41 (1.97)^{g}	15.0 (8.64)^{cde}	8.55 (4.93)^{bc}	7.36 (4.25)^{ab}	15.43 (8.93)^{c}	4.32 (2.48)^{b}	13.35 (7.90)^{bcd}	1.98 (1.13)^{de}	8.45 (1.88)^{fg}	45.21
	T_{11}	$T_1 + T_8$	5.70 (3.30)^{b}	6.51 (3.74)^{ed}	5.64 (3.24)^{def}	12.75 (7.33)^{ef}	11.30^{bc} (6.53)	5.36 (3.07)^{bc}	20.98 (12.27)^{abc}	3.27 (1.88)^{b}	7.54 (4.34)^{d}	4.61 (2.65)^{bc}	8.37 (2.00)^{cdefg}	45.76
Nursery + Main field	T_{12}	$T_3 + T_7$	6.03 (3.50)^{b}	6.81 (3.92)^{cde}	3.26 (1.88)^{g}	7.42 (4.27)^{g}	9.81^{bc} (5.666)	6.64 (3.97)^{b}	22.36 (12.98)^{abc}	3.90 (2.28)^{b}	6.88 (3.98)^{d}	1.42 (0.82)^{e}	7.46 (1.74)^{g}	51.67
	T_{13}	$T_3 + T_8$	5.32 (3.05)^{b}	4.90 (2.81)^{e}	4.56 (2.61)^{efg}	7.91 (4.54)^{g}	11.48^{bc} (6.70)	6.68 (3.84)^{b}	24.45 (14.37)^{ab}	3.96 (2.27)^{b}	10.51 (6.14)^{cd}	3.51 (2.02)^{cde}	8.33 (1.98)^{defg}	45.99
Untreated control	T_{14}	Untreated Control	11.06^{a} (6.40)	18.40 (10.72)^{a}	13.62 (7.89)^{a}	29.57 (17.41)^{a}	9.92^{bc} (5.71)	6.98 (4.02)^{b}	20.83 (12.09)^{abc}	15.26 (8.77)^{a}	18.95 (11.25)^{abc}	9.70 (5.60)^{a}	15.4278 (3.78)^{a}	0.00
LSD (P=0.05)			1.61	2.24	1.12	1.88	4.48	3.40	5.01	1.54	6.30	1.50	0.3818	

Note: Figures in parentheses are square root transformed values.
Means within a column followed by same alphabet are not significantly different from one another (LSD, P<0.05).

Table 2.3.1.4 Field efficacy of granular insecticides on leaf folder, spiders and Mirid bugs in rice across the locations

Crop Stage	Treatment		Leaf folder	Spiders	Mirid bugs
Seed Treatment alone	**T_1**	Thiamethoxam 25% WG	7.07 (3.33) bc	0.99 (19.78) a	1.57 (10.54) ab
Nursery alone (15 DAS/one week before transplantation)	**T_2**	Carbofuran 3% CG (Check1)	7.91 (3.79) b	0.98 (19.73) a	1.71 (10.93) ab
	T_3	Fipronil 0.3 GR	6.01 (2.89) cd	0.91 (19.24) a	1.63 (10.72) ab
	T_4	Chlorantraniliprole 0.4 GR	6.23 (2.89) cd	0.91 (19.18) a	1.68 (10.70) ab
Main field alone (20-25 DAT)	**T_5**	Carbofuran 3% CG (Check2)	5.98 (2.76) cd	0.91 (19.21) a	1.54 (10.44) ab
	T_6	Fipronil 0.3 GR	6.25 (2.98) cd	0.93 (19.55) a	1.31 (10.01) b
	T_7	Chlorantraniliprole 0.4 GR	5.99 (2.76) cd	0.91 (19.39) a	1.76 (11.09) a
	T_8	Cartap hydrochloride 4% GR	6.49 (3.16) cd	1.09 (19.60) a	1.69 (10.88) ab
Seed Treatment + Main field	**T_9**	**$T_1 + T_6$**	6.49 (2.98) cd	0.91 (19.21) a	1.70 (10.97) ab
	T_{10}	**$T_1 + T_7$**	5.91 (2.84) cd	0.94 (19.37) a	1.58 (10.71) ab
	T_{11}	**$T_1 + T_8$**	7.03 (3.32) bc	0.89 (19.12) a	1.62 (10.81) ab
Nursery + Main field	**T_{12}**	**$T_3 + T_7$**	5.25 (2.51) d	0.89 (19.12) a	1.80 (11.16) a
	T_{13}	**$T_3 + T_8$**	6.38cd (2.96)	0.89 (19.24) a	1.74 (11.05) a
Untreated control	**T_{14}**	Untreated Control	11.68 (5.56) a	0.99 (19.62) a	1.56 (10.53) ab
LSD (P=0.05)			0.6022	0.6996	0.9897

Note: Figures in parentheses are square root transformed values.
Means within a column followed by same alphabet are not significantly different from one another (LSD, P<0.05).

Table 2.3.1.5. Effect of granular insecticides on yield in rice at different locations

Treatment		ADT	AMB	CHP	GNV	JDP	MTU	NLR	PTB	RGL
T_1	Thiamethoxam 25% WG	2261.7^{bc}	3633.3^{abc}	4100^{h}	3472^{j}	4406.7^{d}	1822.5^{cd}	6050^{ab}	3783.3^{cd}	5786.7^{a}
T_2	Carbofuran 3% CG (Check1)	2686.7^{ab}	3371.7^{cd}	3900^{i}	4459.3^{i}	4650^{cd}	2283.3^{abcd}	6160^{ab}	3476.7^{d}	5746.7^{a}
T_3	Fipronil 0.3 GR	2723.3^{ab}	3518.3^{bcd}	4216.67^{fgh}	4706.7^{h}	4608.3^{cd}	2344.3^{abcd}	6480^{ab}	4058.3^{abcd}	5826.7^{a}
T_4	Chlorantranili prole 0.4 GR	2850.0^{a}	3725.0^{abc}	4300^{efg}	5169^{g}	4616.7^{cd}	2031.5^{abcd}	6190^{ab}	4010^{abcd}	5853.3^{a}
T_5	Carbofuran 3% CG (Check2)	2463.3^{ab}	3740.0^{abc}	4183.33g^{h}	5933.3^{ef}	4873.3^{bc}	2469.5^{abc}	6363.3^{ab}	4626.7^{a}	5920^{a}
T_6	Fipronil 0.3 GR	2823.3^{a}	3840.0^{abc}	4333.33^{defg}	6077.3^{de}	4638.3^{cd}	2499.7^{abc}	5543.3^{ab}	4236.7^{abcd}	5733.3^{ab}
T_7	Chlorantraniliprole 0.4 GR	2593.3^{ab}	3691.7^{abc}	4491.67^{bcd}	6261.3^{de}	4711.7^{cd}	2395.3^{ab}cd	5696.7^{ab}	4575^{ab}	5712^{a}
T_8	Cartap hydro-chloride 4% GR	2641.7^{ab}	3738.3^{abc}	4283.33^{efg}	5769.7^{f}	4656.7^{cd}	1719^{d}	5890^{ab}	4040^{abcd}	5757.3^{a}
T_9	**T_1 + T_6**	2941.7^{a}	3801.7^{abc}	4583.33^{ab}	7328^{a}	4745^{cd}	2712.3^{a}	7263.3^{a}	3853.3^{bcd}	5906.7^{a}
T_{10}	**T_1 + T_7**	2816.7^{a}	3858.3^{abc}	4683.33^{a}	7535.3^{a}	4790^{bc}	1839.3^{bcd}	6996.7^{ab}	3708.3^{cd}	5722.7^{ab}
T_{11}	**T_1 + T_8**	2961.7^{a}	4121.7^{ab}	4450^{bcde}	6525.7^{c}	4953.3^{bc}	2525.7^{ab}	6310^{ab}	3918.3^{abcd}	5800^{a}
T_{12}	**T_3 + T_7**	2966.7^{a}	4261.7^{a}	4516.67^{abc}	6935^{b}	5333.3^{a}	2398^{abcd}	6510^{ab}	4346.7^{abc}	5814.7^{a}
T_{13}	**T_3 + T_8**	2483.3^{ab}	4186.7^{a}	4366.67^{cdef}	6691.7^{c}	5096.7^{ab}	2254.8^{abcd}	5983.3^{ab}	4000^{abcd}	5680^{ab}
T_{14}	Untreated Control	1766.7^{c}	2981.7^{d}	3050^{j}	2952.3^{k}	3991.7^{e}	2088.2^{abcd}	4926.7^{b}	3751.7^{d}	5386.7^{ab}
	LSD (0.05)	506.24	639.67	181.02	242.98	384.04	695.33	1870.6	769.85	359.34

Note: Means within a column followed by same alphabet are not significantly different frpm one another (LSD, P<0.05).

ii) Insecticide-Botanicals Evaluation Trial (IBET)

Use of plant extracts or botanicals is one of the earliest and traditional practice adapted in control of insect pests of crops. Botanicals can play a key role in sustainable management of pests as they are environment-friendly, safe to non-target organisms, renewable and cost effective. Integration of botanicals in rice IPM will reduce pesticide load in environment, prevent insecticide resistance and help in conserving natural enemy populations. Increasing emphasis on natural and organic farming in the recent past makes use of botanicals all the more relevant in pest control. Earlier efforts under AICRIP were mainly focussed on evaluation of efficacy of various commercial botanical formulations and insecticides against insect pests. Hence, it was felt necessary to test combination of insecticide and botanicals as modules against major pests of rice in order to identify the effective combination and strategically integrate use of botanicals for ideal rice IPM. So, a trial consisting of various treatments having combinations of effective and commercially available essential oils, neem formulations with recommended insecticides was evaluated during *kharif* 2022 to evaluate their performance against major insect pests at 30 check locations. The locations, planting dates and date and time of application are given in the following table (Table 2.3.2.1)

Table 2.3.2.1a: Details of locations, sowing, planting, harvesting and application dates

Sl. No.	Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
1	Bapatla	03-08-2022	06-09-2022	02-09-2023	3	30,50 & 60
2	Chiplima	05-07-2022	30-07-2022	28-11-2022	3	25, 45 & 65
3	Cuttack	02-07-2022	20-08-2022	29-11-2022	3	25, 55 & 65
4	Gangavathi	02-07-2022	09-08-2022	11-12-2022	3	25,49 & 60
5	Jagdalpur	23-06-2022	20-07-2022	28-11-2022	3	30,49 & 60
6	Khudwani	05-04-2022	-	-	-	-
7	Karjat	16-06-2022	-	30-11-2022	2	30 & 46
8	Karaikal	17-06-2022	15-07-2022	01-10-2022	3	30,42 & 55
9	Kaul	-	-	-	4	25,30,50 & 65
10	Ludhiana	26-05-2022	27-06-2022	02-11-2022	3	55, 75 & 90
11	Mandya	11-08-2022	05-09-2022	19-12-2022	3	25, 45 & 60
12	Masodha	30-06-2022	29-07-2022	22-10-2022	3	28,53 & 65
13	Maruteru	23-06-2022	19-07-2022	11-11-2022	2	30,43 & 68
14	Moncompu	15-06-2022	01-07-2022	22-10-2022	-	-
15	Navsari	17-07-2022	06-08-2022	22-11-2022	3	30, 50 & 65
16	Nawagam	21-07-2022	26-08-2022	05-12-2022	3	31, 46 & 63
17	New Delhi	22-06-2022	22-07-2022	27-10-2022	4	24, 40, 45 & 60
18	Pattambi	07-07-2022	29-07-2022	05-011-2022	3	15,45 & 75
19	Pusa	21-06-2022	13-07-2022	10-11-2022	3	24, 44 & 59
20	Ranchi	07-07-2022	04-08-2022	17-11-2022	3	27,47 & 60
21	Rajendranagar	27-06-2022	23-07-2022	-	2	35 & 54
22	Raipur	11-07-2022	05-08-2022	09-12-2022	3	30, 50 & 90
23	Titabar	16-06-2022	12-07-2022	18-11-2022	-	-

Treatments:

Four combination modules/treatments consisting of three insecticides- Chlorantraniliprole 20% SC, Cartap hydrochloride 50% SC and Triflumezopyrim 10% SC, one commercial neem formulation - Neemazal and two plant oils - Neem and Eucalyptus oil procured from local market, Hyderabad (Telangana) were compared along with untreated control (only water spray). There were five treatments replicated four times and laid out in Randomized Complete Block Design (RCBD). Spray applications of the treatments were done based on pest incidence exceeding the economic threshold level guidelines at 10-15 days interval. All the treatments were applied as high-volume sprays @ 500 litres of spray fluid/ha.

Standard observation procedures were followed to record insect pest incidence in data sheets at regular intervals throughout the crop growth period. To assess stem borer and gall midge damage, observations were recorded on total tillers (TT), dead hearts (DH) and silver shoots (SS) at 30 and 50 DAT, while stem borer damage at heading stage was expressed as per cent white ears based on counts of panicle bearing tillers (PBT) and white ear heads (WE). In case of sucking pests such as brown planthopper (BPH), white backed planthopper (WBPH), green leafhopper (GLH) and natural enemies, number of insects were recorded on 10 randomly selected hills. The damage due to foliage feeders such as leaf folder, whorl maggot, hispa, blue beetle etc., was assessed based on counts of damaged leaves/10 hills. At the time of harvest, the grain yield from net plot leaving 2 border rows on all sides was collected and expressed as kg/ha.

ANOVA test for Random Complete Block Design (RCBD) was applied to analyse data collected for each date of application at each location as well as for yield at harvest to assess the performance of the different treatments using SAS. The comparative efficacy of the treatments was worked out based on efficacy at each DAT and pooled means of the pest damages across observations and over locations. Pooled yield data analysis was carried out to assess the impact of each treatment on yield.

Results

Pest Infestation (Table. 2.3.2.1)

Stem borer infestation was recorded in 16 locations and damage during vegetative stage ranged from 1.0 to 9.7% dead hearts (DH) in all insecticide treatments and 0.7 to 16.1% in other combination treatments compared to 1.7 to 21.6% in untreated control, during 30 to 85 DAT. There were significant differences in dead heart damage among the treatments at 16 locations. All insecticides treatment module recorded the lowest mean damage of 3.2% when compared to 9.5% in untreated control. Among other treatments, neemazal, eucalyptus oil and cartap hydrochloride combination showed lowest mean infestation of 5.0% DH.

White ears damage at heading stage in all insecticide treatment ranged from 1.0 to 25.9% compared to 2.6 to 39.3% in control across 19 centres. There were significant differences among treatments in white ear (WE) damage at 18 locations. Highest white ear damage was reported from Pattambi which ranged from 22.7 to 29.4% compared to a maximum of 39.3% in untreated control. Mean WE infestation ranged from 5.1

to10.0% in treatments as compared to 15.6% in control. Among modules, all insecticides module was found to be the best with 5.1% mean white ear damage followed by neemazal, eucalyptus oil and cartap hydrochloride module with 8.1% WE. Overall, all insecticides module was found to be superior in reducing stem borer damage compared to other insecticide-botanical modules and was the most effective treatment at both vegetative and reproductive phases.

Gall midge occurrence was reported from 5 centres of which Jagdalpur recorded highest damage ranging from 11.5 to 30.0% silver shoots (SS)in treatments and 62.2% in control at 50 DAT followed by Chiplima at 55 DAT. At other locations, the SS damage varied from 0.0 to 14.5% across treatments and 4.8 to 13.6% in control. There were significant differences in the efficacy among the treatments at 4 locations. Lowest mean infestation was recorded in all insecticides treatment (8.1%). However there was no significant difference in damage among treatments but and significantly superior to control (16.2%).

Brown planthopper incidence was recorded at very high at Maruteru (913.3 to 1019.3 hoppers/10hills) at 70 DAT followed by New Delhi with population of 94.0 to 281.5 at 80 DAT. Across 9 locations, combination of Neemazal, neem oil and triflumezopyrim treatment was found to be the most effective one with mean number of 31.6 hoppers/10 hills followed by all insecticide treatment in reducing BPH populations (36.7) and they were significantly superior to control (127.5).

White backed planthopper populations were observed at 7 locations and Maruteru recorded the highest populations ranging from 128.0 to 249.0. Hoppers/10 hills across the control at 45 to 75 DAT. Treatment consisting of all insecticides was the most effective in reducing WBPH populations which ranged from 3.2-125.0 across locations. Lowest mean hopper numbers (36.1/10 hills) was also recorded in all insecticide treatment followed by combination of Neemazal, neem oil and triflumezopyrim treatment (38.5) compared to that of control (98.2).

Green leafhopper infestation was high at Masodha (25.0-250.5 hoppers/10 hills) at 50 DAT among the 4 centres. All insecticides combination was the most effective treatment showing mean population of 18.6/10 hills followed by neeamazal, neem oil and Triflumezopyrim combination (25.1)) and were superior to control (68.7 hoppers/10 hills). There were significant differences in hopper populations among the treatments at 3 locations as well as in populations recorded at 35, 38 and 56 DAT in Bapatla.

Leaf folder damage was recorded from 11 locations and highest leaf damage was recorded in Ranchi centre (22.2%) during 30 DAT at Masoda and followed by Navsari at 65 DAT (21.2%) in control plots. There were significant differences in leaf damage among the treatments at 10 locations. All insecticides module was the most effective treatment showing significant mean leaf damage of 4.8 % followed by treatment with neemazl, Eucalyptus oil and cartap hydrochloride (6.5%). The leaf damage in treatments was significantly low when compared to control 11.6%).

Whorl maggot infestation was recorded at 5 centres and damage in general was low. Highest foliage damage was noticed in Titabar ranging from 9.8-13.0% in control at 15-25 DAT. The lowest mean damage was recorded in insecticides treatment (3.5%). The damage in botanical and insecticide combination treatments was significantly low (3.6-4.2%) compared to 5.7% in control.

The damage by other minor pests like Hispa, Gundhi bug and Grasshoppers were reported from Ranchi, Navsari and Khudwani centres respectively. The damage levels in case of Gundhi bug were on par in both treatments which ranged from 20.1 to 23.3% as against 29.2% in control. There was no significant difference in leaf damage caused by Hispa among treatments (24.8-32.9%) and control (42.2%). Only Khudwani centre reported grasshopper incidence where all insecticide treatment was effective in reducing mean hopper damage (5.15%) as compared to control (8.8%).

Natural enemies Populations of mirid bug, an important natural enemy of BPH, were recorded in 5 centres. High populations of 34.2 to 38.5 mirid were observed in Moncompu at 72 DAT followed by Maruteru (24.0-35.0 bugs/10 hills) at 50 DAT. No significant difference in mirid population was noticed at Bapatla and Moncompu. Mean mirid population was at par in all 4 treatments and control (15.9-19.9) indicating that botanicals and their combinations with insecticide were safe to the predator.

Spider populations were recorded in 9 locations, of which Maruteru reported more numbers of spider (24.0-35.0 /10 hills at 40 DAT). There was significant difference in populations at 4 locations. There was no significant difference in mean spider population between treatments and control (10.5-12.4) indicating the safety of botanicals and insecticide treatments to spiders.

Coccinellid populations were reported from 3 centres-Bapatla, moncompu and kaul. There were significant differences in populations among various treatments and control at all locations except Moncompu at 57 DAT. However, there was no significant difference in mean populations in all treatments and control indicating that the treatments did not have any adverse effect on predators.

Grain Yield (Table. 2.3.2.2)

There were significant differences in grain yield among the treatments including control at all locations except 4 locations- Ambikapur, Bapatla, Pattambhi and Rajendranagar. Based on mean yield of these locations, all insecticides treatment- Chlorantraniliprole, Cartap hydrochloride, Triflumezopyrim recorded the highest grain yield of 4991.0 kg/ha followed by neemazal, neem oil and triflumezopyrim with 4554.2 kg/ha. Yield in all the treatments were significantly superior to control plot which showed a yield of 3595.6 kg/ha.

Insecticide Botanicals Evaluation Trial (IBET) was carried out at 25 locations across the country to evaluate performance of various treatments having combinations of commercially available neem formulation, effective plant oils along with *recommended insecticides against major insect pests of rice and consequent impact on natural enemies and grain yield during kharif, 2022. Based on the performance of the various treatment combinations in controlling the pest damage at various locations, all insecticides module was found to be superior in reducing stem borer damage at both vegetative and reproductive phases compared to other insecticide-botanical modules. Among combinations, lowest silver shoot damage was recorded in all insecticide treatment which was on par with other treatments. Combination of Neemazal, neem oil and triflumezopyrim treatment was found to effective against BPH. Against WBPH and GLH all insecticides combination was found to be the most effective treatment. Against leaf folder also insecticides module was effective in reducing leaf damage. All insecticide combination treatments were found moderately effective in reducing damage by whorl maggot, gundhibug and grasshopper pests. There was no significant difference in natural enemy (mirid, spider and coccinellid) populations among treatments, signifying that both insecticides and botanicals are safe to beneficial organisms. Among various treatments, all insecticides treatment recorded highest mean yield of 4991.0 kg/ha followed by treatment consisting of neemazal, neem oil and triflumezopyrim giving yield of 4554.2 kg/ha.*

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Stem borer Damage (% Dead hearts)																	
		ABP						CHP		CTC		LDN							GNV
		30DT	40DT	50DT	60DT	65DT	70DT	55DT	75DT	30DT	60DT	30DT	35DT	40DT	45DT	55DT	60DT	70DT	50DT
1	Botanical-Insecticide 1	5.1b	4.6b	3.9b	3.6b	3.7b	2.7b	4.2b	4.9c	4.7c	2.5c	3.4a	3.4b	3.8b	3.7b	4.5a	2.5c	3.1c	2.5bc
2	Botanical-Insecticide 2	5.5b	5.1b	4.4b	3.7b	3.6b	2.9b	5.7b	7.1a	4.7c	3.0c	4.0a	3.1b	3.5b	3.4b	3.9b	2.7c	3.3c	3.5bc
3	All Botanical	5.8b	4.5b	4.1b	3.5b	3.5b	3.1b	4.3b	5.3bc	6.5b	4.3b	4.5a	3.4b	3.9b	3.7b	4.5b	4.3b	4.7b	4.4b
4	All Insecticide	5.3b	5.2b	4.5b	3.8b	3.3b	3.2b	1.2c	2.0d	2.9d	1.6d	4.5a	0.9c	1.8c	1.1c	1.8c	2.0c	2.5c	1.7c
5	Control (Water Spray)	7.8a	7.1a	6.3a	6.7a	6.7a	6.8a	8.5a	11.0a	8.7a	6.1a	4.7a	5.0a	5.2a	5.8a	6.4a	7.3a	7.8a	10.1a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Stem borer Damage (% Dead hearts)															
		JDP			KJT		KRK		KUL	MNC		MND		MSD		NWG	
		30DT	50DT	70DT	30DT	50DT	30DT	50DT	45DT	45DT	60DT	30DT	0DT	30DT	50DT	30DT	50DT
1	Botanical-Insecticide 1	0.7a	3.1bc	5.7c	9.2a	3.7b	1.6a	10.9a	1.8b	5.5b	8.0b	6.5bc	2.4c	8.7c	7.7c	3.0b	11.7b
2	Botanical-Insecticide 2	1.7a	4.1bc	8.1c	9.0a	3.6b	1.8a	6.4ab	2.4ab	6.7b	7.6b	7.6b	8.4b	5.0d	4.2d	3.3b	13.0b
3	All Botanical	4.8a	6.9b	11.0b	9.0a	3.5b	3.6a	9.1ab	2.4ab	6.7b	7.3b	14.14a	9.4b	14.3b	11.9b	3.4b	11.6b
4	All Insecticide	0.7a	0.6c	2.1d	9.7a	2.1c	1.5a	3.8b	1.0b	4.5b	1.7c	2.7c	1.3c	2.3e	0.8e	2.5b	4.1c
5	Control (Water Spray)	4.4a	16.5a	20.7a	9.8a	9.8a	1.7a	7.9ab	3.8a	10.9a	13.3a	15.9a	19.2a	23.5a	29.9a	5.2a	21.6a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Stem borer Damage (% Dead hearts)															Mean
		NVS			NWG		WGL										
		30DT	50DT	65DT	30DT	0DT	33DT	38DT	42DT	50DT	57DT	61DT	69DT	73DT	77DT	85DT	
1	Botanical-Insecticide 1	12.0bc	10.6bc	12.9c	3.0b	11.7b	4.8a	7.1a	5.8a	7.0b	3.2a	2.4ab	3.1ab	1.1ab	2.9b	2.6a	**5.0bc**
2	Botanical-Insecticide 2	9.7bc	9.2bc	16.1c	3.3b	13.0b	5.3a	6.3a	4.9a	7.0b	3.3a	3.4ab	3.4ab	1.5ab	4.0ab	37a	**5.9abc**
3	All Botanical	131ab	11.4b	16.1b	3.4b	11.6b	4.5a	6.6a	5.2a	6.9b	3.2a	2.7ab	2.9bc	1.7ab	4.4a	3.3a	**8.6ab**
4	All Insecticide	8.5c	8.3c	8.7d	2.5b	4.1c	5.7a	8.0a	4.8a	3.7c	1.3b	2.7b	1.0c	1.0b	1.8b	2.3a	**3.1c**
5	Control (Water Spray)	17.0a	14.0a	18.6a	5.2a	21.6a	5.0a	5.2a	5.7a	9.30a	4.3a	3.7a	4.9a	2.2a	4.1a	4.3a	**9.5a**

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT), Cartap hydrochloride 50% SC 2g/l (60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Stem Borer Damage (% White ears)									
		ABP	CHP	CTC	GNV	JDP	KJT	KUL	KRK	MNC	MND
1	Botanical-Insecticide 1	2.2b	2.5bc	4.7cd	4.2bc	20.0ab	1.7b	2.4bc	6.9a	6.6bc	4.9c
2	Botanical-Insecticide 2	2.1b	3.8b	6.2c	4.4bc	24.9ab	1.5b	3.5ab	9.3a	6.6bc	8.8bc
3	All Botanical	1.8b	3.1bc	10.2b	7.5ab	27.9ab	1.6b	3.3abc	7.8a	7.0b	13.3b
4	All Insecticide	2.3b	1.1c	2.8d	2.0c	15.2b	0.5c	2.1c	1.9b	4.0c	3.2c
5	Control (Water Spray)	7.0a	8.9a	14.0a	11.3a	30.6a	6.4a	3.9a	7.1a	10.7a	22.6a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Stem Borer Damage (% White ears)									Mean
		MSD	NVS	NWG	PUS	PTB	RNR	RPR	TTB	WGL	
1	Botanical-Insecticide 1	6.0bc	10.7bc	23.6b	4.7d	29.4ab	1.3a	13.8c	4.8ab	2.6a	**8.1b**
2	Botanical-Insecticide 2	3.7cd	10.5bc	23.2b	6.5c	22.7b	1.7a	18.0b	6.6a	2.8a	**8.7b**
3	All Botanical	7.5b	13.0b	24.0b	8.9b	26.9ab	1.8a	17.2b	6.2a	1.3a	**10.0b**
4	All Insecticide	1.0d	8.7c	6.5c	4.2d	25.9ab	0.8a	11.1c	1.8b	2.3a	**5.1b**
5	Control (Water Spray)	28.0a	18.9a	30.8a	14.9a	39.3a	2.1a	30.9a	6.7a	2.6a	**15.6a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Gall midge Damage (% Silver Shoots)											
		ABP						CHP		GNV		JDP	
		30DT	40DT	50DT	60DT	65DT	70DT	55DT	75DT	30DT	55DT	30DT	50DT
1	Botanical-Insecticide 1	7.5a	7.5bc	7.2bc	6.2b	5.8b	5.2b	17.4b	9.7b	5.3b	8.5ab	18.4b	13.9c
2	Botanical-Insecticide 2	9.0a	8.8b	7.8bc	6.5b	6.1b	6.0b	19.1b	11.0b	4.3b	4.6b	20.8b	25.9b
3	All Botanical	7.3a	6.4c	6.3c	5.7b	5.2b	5.2b	15.3b	7.7b	6.4b	8.6ab	17.8b	30.0b
4	All Insecticide	7.5a	7.7bc	8.4b	6.8b	6.1b	6.5b	19.3b	9.8b	0.0c	2.8b	7.9c	11.5c
5	Control (Water Spray)	8.5a	12.1a	10.6a	11.8a	10.1a	12.1a	32.5b	21.3a	13.6a	13.5a	33.9a	62.2a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Gall midge Damage (% Silver Shoots)											Mean
		JDP	WGL										
		70DT	33DT	38DT	42DT	50DT	57DT	61DT	69DT	73DT	77DT	85DT	
1	Botanical-Insecticide 1	14.1c	6.4a	7.8a	7.1a	5.3a	8.7a	10.9a	12.5a	12.9a	10.1a	8.0a	**9.4b**
2	Botanical-Insecticide 2	25.6b	6.4a	9.3a	6.1a	5.3a	7.8a	9.5a	11.6a	10.4a	10.0a	6.1a	**10.3b**
3	All Botanical	30.9c	6.2a	10.1a	5.8a	5.2a	8.7a	12.7a	14.5a	11.8a	8.9a	6.4a	**10.5b**
4	All Insecticide	7.1c	6.8a	7.9a	6.3a	6.2a	7.7a	10.1a	13.2a	10.3a	9.8a	7.4a	**8.1b**
5	Control (Water Spray)	47.3a	6.6a	8.1a	6.0a	4.8a	9.3a	10.0a	12.5a	10.9a	8.7a	6.3a	**16.2a**

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Brown Planthopper (No./10hills)														
		BPT				CHP	GNV				NDL				KUL	
		35DT	38DT	53DT	68DT	75DT	40DT	60DT	80DT	100DT	64DT	68DT	76DT	86DT	53DT	68DT
1	Botanical-Insecticide 1	43.0a	23.0b	32.0a	11.0a	49.6b	50.1b	40.1c	35.9c	29.4c	21.5a	48.5a	326.5a	116.5bc	83.0a	99.0b
2	Botanical-Insecticide 2	28.5a	12.5b	34.5a	14.0a	18.6c	41.9c	36.0c	29.9c	21.5d	29.5a	11.0a	49.5c	94.0c	76.0a	17.5d
3	All Botanical	67.5a	33.5b	.37.0a	20.0a	57.3b	56.2b	52.7b	44.2b	39.2b	29.0a	31.0ab	178.0abc	197.0ab	87.0a	73.5c
4	All Insecticide	30.0a	16.5b	27.0a	11.0a	12.3c	29.2d	24.7d	21.8d	17.1d	9.0a	27.0ab	121.5bc	142.5bc	87.0a	24.0d
5	Control (Water Spray)	48.5a	66.5a	37.0a	12.0a	76.3a	66.0a	70.5a	75.8a	81.5a	11.5a	25.5ab	255.5ab	281.5a	100.5a	121.5a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Brown Planthopper (No./10hills)													Mean
		MNC	MND		MTU			RPR		WGL					
		72DT	60DT	80DT	60DT	70DT	80DT	50DT	70DT	61DT	69DT	73DT	77DT	85DT	
1	Botanical-Insecticide 1	41.5c	16.0abc	9.5bc	231.2ab	913.3a	572.3a	11.2b	17.7b	24.5a	34.5a	36.0a	40.2b	41.5ab	**107.0ab**
2	Botanical-Insecticide 2	45.5c	13.2bc	6.0c	97.0b	112.5b	106.3b	9.7b	13.7bc	25.0a	36.2a	7.5c	10.0c	13.0c	**36.0b**
3	All Botanical	86.2a	19.7ab	13.7b	242.75a	947.5a	590.8a	11.7b	16.7b	23.5a	36.0a	38.7b	36.0b	33.2b	**110.7ab**
4	All Insecticide	80.7b	8.7c	3.2c	104.5ab	63.5b	81.0b	10.5b	11.0c	24.7a	36.2a	6.5c	8.7c	12.0c	**37.5b**
5	Control (Water Spray)	97.2a	24.5a	31.2a	193.2ab	1019.3a	595.3a	21.2a	34.5a	25.0a	37.5a	49.2a	62.0a	48.7a	**127.4a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Whitebacked Planthopper (No./10hills)									
		BPT				GNV				KUL	
		35DT	38DT	53DT	68DT	40DT	60DT	80DT	100DT	53DT	68DT
1	Botanical-Insecticide 1	47.0a	23.5b	26.5a	11.0a	151.3b	133.6c	114.3b	74.3b	17.5b	22.0b
2	Botanical-Insecticide 2	33.5a	12.5b	32.0a	12.5a	134.3c	11.0d	71.0c	47.0c	17.5b	5.5cd
3	All Botanical	71.0a	36.5ab	29.5a	17.0a	166.6a	149.3b	123.3b	85.6b	14.5b	11.5c
4	All Insecticide	34.5a	17.0b	30.0a	10.0a	103.3d	90.3e	49.6d	30.0d	14.0b	4.0d
5	Control (Water Spray)	50.0a	65.0a	36.0a	11.0a	165.0a	177.6a	182.6a	192.3a	30.0b	37.0a

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Whitebacked Planthopper (No./10hills)									Mean
		MND		MTU			NWG			RPR	
		60DT	80DT	60DT	70DT	80DT	45DT	60DT	75DT	70DT	
1	Botanical-Insecticide 1	14.0bc	6.7bc	27.5a	104.5a	67.0a	102.0bc	168.0b	63.0c	3.5a	**61.9ab**
2	Botanical-Insecticide 2	8.2cd	3.5c	10.5b	0.7b	9.0b	107.0abc	170.0b	42.0c	3.2a	**38.4b**
3	All Botanical	17.7ab	9.2b	28.7a	152.0a	89.0a	108.0ab	165.0b	87.0b	3.7a	**71.8ab**
4	All Insecticide	5.5d	2.0c	10.2b	6.0b	11.2b	84.0a	125.0c	57.0c	3.2a	**36.1b**
5	Control (Water Spray)	22.5a	18.0a	25.2a	152.0a	93.2a	128.0a	226.0a	249a	4.7a	**98.1a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Leaf folder (No./10hills)										
		ABP						BPT				
		30DT	40DT	50DT	60DT	65DT	70DT	35DT	42DT	53DT	60DT	68DT
1	Botanical-Insecticide 1	5.3b	3.3c	4.0c	3.2c	2.7b	2.7b	9.1ab	2.5b	16.2b	12.8b	8.4a
2	Botanical-Insecticide 2	5.2b	3.5c	4.3bc	2.9c	3.1b	3.6b	10.2ab	2.4b	21.8a	10.6b	10.2a
3	All Botanical	4.9b	4.5c	5.6b	3.7c	2.7b	2.6b	11.3a	3.1b	15.1b	11.0b	9.2a
4	All Insecticide	5.2b	6.5b	4.3bc	5.3b	2.8b	3.4b	8.7ab	2.4b	15.4b	10.6b	9.8a
5	Control (Water Spray)	8.3a	8.3a	11.5a	10.1a	6.7a	7.6a	8.2b	10.5a	15.5b	20.7a	9.8a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Leaf folder (% Damaged Leaves)											
		GNV			JDP		KRK		KUL		MNC		
		60DT	90DT	30DT	50DT	70DT	30DT	50DT	57DT	72DT	37DT	57DT	72DT
1	Botanical-Insecticide 1	3.5bc	3.6bc	2.1b	3.1b	2.7dc	2.8a	2.6a	6.3ab	5.4b	8.8b	5.8bc	10.0ab
2	Botanical-Insecticide 2	2.5c	2.8c	2.7b	2.9b	3.7bc	2.7a	2.4a	6.6a	6.1b	8.1b	6.8b	7.8bc
3	All Botanical	4.7b	4.6b	2.5b	3.2b	4.7b	2.1a	2.3a	7.6a	6.4b	7.7b	7.3b	8.1abc
4	All Insecticide	1.0d	1.6d	2.2b	1.4b	2.4d	2.4a	0.5b	2.0b	2.6c	6.3b	3.9c	6.4c
5	Control (Water Spray)	7.6a	9.2a	6.0a	8.3a	10.6a	3.5a	1.9ab	8.5a	9.2a	20.1a	10.9a	10.3a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

Sl. No.	Treatment details	Leaf folder (% Damaged Leaves)										Mean
		MND		MSD		NVS			NWG			
		30DT	50DT	30DT	50DT	30DT	50DT	65DT	30DT	45DT	60DT	
1	Botanical-Insecticide 1	4.5c	3.4c	10.1bc	4.2bc	11.1c	12.0bc	12.5c	5.2b	10.2b	16.2b	**6.5bc**
2	Botanical-Insecticide 2	6.1bc	4.9bc	7.0cd	2.2cd	9.9c	11.9bc	12.0c	5.0b	10.5b	16.6b	**6.6bc**
3	All Botanical	8.9b	7.0b	14.2b	5.6b	13.1ab	14.2b	16.0b	5.2b	10.6b	16.8ab	**7.4b**
4	All Insecticide	3.0c	2.6c	3.4d	1.0d	6.5d	10.2c	9.2d	1.8c	5.0c	8.2c	**4.7c**
5	Control (Water Spray)	14.0a	15.4a	22.2a	12.1a	15.2a	18.2a	21.2a	7.3a	13.2a	22.4a	**11.6a**

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Green Leafhopper (No./10hills)							
		BPT						GNV	
		35DT	38DT	53DT	56DT	68DT	71DT	40DT	60DT
1	Botanical-Insecticide 1	8.0ab	30.5ab	39.5a	33.0a	22.0a	11.0a	31.3c	25.3c
2	Botanical-Insecticide 2	27.0b	14.5b	45.5a	25.5b	23.5a	14.5a	25.3d	21.0c
3	All Botanical	77.5a	34.0ab	33.0a	31.0a	22.5a	14.5a	39.0b	33.0b
4	All Insecticide	38.0ab	14.0b	38.0a	28.0b	21.5a	12.5a	18.6e	13.6d
5	Control (Water Spray)	41.5ab	57.5a	52.5a	58.5a	16.5a	18.0a	46.0a	50.3a

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Green Leafhopper (No./10hills)							Mean
		GNV		JDP			MSD		
		80DT	100DT	30DT	50DT	70DT	30DT	50DT	
1	Botanical-Insecticide 1	21.0c	16.6c	16.5a	15.0a	9.0b	117.7c	121.7c	**37.2b**
2	Botanical-Insecticide 2	15.3c	9.6d	17.5a	12.0b	9.5b	64.5d	51.7d	**25.1b**
3	All Botanical	28.0b	22.3b	13.5ab	12.0b	16.5b	139.7b	134.7b	**43.4ab**
4	All Insecticide	8.3d	4.0e	9.0b	8.5b	8.0b	32.2e	25.0e	**18.6b**
5	Control (Water Spray)	54.0a	57.0a	17.5a	30.0a	36.5a	244.7a	250.5a	**68.7a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Rice Hispa (% Damaged Leaves)			Mean
		KRK	RCI		
		30DT	29DT	35DT	
1	Botanical-Insecticide 1	2.7a	59.2a	33.5b	**31.8a**
2	Botanical-Insecticide 2	1.9a	58.2a	36.2b	**32.1a**
3	All Botanical	2.5a	60.7a	35.5b	**32.9a**
4	All Insecticide	1.7a	60.2a	12.7c	**24.8a**
5	Control (Water Spray)	1.7a	60.0a	65.0a	**42.2a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Whorl Maggot (% Damaged Leaves)							
		NDL					JDP		
		26DT	30DT	36DT	46DT	51DT	30DT	50DT	70DT
1	Botanical-Insecticide 1	3.7b	4.8a	4.1a	2.8a	1.6b	4.9b	3.2bc	3.6c
2	Botanical-Insecticide 2	5.1ab	5.5a	4.0a	4.1a	2.5a	5.3b	5.5b	5.9b
3	All Botanical	5.1ab	6.1a	4.6a	3.1a	2.5a	5.5b	5.7b	5.4b
4	All Insecticide	6.5a	7.0a	3.8a	3.6a	2.5a	3.2b	2.4c	3.3c
5	Control (Water Spray)	4.9a	5.4a	5.8a	3.0a	2.8a	11.1a	10.9a	10.9a

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Whorl Maggot (% Damaged Leaves)								Mean
		RNR				PTB		TTB		
		41DT	48DT	61DT	70DT	15DT	25DT	30DT	50DT	
1	Botanical-Insecticide 1	0.9a	0.8ab	1.8a	1.1a	8.1b	9.6a	2.3b	4.4a	**3.6b**
2	Botanical-Insecticide 2	1.3a	1.4ab	1.6a	1.6a	7.6b	9.1a	3.3ab	3.7ab	**4.2ab**
3	All Botanical	1.3a	1.5a	1.8a	1.2a	7.9b	6.9a	1.6b	3.7ab	**4.2ab**
4	All Insecticide	1.7a	0.7b	1.4a	1.4a	6.8b	8.8a	1.5b	2.1b	**3.5b**
5	Control (Water Spray)	0.9a	0.8b	1.6a	1.5a	13.0a	9.8a	5.1a	4.6a	**5.7a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Gundhi Bug (% Damage)				Mean
		NVS				
		70DT	73DT	80DT	83DT	
1	Botanical-Insecticide 1	32.0a	15.5bc	26.0a	15.2c	**22.1a**
2	Botanical-Insecticide 2	28.7a	15.0c	23.2a	16.0c	**20.7a**
3	All Botanical	27.0a	19.5b	26.5a	20.2b	**23.3a**
4	All Insecticide	30.5a	10.5d	28.2a	11.5d	**20.1a**
5	Control (Water Spray)	30.5a	32.5a	25.0a	29.0a	**29.2a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Grasshopper (%Damaged Leaves)						Mean
		KHD						
		30DT	37DT	50DT	53DT	60DT	63DT	
1	Botanical-Insecticide 1	9.4b	5.1b	7.4c	4.9c	8.2ab	2.7c	**6.2ab**
2	Botanical-Insecticide 2	8.8b	4.4b	8.6ab	6.0b	7.9bc	2.9c	**6.4ab**
3	All Botanical	9.5b	4.9b	8.7a	5.6bc	7.0c	4.1b	**6.6ab**
4	All Insecticide	7.0c	2.7c	8.0bc	3.0d	7.4bc	2.6c	**5.1b**
5	Control (Water Spray)	11.2a	8.4a	8.3ab	9.4a	9.2a	6.3a	**8.8a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Insect pests incidence in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Coccinellids (No./10hills)					Mean
		BPT	MNC			KUL	
		53DT	37DT	57DT	72DT	75DT	
1	Botanical-Insecticide 1	3.5b	17.0a	17.7a	6.7b	7.5a	**10.4a**
2	Botanical-Insecticide 2	4.0b	13.7ab	12.5a	9.7ab	7.5a	**9.4a**
3	All Botanical	5.0b	10.0bc	12.2a	11.2a	7.5a	**9.1a**
4	All Insecticide	6.5ab	7.7c	12.2a	9.2ab	7.9a	**8.7a**
5	Control (Water Spray)	9.0a	8.7c	10.7a	7.5b	6.5b	**8.4a**

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Incidence of Natural enemies in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Mirid bugs (No./10 hills)															
		BPT						KUL	MTU					NVS	MNC		Mean
		35DT	38DT	53DT	56DT	68DT	71DT	75DT	40DT	50DT	60DT	70DT	80DT	80DT	57DT	72	
1	Botanical-Insecticide 1	19.0a	10.1a	17.0a	10.1a	7.0a	10.1a	2.5c	17.5a	24.0a	23.5ab	34.7a	22.2ab	10.0c	27.2a	34.2a	**17.9a**
2	Botanical-Insecticide 2	15.5a	7.8a	14.0a	7.8a	7.5a	7.8a	3.5abc	18.5a	31.0a	15.2b	13.7b	20.0b	14.7a	26.0a	36.0a	**19.9a**
3	All Botanical	25.0a	9.6a	19.5a	9.6a	6.5a	9.6a	5.0ab	20.0a	28.0a	24.5a	33.0a	27.0a	11.5bc	28.7a	35.5a	**19.5a**
4	All Insecticide	24.0a	9.4a	21.5a	9.4a	7.5a	9.4a	3.0bc	19.0a	35.0a	20.0ab	12.5b	18.7b	9.3c	27.5a	38.5a	**17.6a**
5	Control (Water Spray)	22.5a	10.3a	21.0a	10.3a	6.0a	10.3a	5.5a	18.0a	35.0a	22.5ab	33.0a	28.0a	14.2ab	28.0a	35.2a	**19.9a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Incidence of Natural enemies in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	No of spiders/10 hills																
		BPT				NDL								KUL	KHD			
		53DT	56DT	68DT	71DT	30DT	36DT	46DT	51DT	55DT	64DT	68DT	76DT	75DT	30DT	33DT	50DT	57DT
1	Botanical-Insecticide 1	8.0ab	7.0ab	9.0b	7.0a	12.5a	18.0a	13.5a	13.5a	9.5a	8.5a	17.0a	13.0a	2.0a	3.6a	3.3ab	4.3a	4.3b
2	Botanical-Insecticide 2	9.0a	9.5ab	15.5a	4.5a	17.5a	12.0a	14.0a	12.0a	8.5a	12.0a	17.5a	13.0a	2.5a	4.6a	4.0ab	5.6a	3.6bc
3	All Botanical	8.5ab	6.5b	14.0a	6.0a	15.5a	15.5a	13.0a	12.5a	9.0a	11.0a	17.5a	12.0a	2.0a	4.0a	3.0b	5.3a	3.3bc
4	All Insecticide	7.5b	11.0a	16.5a	5.0a	16.0a	16.5a	17.5a	12.0a	10.0a	13.0a	16.5a	15.5a	1.5a	5.0a	4.0ab	5.0a	2.6c
5	Control (Water Spray)	7.5b	9.5ab	14.5a	4.5a	17.0a	13.5a	18.5a	13.5a	11.0a	10.0a	15.0a	16.0a	3.5a	5.0a	5.0a	5.3a	9.0a

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Incidence of Natural enemies in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	No of spiders/10 hills																	
		KHD						MNC			MND	MTU				NVS	WGL		
		50DT	53DT	60DT	67DT	60DT	63DT	37DT	57DT	72DT	60DT	40DT	55DT	60DT	70DT	60DT	33DT	38DT	42DT
1	Botanical-Insecticide 1	4.3a	4.0a	5.0a	5.0b	5.0a	4.3a	8.5ab	10.2ab	8.7a	17.5a	24.0a	23.5ab	34.7a	22.2ab	12.0c	3.7a	6.5a	16.7ab
2	Botanical-Insecticide 2	5.6a	4.6a	6.0a	5.3b	6.0a	4.6a	8.2ab	8.7ab	6.7a	18.5a	31.0a	15.2b	13.7b	20.0b	15.5b	7.2a	5.7a	14.0c
3	All Botanical	5.3a	4.6a	5.3a	4.6b	5.3a	5.0a	7.0b	6.0b	8.7a	20.0a	28.0a	24.5a	33.0a	27.0a	13.0bc	5.7a	7.2a	17.0a
4	All Insecticide	5.0a	4.3a	6.3a	5.0b	6.3a	5.0a	8.7ab	11.5a	8.7a	19.0a	35.0a	20.0ab	12.5b	18.7b	11.5c	6.2a	10.7a	12.5c
5	Control (Water Spray)	5.3a	5.0a	6.6a	7.6a	6.6a	6.0a	10.7a	11.0a	8.5a	18.0a	35.0a	22.5ab	33.0a	28.0a	22.2a	4.5a	8.7a	14.5bc

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.3.2.1 Incidence of Natural enemies in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	No of spiders/10 hills							Mean
		WGL							
		50DT	57DT	61DT	69DT	73DT	77DT	85DT	
1	Botanical-Insecticide 1	16.0a	13.2a	11.7ba	15.0a	16.0a	12.2a	14.5a	**10.8a**
2	Botanical-Insecticide 2	14.0a	11.7a	11.5b	13.0b	15.5a	14.0a	11.2a	**10.5a**
3	All Botanical	14.7a	13.2a	12.7ab	13.2ab	17.0a	12.7a	13.2a	**11.2a**
4	All Insecticide	14.7a	11.0a	13.2ab	15.0a	14.5a	14.0a	13.7a	**11.0a**
5	Control (Water Spray)	15.0a	12.7a	15.0a	14.5a	15.5a	14.2a	12.5a	**12.4a**

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.1 Incidence of Natural enemies in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Yield (Kg/ha)								
		ABP	BPT	CHP	CTC	GNV	NDL	JDP	KHD	KJT
1	Botanical-Insecticide 1	3250.0a	5525.0a	4470.5b	3800.0a	6400.0c	4750.0ab	5700.0ab	7825.0b	3120.0b
2	Botanical-Insecticide 2	3250.0a	5800.0a	4411.7bc	3600.0c	8000.0b	4700.0ab	5400.0bc	8100.0ab	3400.0a
3	All Botanical	3000.0a	4200.0a	4235.2c	3250.0d	5600.0c	4900.0a	5050.0cd	8100.0ab	3200.0b
4	All Insecticide	3800.0a	5175.0a	5000.0a	4050.0a	9600.0a	4950.0a	6050.0a	8225.0a	3440.0a
5	Control (Water Spray)	3000.0a	4275.0a	3176.4d	2600.0e	4000.0d	4400.0b	4750.0d	7300.0c	2320.0c

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.2 Grain Yield in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Yield (Kg/ha)								
		KRK	KUL	LDN	MND	MTU	MSD	MNC	NVS	NWG
1	Botanical-Insecticide 1	4480.0b	3030.0b	6511.6b	4160.0ab	2400.0b	3250.0b	1160.0b	4050.0b	2901.0ab
2	Botanical-Insecticide 2	5040.0ab	3030.0b	6651.1b	3880.0abc	3650.0a	3150.0b	1200.0b	4050.0b	2902.0ab
3	All Botanical	4760.0b	2920.0b	6418.6c	3160.0bc	2800.0b	2250.0c	1200.0b	3600.0c	2838.0b
4	All Insecticide	6400.0a	3200.0a	7116.2a	4920.0a	3550.0a	3650.0a	1440.0a	4500.0a	3468.0a
5	Control (Water Spray)	4720.0b	2628.0c	6093.0d	2600.0c	2600.b	2150.0c	1040.0b	3200.0d	2319.0b

Means in a column followed by different letters are significantly different at P=0.05

Table: 2.3.2.2 Grain Yield in different treatments, IBET, *Kharif* 2022

S. No.	Treatment details	Yield (Kg/ha)							Mean
		PTB	PUS	RCI	RNR	RPR	TTB	WGL	
1	Botanical-Insecticide 1	3218.7a	5643.9a	4600.0ab	3750.0a	6700.0b	4160.0b	5543.1bc	**4416.0ab**
2	Botanical-Insecticide 2	3250.0a	5227.2a	4400.0b	4200.0a	6650.0b	4160.0b	5754.0ab	**4554.2a**
3	All Botanical	3062.5a	4583.3ab	3800.0b	4150.0a	6600.0b	3920.0c	5183.5c	**4111.2ab**
4	All Insecticide	3312.5a	5113.6ab	5350.0a	4600.0a	7150.0a	4640.0a	6076.4a	**4991.0ab**
5	Control (Water Spray)	3062.5a	3901.5b	2300.0c	3800.0a	6050.0c	2880.0d	4724.7d	**3595.6b**

Means in a column followed by different letters are significantly different at P=0.05

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT),Eucalyptus oil 2ml/l (45-50 DAT),Cartap hydrochloride 50% SC 2g/l(60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

2.4 Optimum Pest Control Trial (OPCT)

The trial was constituted to evaluate the performance of the identified multiple pest resistant rice cultures under protected and unprotected conditions against the pest damages in a location. The trial was conducted at 10 locations *viz.,* Ambikapur, Cuttack, Chinsurah, Gangavati, IIRR, Ludhiana, Raipur, Warangal, Titabar and Kaul. But the trial was vitiated at Kaul. Nine insect pest resistant cultures *viz.*, V1-CUL M9, V2-CR 3006-8-2, V3-CR Dhan 317, V4- Akshaydhan PYL, RP5587-273-1-B-B-B, KMR 3, Suraksha, W1263, RP2068 -18-3-5 along with the susceptible check TN1 were raised in 3 replications in a split plot design with main treatments being protected and unprotected conditions and varieties as sub plots. Observations on pest incidence were recorded along with the grain yield. At Warangal and Ludhiana observations were recorded before and after imposition of insecticide treatments. Insecticide treatments were taken up based on the intensity of the damage. The general information pertaining to the trial is given in **Table 2.4.1**.

Table 2.4.1 General information pertaining to OPCT trial, Kharif 2022

Location	Chemical	Date of insecticide application	Time of application	Observations recorded
Ambikapur	NM	10-06-2022	56 DAT	SBDH, SBWE, SS
Chinsurah	Cartap hydrochloride (Kritap)	08-09-2022, 28-09-2022	31 DAT, 51 DAT	SBDH, SBWE
Cuttack	NM	09-11-2022	87 DAT	LF , GrH
Gangavati	Fipronil 0.3 GR	23-08-2022	5 DAT	SBDH, SBWE, SS, PH, NE-mirid, spiders, dragonflies & damsel flies
IIRR	Fipronil 0.3GR	20-09-2022	22 DAT	SBWE
Ludhiana	Chlorantraniliprole 18.5 SC @ 60 ml/acre (Coragen)	Not provided	NM	SBDH, SBWE, LF
Raipur	Spraying of Fipronil 5% w/w SC.	08-09-22, 23-09-22, 10-10-22, 25-10-22, 10-11-22, 25-11-22 .Repeated 5 times at 15 day interval	30 , 45, 60, 75,90, 105 DAT)	SBDH, SBWE, LF, RHDL, NE- spiders, dragonflies & damsel flies
Titabar	Chlorantraniliprole 18.5 SC	26-9-2022 & 15-10-2022	45 DAT, 63 DAT	SBDH, SBWE, SS, LF, CWDL, NE
Warangal	Carbofuran 3G	23-09-2022	20 DAT	SBDH, SS
	Chlorantraniliprole 18.5 SC	09-11-2022	67 DAT	SBWE

NM- not mentioned

The reaction of test entries across locations to gall midge **(Table 2.4.2)**, stem borer dead heart damage **(Table 2.4.3)**, stem borer white ear damage **(Table 2.4.4)**, leaffolder **(2.4.5)** and the grain yield **(2.4.6)** are tabulated pest wise and discussed location wise.

Ambikapur: Observations on gall midge (% SS) and stem borer damage (%DH & WE) were recorded in the trial. SS (%) was significantly low in Cul M9, Suraksha, W1263 and Akshaydhan PYL. No significant difference in stem borer damage was observed between protected and unprotected treatments but damage was significantly low in Cul M9, W 1263, CR 3006-8-2 and CR Dhan 317.

Cuttack: Observations on leaffolder damage (5.73 – 8.26 % DL) and grasshopper count (6.5/10 h) was recorded.

Chinsurah: Incidence of stem borer was recorded in this trial. Dead heart damage was significantly lower in protected treatments at 51DAT and 57 DAT. Among the varieties tested RP 2068-18-3-5, RP5587-273-1-B-B-B and Cul M9 recorded significantly lower damage as compared to other entries. Suraksha, RP 2068-18-3-5, RP5587-273-1-B-B-B had significantly low white ear damage.

Gangavati: Incidence of gall midge, stem borer and planthoppers along with counts on spiders, mirids bugs, damsel and dragonflies and hymenopteran parasitoids were recorded in this trial. Granular application had significantly reduced the gall midge damage in the protected treatments (5.73%SS) as compared to unprotected treatments (11.06%SS). White ear damage was significantly higher in unprotected treatments (8.75%) as compared to the protected (3.12%WE) treatments. CR 3006-8-2, RP5587-273-1-B-B-B and TN1 had lower dead heart damage (<10.6%). Cul 9, RP 2068-18-3-5, W1263 had significantly lower white ear damage followed by other entries. No significant difference was observed in planthopper (226 BPH/10h and 128 WBPH /10 hills) incidence, leaffolder incidence (mean 2.26% DL and mirid bug counts (39.28/ 10 hills) dragon and damsel flies (3.01/10 hills) and spiders (4.52 /10 hills). Cul 9 had higher grain yield followed by RP 2068-18-3-5 and RP5587-273-1-B-B-B.

IIRR: Stem borer white ear damage was recorded from the trial under infested conditions, W1263, RP 2068-18-3-5, KMR3 had significantly low damage as compared to other test entries. No significant difference in damage was observed between protected and unprotected treatments.

Ludhiana: Incidence of stem borer, leaffolder and counts of natural enemies viz., spiders, dragon and damsel flies were recorded. Precount and post count of pest damages after an insecticide spray were recorded. SBDH and SBWE was significantly low in the insecticide treated plots (2.7 %DH, 5.01 %WE) as compared to unprotected control (5.4%DH, 6.4%). Cul M9, CRDhan 3006-8-2, W1263 and CR Dhan 317 recorded significantly lower SBDH. CR Dhan 3006-8-2, CR Dhan 317, KMR3, W1263 and Suraksha had lower white ear damage as compared to other test entries. CulM9 and leaffolder damage was significantly low in Cul M9 and W1263 in insecticide treated plots. However, Cul M9 and RP 2068-18-3-5 did not flower at this location. Treatments had no effect on the spider population. The grain yield in unprotected plots was significantly higher than that of the unprotected plots (P=0). Among the test entries CR Dhan 317 and CR 3006-8-2 had higher grain yield as compared to other test entries.

Raipur: In the protected treatments spraying of Fipronil 0.3%SC was taken up at 15 days interval for six times starting from 30 DAT. Observations were recorded on the incidence of gall midge, stem borer, planthoppers, rice hispa and leaf folder. Despite 6 sprays of insecticide application SBDH and SBWE did not differ significantly between the insecticide treated plots (19.9 % DH, 29.8 % WE and unprotected plots (31.2% DH, 34.5%WE). RP2068, KMR3 CR Dhan 317 and Akshaydhan PYL had significantly lower WE damage as compared to other test entries. No significant difference in hispa and leaf folder damage was observed though insecticide treatment reduced leaffolder damage (3.0 % DL) significantly as compared to the control (6.91 % DL). Counts on natural enemies like ground beetles (1.0/10 hills in treated and 1.2/10 h in unprotected), coccinellids (treated -1.63/10 h; unprotected1.87/10h), rove beetles (treated- 0.53/10 h; unprotected-0.3/10h), spiders (1.67/10 h) were observed. CR Dhan 317 and RP5587-273-1-B-B-B recorded the highest grain yield among the test entries. Cul M9 did not flower at this location.

Warangal: Observations were recorded on the incidence of gall midge before and after the insecticide treatments. Granular application alone reduced the SS damage significantly. W1263 (*Gm1*), CUL M9, Suraksha (*Gm11*), Akshyadhan PYL, RP2068-18- 3-5 (*gm3*) recorded significantly lower damage in all the four observations on silver shoot damage as compared to other entries. Application of Chlorantraniliprole had significantly lowered the dead heart damage and white ear damage significantly. Suraksha, KMR3, CR3006-8-2, RP5587-273-1-B-B-B, Akshyadhan PYL recorded significantly lower dead heart damage compared to other test entries.CR Dhan 317, Cul M9 and TN1 had lower white ear damage. Cul M9, Suraksha and W1263 had significantly higher grain yield.

Titabar: Incidence of gall midge, stem borer, leaffolder and case worm were reported from this location. Though two sprays of Chlorantraniliprole were given at this location, damage by case worm, dead heart and white ear damage by stem borer in the treatments were non significant. Silver shoot damage was significantly low in the protected (6.15%SS) plots as compared to control (10.3%SS). Silver shoot damage in test entries (7.15-9.56%SS) was not significant. The dead heart damage (3. 28% DH-7.57 % DH), white ear damage (3.11-10.5%WE) and leaf folder damage (1.67-3.73 % DL) were not significant between the test entries. The mirid bug population was significantly low (0.48/10 hills) as compared to untreated control (1.8 /10 hills).

Reaction across locations: In this trial, 9 resistant cultures were evaluated at 9 locations. Silver shoot damage by **gall midge** was reported across 4 locations. Observations revealed that across locations the **damage was significantly lower** (1.7-3.03%SS) in **W1263 (*Gm1*), CUL M9, Suraksha (*Gm11*), Akshyadhan PYL, RP2068- 18- 3-5 (*gm3*)** as compared to other varieties (F val, 8.901 at9 df P =0) where the damage ranged from 7.7-11.6% SS. These entries were possessing different gall midge resistance genes and can be utilized as donors in the breeding programs for development of gall midge resistant varieties for the endemic locations.

Dead heart damage was reported from 7 locations and it was significantly lower in insecticide treatments at 4 locations as compared to unprotected control. **CUL M9, RP2068, RP5587-273-1-B-B-B** and **Suraksha** recorded lower damage across locations though statistically not significant (F val 0.426, P val 0.916).

White ear damage was reported from 8 locations. White ear damage was significantly lower in protected treatments at 3 locations. This variation could be due to the type of insecticide used and the timing of insecticide spray. Though Cul9 had the least damage followed by KMR3, RP 2068-18-3-5, CR Dhan317, Akshaydhan PYL, W 1263 and RP5587-273-1-B-B-B the reaction was statistically not significant (F val 0.098, Pr 1.0 at 9 df).

Analysis of grain yield from 5 locations identified CR Dhan 317, KMR 3, RP2068-18-3-5, with higher yield (4 -4.5/ha) though statistically not significant (F val 1.563, P val 0.144).

Table 2.4.2 Reaction of resistant cultures to gall midge damage, OPCT, kharif 2022.

Test entry	ABK	ABK	GNV	TTB	WGL	WGL	WGL	WGL
	%SS 41 DAT	%SS 59 DAT	%SS 30 DAT	%SS 45 DA	%SS PRECOUNT I	%SS 15 days after Trt.1	precount II	%SS 15 DAYS after Trt
CUL M9	0.30(0.86) e	0.42(0.90) f	5.58(2.38) i	8.56(2.96)	3.15(1.87) c	3.33(1.88) c	2.48(1.70)c	1.57(1.37) c
CR 3006-8-2	16.30(4.05) a	14.76(3.81) b	9.14(3.08) d	7.46(2.79)	9.71(3.19) ab	10.10(3.19) a	12.67(3.58) a	3.38(1.94)b
CR Dhan 317	17.57(4.21) a	19.64(4.47) a	8.82(3.03) d	8.34(2.95)	10.72(3.32) ab	11.33(3.42) a	10.61(3.31) a	6.88(2.68) a
Akshayadhan PYL	0.59(0.97) b	1.19(1.26) e	9.69(3.17) c	7.57(2.81)	2.20(1.63) cd	2.87(1.68) c	4.45(2.11) b	1.54(1.41) cd
RP5587-273-1-B-B-B	8.02(2.85) b	11.96(3.48) a	8.25(2.93) e	9.28(3.08)	8.91(3.04) ab	8.44(2.97) b	10.61(3.30) a	1.54(1.40) cd
KMR 3	18.18(4.27) a	17.52(4.22) a	7.70(2.83)f	7.15(2.74)	7.32(2.78) b	10.63(3.32) a	12.04(3.53) a	2.00(1.53) bc
Suraksha	1.01(1.17) d	2.32(1.62) d	11.42(3.43) a	7.72(2.86)	2.79(1.75) cd	2.82(1.75) c	1.16(1.25) d	0.74(1.01) d
W1263	0.00(0.71) e	1.14(1.18) d	6.76(2.64) g	8.15(2.89)	0.77(1.06) e	3.18(1.89) c	2.70(1.68)cd	0.64(1.01) d
RP2068	1.98(1.41)c	4.84(2.19)c	6.22(2.53) h	8.24(2.92)	1.69(1.42) cd	4.45(2.16) a	2.71(1.74)c	0.98(1.16) cd
TN1	18.78(4.34) a	17.78(4.23) a	10.38(3.27) b	9.56(3.14)	11.85(3.49) a	12.46(3.58) a	8.97(3.04) a	7.14(2.73) a
CD(0.05)	0.7	0.55	0.06	ns	0.54	0.6	0.68	0.51
CV(%)	24.23	17.1	1.69	11.18	19.77	19.99	23.24	26.83
Main Treatments								
Protected	7.75(2.42)	6.98(2.39)	5.73(2.47)	6.15(2.57)	5.78(2.33)	6.27(2.42)	6.36(2.43)	2.18(1.49)
Unprotected	8.79(2.55)	11.34(3.08)	11.06(3.39)	10.26(3.26)	6.04(2.38)	7.66(2.75)	7.32(2.62)	3.10(1.76)
CD(0.05)	ns	0.59	0.14	0.17	ns	0.32	ns	ns
CV(%)	25.16	19.55	4.38	5.12	16.39	11.1	7.5	15.57
Interaction								
M and T	ns	ns	0.08	ns	ns	ns	ns	ns
T and M	ns	ns	0.13	ns	ns	ns	ns	ns
Experimental Mean	2.48	2.74	2.93	2.91	2.35	2.58	2.52	1.62

M- Main treatments; T -sub treatments (Varieties) Fgures in parentheses are square root transformed values .Means in a column followed by same letter are not significantly different from one other at P≤0.05..

Table 2.4.3 Reaction of resistant cultures to dead heart damage by stem borer at vegetative phase, OPCT, kharif 2022.

Test entry	ABK	CHN	CHN	GNV	LDN	LDN	RPR	TTB	WGL	WGL	WGL	WGL
	%DH40 DT	%DH 51 DAT	%DH 57 DAT	%DH 45 DAT		DH after spray	%DH	%DH	%DH PRECOUNT I	%DH 15 DAYS AFTER TREATMENT1	%DH PRECOUNT II	%DH 15 DAYS AFTER II TREATMENT
CUL M9	3.86(2.06)bc	3.49(1.94)a	0.71(1.08)d	17.29(4.18)a	2.66(1.78)e	2.88(1.80)g	20.98(4.52)	3.28(1.87)	1.17(1.19)	4.19(2.00)	2.12(1.58)	4.11(2.04)bc
CR 3006-8-2	2.05(1.53)c	2.26(1.65)ab	14.72(3.78)a	8.64(3.01)f	3.00(1.87)de	3.16(1.87)ef	26.03(5.09)	6.40(2.61)	2.86(1.81)	3.25(1.84)	4.30(2.02)	3.62(1.94)d
CR Dhan 317	5.23(2.37)ab	2.32(1.58)a	12.69(3.53)a	15.73(3.89)b	2.92(1.85)e	3.10(1.86)f	27.05(5.18)	3.85(2.08)	2.62(1.69)	5.31(2.25)	4.17(2.05)	4.47(2.10)b
Akshayadhan PYL	5.14(2.28)b	3.16(1.74)a	11.48(3.39)a	13.37(3.68)c	5.68(2.48)a	5.93(2.51)a	21.90(4.67)	5.96(2.41)	2.55(1.50)	4.09(1.96)	4.02(2.04)	3.07(1.85)d
RP5587-273-1-B-B-B	4.82(2.22)b	0.86(1.12)b	4.44(2.15)c	10.56(3.06)f	5.36(2.42)ab	5.41(2.41)b	31.91(5.55)	7.57(2.55)	1.30(1.30)	5.19(2.26)	4.58(2.23)	3.52(1.83)d
KMR 3	3.65(2.01)bc	3.29(1.93)bc	11.02(3.30)b	16.49(4.07)a	5.24(2.40)abc	5.00(2.32)c	20.04(4.45)	6.03(2.39)	1.55(1.34)	5.20(2.22)	3.15(1.79)	3.99(2.04)bcd
Suraksha	4.21(2.07)b	1.17(1.26)b	5.04(2.22)c	12.39(3.54)d	5.37(2.42)ab	4.73(2.26)d	29.77(5.38)	6.19(2.55)	0.47(0.95)	2.42(1.58)	2.05(1.45)	1.52(1.30)f
W1263	4.06(2.10)b	3.60(1.97)a	11.43(3.34)a	10.17(3.24)e	3.24(1.93)cd	3.36(1.92)e	27.86(5.29)	4.63(2.25)	0.89(1.14)	2.79(1.74)	1.99(1.54)	2.36(1.57)e
RP2068	3.78(2.04)bc	0.69(1.01)c	5.28(2.32)c	13.06(3.61)cd	3.32(1.95)bc	3.27(1.90)ef	22.35(4.73)	6.14(2.55)	2.21(1.52)	5.28(2.33)	2.56(1.67)	4.36(2.10)bc
TN1	7.75(2.82)a	4.29(2.03)a	11.73(3.34)a	8.33(2.56)f	5.92(2.53)a	5.29(2.37)b	27.95(5.22)	5.34(2.39)	0.47(0.95)	5.95(2.41)	3.51(1.94)	4.92(2.09)a
CD(0.05)	0.61	0.51	0.45	0.92	0.07	0.04	ns	ns	ns	ns	ns	0.45
CV(%)	24.21	26.88	13.63	22.74	2.71	1.73	15.08	32.93	45.72	28.04	36.62	20.4
Main treatments												
Protected	4.23(2.09)	1.45(1.32)c	4.79(2.21)b	10.71(3.18)	4.20(2.15)	2.68(1.76)b	19.94(4.44)	5.66(2.33)	1.51(1.32)	2.72(1.67)	2.44(1.63)b	2.99(1.73)
Unprotected	4.68(2.21)	3.58(1.92)a	12.92(3.48)a	14.49(3.79)	4.34(2.18)	5.74(2.49)a	31.23(5.58)	5.42(2.40)	1.71(1.36)	6.01(2.45)	4.06(2.03)a	4.19(2.04)
CD(0.05)	NS	0.07	0.45	NS	ns	0.14	NS	NS	NS	NS	0.18	NS
CV(%)	33.11	3.69	14.32	17.29	2.41	6.13	25.78	10.81	12.04	54.1	8.87	23.01
Interaction												
M and T	ns	ns	0.64	1.31	ns	0.06	ns	ns		ns	ns	ns
T and M	ns	ns	0.7	1.35	ns	0.12	ns	ns		ns	ns	ns
Experimental Mean	2.15	1.62	2.85	3.48	2.16	2.12	5.01	2.37		2.06	1.83	1.89

Main treatmens; T -sub treatments (Varieties) Fgures in parentheses are arc sine transformed values .Means in a column followed by same letter are not significantly different from one other at P≤0.05...

Table 2.4.4 Reaction of resistant cultures to white ear damage by stem borer at reproductive phase, OPCT, kharif 2022

Test entry	ABK	CHN	GNV	IIRR*	LDN	RPR	TTB	WGL
	%WE 59 DAT	%WE 89 DAT	%WE 100 DAT	%WE	%WE	%WE	%WE	%WE
CUL M9	4.50(2.23)c	7.54(2.78) bc	3.22(1.77) e	27.93(31.81)ab	NF	NF	6.38(2.34)	1.76(1.45) b
CR 3006-8-2	4.40(2.20)c	12.82(3.55) a	6.91(2.66) abc	30.50(33.49) a	5.03(2.35)e	52.82(46.69)a	9.21(3.07)	4.52(2.21)a
CR Dhan 317	4.92(2.30)c	8.34(2.88) bc	6.23(2.55) bc	27.39(31.49) ab	4.81(2.30)e	25.98(30.56) c	3.11(1.75)	1.61(1.37)b
Akshayadhan PYL	7.31(2.76)ab	9.86(3.16) ab	7.33(2.72) ab	26.99(31.14) ab	9.04(3.08) b	26.47(30.73)c	10.16(3.19)	2.91(1.78) a
RP5587-273-1-B-B-B	5.61(2.42) b	5.90(2.45) cd	5.14(2.30) cd	29.00(32.55)a	8.25(2.95) c	36.46(37.04)b	4.04(1.75)	3.53(1.99) a
KMR 3	5.26(2.37)b	9.14(3.07) b	5.29(2.34) bcd	24.17(29.37) b	6.91(2.72) d	24.93(29.84)c	8.11(2.87)	2.79(1.80) a
Suraksha	8.36(2.92) a	5.17(2.33) d	9.25(3.00) a	26.12(30.67) ab	6.93(2.72) d	40.60(39.51)b	6.81(2.52)	2.79(1.79) a
W1263	4.56(2.18)c	7.99(2.86) bc	3.92(1.99)e	21.46(27.51) c	6.66(2.67)d	41.35(39.95)b	10.50(3.22)	3.72(2.04) a
RP2068	5.52(2.41) b	5.53(2.43) cd	3.04(1.74) e	21.22(27.34) c	NF	20.20(26.14)c	9.06(2.90)	4.88(2.26) a
TN1	5.66(2.44)b	8.49(2.94) b	8.99(3.03) a	27.47(31.57) ab	9.44(3.14)a	52.86(46.65) a	6.43(2.31)	2.27(1.60) b
CD(0.05)	0.4	0.45	0.34	3.45	0.05	5.68	ns	0.45
CV(%)	14.21	13.49	12.24	9.64	1.78	14.87	38.75	20.9
Main treatments								
Protected	4.43(2.18)	5.24(2.36)	3.12(1.82)	26.10(30.64)	5.01(2.21)	29.82(31.30)	7.36(2.62)	2.52(1.68)
Unprotected	6.79(2.67)	10.91(3.33)	8.75(3.01)	26.35(30.74)	6.40(2.46)	34.52(34.12)	7.40(2.57)	3.63(1.98)
CD(0.05)	ns	0.48	0.13	ns	0.04	ns	ns	0.27
CV(%)	20.63	15.15	4.97	11.18	1.6	17.87	15.38	13.26
Interaction								
M and T	ns	ns	ns	ns	0.07	ns	ns	ns
T and M	ns	ns	ns	ns	0.07	ns	ns	ns
Experimental Mean	2.42	2.84	2.41	30.69	2.33	32.71	2.59	1.83

NF- no flowering; Main treatmens; T -sub treatments (Varieties) Fgures in parentheses are arc sine transformed values .Means in a column followed by same letter are not significantly different from one other at P≤0.05..

Table 2.4.5 Reaction of resistant cultures to leaffolder damage, OPCT, kharif 2022

Test entry	CHN	CTC	CTC	GNV	LDN	LDN	RPR	TTB
	%LFDL	%LFDL 30DAT	%LFDL 50DAT	%LFDL	%LFDL PRECOUNT	%LFDL AFTER SPRAY	%LFDL	%LFDL
CUL M9	2.60(1.74)	7.74(2.84)	6.70(2.67)	2.65(1.55)	4.69(2.28)c	4.73(2.26)d	4.76(2.22)	3.43(1.90)
CR 3006-8-2	1.79(1.49)	6.73(2.67)	6.67(2.66)	4.82(2.18)	5.45(2.44)b	5.19(2.37)c	5.31(2.37)	2.51(1.67)
CR Dhan 317	2.27(1.62)	5.79(2.51)	5.74(2.50)	7.29(2.73)	5.92(2.53)b	5.48(2.42)bc	4.18(2.14)	2.94(1.77)
Akshayadhan PYL	1.74(1.46)	6.46(2.62)	6.36(2.60)	7.21(2.74)	5.73(2.49)b	5.76(2.48)bc	5.62(2.36)	2.85(1.75)
RP5587-273-1-B-B-B	1.69(1.43)	8.26(2.93)	6.44(2.62)	2.87(1.60)	5.97(2.54)b	6.02(2.53)b	4.88(2.27)	3.73(1.96)
KMR 3	2.63(1.74)	5.73(2.50)	6.66(2.65)	5.94(2.38)	5.72(2.49)b	5.37(2.40)b	5.31(2.35)	3.64(2.01)
Suraksha	1.94(1.48)	5.75(2.50)	6.65(2.66)	7.87(2.65)	5.56(2.46)b	5.90(2.52)b	4.30(2.13)	2.16(1.58)
W1263	2.66(1.66)	7.32(2.76)	6.19(2.58)	4.37(2.11)	4.20(2.17)c	4.46(2.21)d	6.07(2.44)	2.48(1.65)
RP2068	2.26(1.61)	7.34(2.77)	6.35(2.60)	7.26(2.74)	5.89(2.53)b	5.39(2.41)bc	4.20(2.09)	1.67(1.39)
TN1	1.61(1.43)	6.78(2.67)	5.79(2.51)	4.90(1.92)	6.86(2.71)a	7.29(2.76)a	4.95(2.32)	2.96(1.78)
CD(0.05)	ns	ns	ns	ns	0.13	0.1	ns	ns
CV(%)	23.23	12.96	10.19	38.15	4.53	3.69	15.33	32.47
Main treatments								
Protected	1.57(1.39)	6.27(2.59)	6.37(2.61)	5.42(2.26)	5.89(2.52)	4.10(2.14)	3.00(1.84)	2.97(1.78)
Unprotected	2.67(1.74)	7.31(2.77)	6.34(2.60)	5.62(2.26)	5.30(2.40)	7.01(2.74)	6.91(2.70)	2.71(1.72)
CD(0.05)	ns	ns	ns	ns	ns	0.13	0.76	ns
CV(%)	43.96	18.89	19.69	90.83	5.23	4.64	30.26	19.49
Interaction								
M and T	ns	ns	ns	ns	ns	ns	ns	ns
T and M	ns	ns	ns	ns	ns	ns	ns	ns
Experimental Mean	1.57	2.68	2.6	2.26	2.46	2.44	2.27	1.75

M- Main treatments; T -sub treatments (Varieties) Fgures in parentheses are square root transformed values .Means in a column followed by same letter are not significantly different from one other at P≤0.05.

Table 2.4.6 Grain yield of resistant cultures tested in OPCT kharif 2022

	Grain Yield (Kg/ha)					
Test entry	**AMB**	**CHN**	**GNV**	**RPR**	**TTB**	**WGL**
CUL M9	2306.67 bc	3966.7	6727.78a	276.39g	12.9	3051.15 e
CR 3006-8-2	2741.67a	3900.0	2864d	2754.17de	12.3	6238.98 b
CR Dhan 317	2001.67de	4888.9	3561.09c	5747.22a	12.1	5993.17 bc
Gmss-20-74	1750.83ef	3977.8	2909.56d	2936.11d	11.7	5759.48 bc
RP5587-273-1-B-B-B	2200.83cd	4555.6	3784.95c	2500e	11.7	7660.94 a
KMR 3	1925.83de	3477.8	3658.96c	5090.28b	10.7	7118.61 a
Suraksha	1178.33g	3244.4	2130.67d	1005.56f	13.1	3196.65 e
W1263	1625f	4066.7	3640c	1065.28 f	11.4	4205.25 d
RP2068	1901.67ef	3900.0	5447.72b	2958.33d	11.6	5522.49 c
TN1	2538.33ab	4144.4	2419.29d	3397.22c	12.4	7153.88a
CD(0.05)	291.61	632.81	859.35	327.75	ns	642.81
CV(%)	12.39	13.52	19.83	10.13	11.69	9.86
Main treatments						
Protected	2161a	4133.33	4147.83	2482.22	15.63a	5912.48a
Unprotected	1873.17b	3891.11	3280.98	3063.89	8.37b	5267.64b
CD(0.05)	193.11	ns	ns	125.52	2.32	358.74
CV(%)	8.62	12.19	32.22	4.07	17.41	5.78
Interaction						
M and T	ns	ns	ns	ns	2.31	ns
T and M	ns	ns	ns	ns	2.85	ns
Experimental Mean	2017.08	4012.22	3714.4	2773.06	12	5590.06

M- Main treatmens; T -sub treatments (Varieties) Means in a column followed by same letter are not significantly different from one other at P≤0.05..

2.5 Ecological Studies

1. Influence of Establishment Methods on Pest Incidence (IEMP)

With growing water scarcity worldwide, especially in Asia and India, the pressure to reduce water use in irrigated agriculture is mounting. The traditional method of rice production is a serious concern in India for water conservation. Rice farmers are already adopting several alternative establishment methods like direct seeding, aerobic rice, mechanical transplanting and System of Rice Intensification (SRI). Keeping this in mind, a collaborative trial with the Agronomy section aimed to assess the influence of crop establishment methods on insect pest incidence was formulated and continued.

During *Kharif* 2022, the trial was conducted at 11 locations: Aduthurai, Chatha, Jagdalpur, Malan, Moncompu, Nawagam, Pantnagar, Pattambi, Pusa, Rajendranagar, and Titabar. The results are summarised below.

1. Aduthurai

Three crop establishment methods, mechanical transplanting, direct seeding and normal transplanting, were evaluated with ADT 53 variety (**Table 2.5.1.1**). The incidence of white ears caused by stem borer at the flowering stage was significantly high in direct-seeded rice (14.3% WE) as compared to normal transplanting (8.1% WE) and mechanical transplanting (4.4% WE) methods. The incidence of gall midge (<3% SS), leaf folder (<2% LFDL), whorl maggot (<1% WMDL), hispa (2%) and BPH (<1/hill) was low in all the crop establishment methods.

Table 2.5.1.1 Influence of Crop Establishment Methods on Pest Incidence at Aduthurai, *Kharif* 2022

Treatments	% DH		% WE	% SS	% LFDL	% WMDL	% HDL	BPH /5 hills
	45 DAT	60 DAT	Pre har	45 DAT	75 DAT	45 DAT	30 DAT	90 DAT
T1 = Mechanical transplanting	0.8 (1.1)b	0.6 (1.0)b	4.4 (2.2)b	0.4 (0.9)b	0.2 (0.8)a	0.8 (1.1)a	0.4 (0.9)a	0.2 (1.0)a
T2 = Direct seeding	2.9 (1.8)a	3.7 (2.0)a	14.3 (3.8)a	3.0 (1.9)a	1.7 (1.4)a	0.7 (1.0)a	1.3 (1.3)a	0.4 (1.0)a
T3 = Normal transplanting	1.5 (1.4)ab	1.0 (1.2)b	8.1 (2.8)b	0.2 (0.8)b	0.4 (0.9)a	0.4 (0.9)a	0.1 (0.8)a	0.8 (1.2)a
LSD (0.05)	***0.49***	***0.44***	***0.90***	***0.66***	***0.64***	***0.32***	***0.64***	***0.47***
CV (%)	***18.53***	***17.41***	***16.99***	***31.14***	***34.85***	***17.11***	***35.54***	***24.21***

Means followed by the same letter in a column are not significantly different; Values in parenthesis are square-root transformed values

2. Chatha

Normal transplanting, puddled direct seeding and line-sowing methods were evaluated with Basmati 370 variety (**Table 2.5.1.2**). Dead heart damage caused by stem borer at the vegetative stage varied from 0 to 15.1% across the treatments. However, the incidence was at par in all three main plot treatments, three sub-plot treatments and their interactions.

Table 2.5.1.2 Influence of Crop Establishment Methods on Pest Incidence at Chatha, *Kharif* 2022

Main plots		% DH
		90 DAT
M1 = Normal transplanting		6.0(2.4)a
M2 = Puddled direct seeding		2.7(1.6)a
M3 = Line sowing		4.0(1.8)a
LSD (0.05)		**1.8**
CV (%)		**15.29**
Sub-plots		
S1 = Weedy check		4.2(2.0)a
S2 = Manual weeding		4.0(1.9)a
S3 = Chemical weed control		4.5(1.9)a
LSD (0.05)		**1.10**
CV (%)		**14.91**
M1 = Normal transplanting	S1 = Weedy check	4.5(2.1)a
	S2 = Manual weeding	4.3(2.2)a
	S3 = Chemical weed control	9.3(3.0)a
M2 = Puddled direct seeding	S1 = Weedy check	3.1(1.5)a
	S2 = Manual weeding	3.0(1.7)a
	S3 = Chemical weed control	1.9(1.4)a
M3 = Line sowing	S1 = Weedy check	4.9(2.3)a
	S2 = Manual weeding	4.8(1.7)a
	S3 = Chemical weed control	2.2(1.4)a
LSD (0.05) M in S		**2.64**
LSD (0.05) S in M		**3.41**

Means followed by the same letter in a column are not significantly different; Values in parenthesis are square-root transformed values

3. Jagdalpur

At this location, three crop establishment methods, normal transplanting, puddled direct seeding and unpuddled direct seeding were evaluated as main plot treatments and weedy check, mechanical weeding and chemical weed control as sub-plot treatments with Durgeshwary variety (**Table.2.5.1.3**). The incidence of stem borer (0 -10.7% DH &0 – 13.5% WE), gall midge (0 – 9.1% SS), leaf folder (3.0 – 7.9% LFDL), whorl maggot (1.7 – 8.0% WMDL), thrips (0 -3.7% THDL) was low and at par in all the main plot and sub-plot treatments.

4. Malan

Direct seeding, normal transplanting and semi-dry rice methods were assessed with HPR 1068 variety at this location. Though the dead heart damage varied from 0 to 15.4% at 60 DAT, 0 to 20% at 75 DAT, 7.1 to 25% at 90 DAT, the damage was at par in all crop establishment methods. Similarly, leaf folder damage was at par in all the main plot and sub-plot treatments (**Table 2.5.1.4**). Low incidence of BPH (<5/ hill), WBPH (<3/ hill) and GLH (<2/hill) was observed in all the methods of crop establishment.

Table 2.5.1.3 Influence of Crop Establishment Methods on Pest Incidence at Jagdalpur, *Kharif* 2022

Main plots		% DH		% WE	% SS	% LFDL	% THDL	% WMDL
		45 DAT	75 DAT	Pre har	60 DAT	90 DAT	45 DAT	45 DAT
M1 = Normal transplanting		4.0(2.0)a	5.2(2.3)a	5.2(2.3)a	4.2(2.1)a	6.1(2.6)a	2.6(1.7)a	5.2(2.4)ab
M2 = Puddled direct seeding		3.6(1.9)a	6.6(2.6)a	7.5(2.8)a	2.7(1.6)a	6.4(2.6)a	1.0(1.2)b	3.7(2.0)b
M3 = Unpuddled direct seeding		4.5(2.0)a	6.0(2.5)a	8.4(2.9)a	2.6(1.6)a	4.8(2.3)a	0.8(1.2)b	6.3(2.6)a
LSD (0.05)		**1.49**	**0.98**	**0.69**	**0.59**	**0.17**	**0.30**	**0.46**
CV (%)		**25.27**	**23.38**	**15.35**	**19.71**	**4.10**	**13.05**	**11.78**
Sub-plots								
S1 = Weedy check		3.5(1.8)a	3.8(2.1)a	7.9(2.9)a	2.1(1.5)a	6.7(2.7)a	1.5(1.4)a	5.2(2.4)ab
S2 = Mechanical weeding		3.8(1.9)a	6.4(2.6)a	7.2(2.7)a	3.9(1.9)a	4.3(2.2)a	1.7(1.4)a	4.6(2.2)a
S3 = Chemical weed control		4.7(2.1)a	7.6(2.8)a	6.0(2.4)a	3.6(1.9)a	6.3(2.6)a	1.2(1.3)a	5.4(2.4)a
LSD (0.05)		**1.29**	**0.69**	**0.69**	**1.18**	**0.22**	**0.32**	**0.23**
CV (%)		**25.38**	**21.86**	**26.50**	**25.58**	**7.09**	**18.86**	**7.95**
M1 = Normal transplanting	S1	3.1(1.7)a	3.8(2.1)a	6.6(2.6)a	1.8(1.4)a	5.9(2.5)abc	2.5(1.7)ab	5.9(2.5)ab
	S2	4.5(2.0)a	5.7(2.4)a	5.7(2.4)a	5.2(2.3)a	5.1(2.4)bc	2.8(1.8)a	4.1(2.1)ab
	S3	4.4(2.2)a	6.1(2.5)a	3.3(1.8)a	5.8(2.4)a	7.2(2.8)ab	2.3(1.7)ab	5.5(2.4)ab
M2 = Puddled direct seeding	S1	3.6(1.8)a	4.1(2.1)a	8.1(2.9)a	2.6(1.6)a	6.5(2.6)abc	1.1(1.2)ab	3.4(1.9)ab
	S2	3.6(2.0)a	6.5(2.6)a	7.5(2.8)a	3.5(1.8)a	5.5(2.4)abc	1.4(1.4)ab	2.7(1.8)b
	S3	3.8(1.9)a	9.3(3.1)a	6.8(2.6)a	1.8(1.4)a	7.2(2.8)ab	0.6(1.0)b	4.9(2.3)ab
M3 = Unpuddled direct seeding	S1	3.9(1.9)a	3.6(2.0)a	9.0(3.0)a	2.0(1.5)a	7.8(2.9)a	0.9(1.2)ab	6.3(2.6)ab
	S2	3.5(1.8)a	7.0(2.7)a	8.5(3.0)a	3.0(1.7)a	2.3(1.7)d	0.8(1.2)ab	6.9(2.7)a
	S3	6.0(2.3)a	7.3(2.8)a	7.7(2.8)a	3.1(1.7)a	4.3(2.2)cd	0.8(1.2)ab	5.7(2.5)ab
LSD (0.05) M in S		**3.11**	**1.65**	**2.14**	**2.84**	**0.53**	**0.78**	**0.56**
LSD (0.05) S in M		**3.33**	**1.96**	**2.01**	**2.47**	**0.50**	**0.77**	**0.82**

Means followed by the same letter in a column are not significantly different; Values in parenthesis are square-root transformed values

Table 2.5.1.4 Influence of Crop Establishment Methods on Pest Incidence at Malan, *Kharif* 2022

Treatments	% DH			% LFDL			
	60 DAT	75 DAT	90 DAT	45 DAT	60 DAT	75 DAT	90 DAT
T1 = Direct seeding	4.4(1.8)a	8.7(2.8)a	14.5(3.8)a	12.2(3.6)a	13.8(3.8)a	13.9(3.8)a	16.3(4.0)a
T2 = Normal transplanting	9.8(3.0)a	16.1(4.1)a	17.7(4.2)a	16.6(4.1)a	18.9(4.4)a	16.8(4.1)a	21.1(4.6)a
T3 = Semi dry rice	7.1(2.4)a	12.2(3.3)a	16.3(4.0)a	14.3(3.8)a	14.7(3.9)a	14.4(3.9)a	15.7(4.0)a
LSD (0.05)	***2.04***	***1.57***	***1.38***	***0.69***	***1.08***	***1.05***	***0.72***
CV (%)	***27.71***	***25.78***	***19***	***10***	***14.94***	***14.86***	***9.46***

5. Moncompu

At this location, two methods of crop establishment, drum seeding, and normal transplanting were assessed with cono weeding and chemical weed control as sub-plot treatments in the Uma variety. Low incidence of dead hearts caused by stem borer (<3% DH), hispa (<1& HDL), leaf folder (<2% LFDL), and BPH (<5/hill) was observed in all the main plot and sub-plot treatments **(Table. 2.5.1.5)**

Table 2.5.1.5 Influence of Crop Establishment Methods on Pest Incidence at Moncompu, *Kharif* 2022

Main plots		% DH	%HDL	%LFDL	BPH (No./5 hills)
		45 DAT	**30 DAT**	**30 DAT**	**60 DAT**
Drum seeding		0.9(1.1)a	0.5(1.0)a	1.1(1.2)a	6(2)a
Normal Transplanting		2.0(1.4)a	0.2(0.8)a	0.8(1.1)a	8(3)a
LSD (0.05)		**0.79**	**0.16**	**0.45**	**0.70**
CV(%)		**15.79**	**14.54**	**32.11**	**21.71**
Subplots					
Cono weeding		0.4(0.9)b	0.5(1.0)a	1.0(1.2)a	6(2)a
Chemical weed control		2.5(1.6)a	0.2(0.8)a	0.8(1.1)a	8(3)a
LSD (0.05)		**0.61**	**0.33**	**0.36**	**1.00**
CV(%)		**18.02**	**36.02**	**31.27**	**28.12**
Drum seeding	Cono weeding	0.8(1.1)ab	0.5(1.0)a	1.5(1.4)a	2(6)a
	Chemical weed control	1.0(1.1)ab	0.5(0.9)a	1.0(1.2)a	27(2)a
Normal Transplanting	Cono weeding	0.0(0.7)b	0.5(0.9)a	0.6(1.0)a	7(2)a
	Chemical weed control	4.0(2.0)a	0.0(0.7)a	0.5(1.0)a	9(3)a
LSD (0.05) M in S		**1.19**	**0.65**	**0.71**	**1.99**
LSD (0.05) S in M		**1.41**	**0.51**	**0.82**	**1.73**

6. Nawagam

GAR 14 variety was grown in three establishment methods, mechanical transplanting, direct seeding, and aerobic rice. Dead heart damage caused by stem borer was low and at par in all three methods during 45 and 60 DAT. However, dead heart incidence was high in mechanical transplanting (11.3%DH) which was at par with aerobic rice (9.9 %DH). White ear incidence was at par in all three methods (**Table.2.5.1.6**). Leaf folder damage was low at 45 DAT while at 75 DAT, it was significantly high in mechanical transplanting (14 %LFDL) followed by aerobic rice which was at par with direct seeding. The incidence of WBPH was low (<1/hill) in all the crop establishment methods.

Table 2.5.1.6 Influence of Crop Establishment Methods on Pest Incidence at Nawagam, *Kharif* 2022

Treatments	% DH			% WE	% LFDL		WBPH / 5 hills	
	45 DAT	**60 DAT**	**75 DAT**	**Pre har**	**45 DAT**	**75 DAT**	**60 DAT**	**75 DAT**
T1 = Mechanical transplanting	4.9(2.2)a	5.4(2.4)a	11.3(3.4)a	16.0(4.1)a	8.6(3.0)a	14.0(3.8)a	4.4(2.2)a	3.2(1.9)a
T2 = Direct seeding	3.2(1.6)a	4.8(2.0)a	6.9(2.8)b	15.3(3.9)a	4.7(2.3)a	6.3(2.6)b	2.8(1.8)b	1.2(1.3)b
T3 = Aerobic rice	3.4(1.6)a	3.8(1.9)a	9.9(3.2)ab	14.2(3.8)a	4.9(2.3)a	9.0(3.0)b	2.4(1.7)b	1.2(1.3)b
LSD (0.05)	***1.81***	***1.56***	***0.63***	***1.42***	***0.9***	***0.58***	***0.36***	***0.31***
CV(%)	***15.56***	***21.57***	***11.15***	***20.16***	***19.92***	***10.17***	***10.58***	***11.61***

7. Pantnagar

Four establishment methods, wet direct seeded rice (WDSR), direct seeding, normal transplanting, and aerobic rice were assessed with PD 24 variety. The incidence of dead hearts, and white ears caused by stem borer, leaf folder, whorl maggot, hispa and BPH was very low in all the methods of rice cultivation **(Table 2.5.1.7).**

Table 2.5.1.7 Influence of Crop Establishment Methods on Pest Incidence at Pantnagar, *Kharif* 2022

Establishment methods	% DH	% WE	% LFDL	% WMDL	%HDL	BPH
	45 DAT	Pre har	75 DAT	45 DAT	45 DAT	75 DAT
Wet DSR	2.7(1.5)a	2.9(1.7)a	0.6(1.0)a	2.0(1.6)a	3.0(1.8)a	0.6(1.0)b
Direct seeding	2.2(1.4)a	4.7(2.0)a	1.2(1.3)a	2.5(1.5)a	5.3(2.2)a	0.8(1.0)ab
Normal transplanting	4.8(2.1)a	9.3(2.9)a	1.4(1.3)a	2.3(1.6)a	2.4(1.7)a	3.2(1.9)a
Aerobic rice	1.2(1.2)a	8.4(2.9)a	1.9(1.5)a	4.0(2.1)a	3.3(1.7)a	0.0(0.7)b
LSD (0.05)	**1.99**	**2.12**	**0.76**	**1.3**	**1.64**	**0.84**
CV(%)	**19.23**	**17.67**	**12.01**	**11.43**	**15.03**	**19.22**

8. Pattambi

The Aishwarya variety was grown in three methods of crop establishment, Line sowing with a drum seeder, direct seeding, and normal transplanting methods at this location (**Table 2.5.1.8)**. The incidence of dead hearts caused by stem borer was significantly high in the normal transplanting method (17.9 %DH) s compared to direct seeding and line sowing. However white ear incidence was at par in all three crop establishment methods (11.7 – 19.2 %WE). At 15 DAT, gall midge incidence was significantly high in the normal transplanting method (37.5 %SS) and was at par with line sowing (24.8 %SS) while it was significantly high in line sowing (30.2 %SS) compared to other methods at 30 DAT. The incidence of whorl maggot, caseworm, and blue beetle was significantly low in direct-seeded rice compared to the other two crop establishment methods.

Table 2.5.1.8 Influence of Crop Establishment Methods on Pest Incidence at Pattambi, *Kharif* 2021

Treatments	% DH	% WE	% SS		% WMDL		% CWDL		%BBDL
	15 DAT	Pre har	15 DAT	30 DAT	15 DAT	30 DAT	15 DAT	30 DAT	15 DAT
T1 = Line sowing with drum seeder	7.3 (2.3)b	11.7 (3.5)a	24.8 (4.4)ab	30.2 (5.5)a	29.2 (5.3)a	21.7 (4.7)a	25.2 (5.0)a	11.2 (3.3)ab	28.0 (5.2)a
T2 = Direct seeding	5.8 (2.4)b	14.1 (3.8)a	1.3 (1.1)b	2.0 (1.5)c	5.0 (2.3)b	4.9 (2.3)b	4.0 (2.1)b	1.7 (1.4)b	1.7 (1.4)b
T3 = Normal transplanting	17.9 (3.9)a	19.2 (4.4)a	37.2 (5.3)a	16.7 (4.1)b	20.2 (4.4)a	25.3 (5.0)a	32.1 (5.4)a	26.3 (4.8)a	30.0 (5.4)a
LSD (0.05)	***2.86***	***0.99***	***3.54***	***1.24***	***1.35***	***1.04***	***2.58***	***2.22***	***2.01***
CV(%)	***15.03***	***14.2***	***14.65***	***18.52***	***18.59***	***14.43***	***14.5***	***18.86***	***27.78***

9. Pusa

Three crop establishment methods, puddled direct seeding, direct seeding and normal transplanting were evaluated with Rajendra saraswati variety. The incidence of dead hearts was significantly low in normal transplanting method (3.0 – 10.2% DH) compared to puddled direct seeding (16.2 – 22.6 %DH) and direct seeding (12.5 – 22.5 %DH). However, the incidence of white ears caused by stem borer and leaf folder damage was at par in all three crop establishment methods **(Table 2.5.1.9)**.

Table 2.5.1.9 Influence of Crop Establishment Methods on Pest Incidence at Pusa, *Kharif* 2022

Treatments	% DH				% WE	% LFDL	
	30 DAT	45 DAT	75 DAT	90 DAT	Pre har	45 DAT	75 DAT
T1 = Puddled direct seeding	19.7(4.0)a	16.2(4.0)a	18.3(4.3)a	22.6(4.8)a	14.7(3.9)a	8.2(2.9)a	14.6(3.8)a
T2 = Direct seeding	22.5(4.8)a	16.2(4.0)a	12.5(3.5)ab	17.3(4.1)ab	13.4(3.7)a	10.5(3.1)a	13.6(3.7)a
T3 = Normal transplanting	4.4(1.9)a	3.0(1.6)b	8.3(2.9)b	10.2(3.2)b	8.6(3.0)a	12.5(3.5)a	15.8(4.0)a
LSD (0.05)	***3.47***	***1.81***	***0.77***	***1.42***	***1.04***	***0.95***	***1.10***
CV(%)	***15.21***	***16.02***	***9.95***	***16.18***	***13.65***	***13.76***	***13.34***

10. Rajendranagar

RNR 15048 variety was grown in split plot design with three crop establishment methods as main plots and four weed management practices as sub-plots. The three crop establishment methods include manual transplanting, puddled direct seeding by drum seeder, and unpuddled direct seeding by line sowing while the sub-plot treatments include weed-free, weedy check, mechanical weeding using weeder and chemical weed control. The incidence of dead hearts, white ears, leaf folder, whorl maggot and BPH was very low in all the treatments and their interactions **(Table 2.5.1.10)**.

Table 2.5.1.10 Influence of Crop Establishment Methods on Pest Incidence at Rajendranagar, *Kharif* 2022

Main plots	% DH	% WE	%LFDL	% WMDL	BPH
	60 DAT	Pre har	60 DAT	60 DAT	60 DAT
M1 = Manual transplanting	0.8(1.1)ab	0.5(0.9)b	4.7(2.3)b	5.6(2.5)a	19(4)b
M2 = Puddled direct seeding by drum seeder	0.3(0.9)b	4.8(2.2)a	5.8(2.5)ab	0.8(1.1)b	32(6)a
M3 = Unpuddled dry direct seeding - line sowing	1.8(1.5)a	1.8(1.4)b	6.5(2.6)a	0.4(0.9)b	37(6)a
LSD (0.05)	**0.52**	**0.46**	**0.34**	**0.27**	**0.98**
CV(%)	**12.38**	**28.31**	**12.63**	**16.89**	**16.77**
Sub-plots					
S1 = Weed free	1.2(1.2)a	1.8(1.3)b	5.6(2.4)ab	2.6(1.6)ab	24(5)a
S2 = Weedy check	0.8(1.1)a	1.4(1.3)b	5.8(2.5)ab	2.1(1.5)ab	33(6)a
S3 = Mechanical weeding	1.1(1.2)a	4.0(1.9)a	6.3(2.6)a	1.9(1.4)b	30(5)a
S4 = Chemical weed control	0.8(1.1)a	2.1(1.5)b	4.9(2.3)b	2.6(1.6)ab	31(6)a
LSD (0.05)	**0.44**	**0.47**	**0.30**	**0.21**	**0.77**
CV(%)	**15.01**	**28.03**	**10.97**	**12.50**	**12.85**

11. Titabar

Four establishment methods, mechanical transplanting, direct seeding, normal transplanting, and aerobic rice were evaluated at this location with Ranjit Sub-1 variety **(Table 2.5.1.11)**. The incidence of stem borer, gall midge, leaf folder, whorl maggot and caseworm was low in all the four methods of crop establishment.

Table 2.5.1.11 Influence of Crop Establishment Methods on Pest Incidence at Titabar, *Kharif* 2022

Establishment methods	% DH	% WE	%SS	% LFDL	% WMDL	% CWDL
	60 DAT	Pre har	45 DAT	60 DAT	45 DAT	45 DAT
Mechanical transplanting	5.0(2.1)a	3.9(2.0)a	4.6(2.0)a	4.6(2.1)a	3.2(1.7)a	3.3(1.7)a
Direct seeding	6.3(2.4)a	2.9(1.7)a	3.6(1.6)a	2.7(1.6)a	3.7(1.8)a	3.7(1.8)a
Normal transplanting	4.4(2.1)a	4.0(2.0)a	2.9(1.5)a	3.2(1.7)a	3.1(1.7)a	3.1(1.7)a
Aerobic rice	4.3(1.9)a	4.5(2.2)a	2.7(1.5)a	3.4(1.9)a	2.6(1.6)a	2.6(1.6)a
LSD (0.05)	**1.96**	**1.41**	**2.34**	**1.69**	**1.86**	**1.14**
CV(%)	**19.26**	**18.11**	**14.26**	**19.27**	**17.55**	**25.29**

Across locations, the incidence of stem borer, gall midge, leaf folder, hispa, whorl maggot, BPH, and WBPH was observed in all the crop establishment methods. In general, the incidence of insect pests was low during *Kharif* 2022. The incidence of dead hearts was significantly high in semi-dry rice (11.9% DH) and was at par with puddled direct-seeded rice (**Figure 2.5.1.1**). In all other methods, the incidence was low. The incidence of white ears caused by stem borer was relatively high in aerobic rice (9.03% WE) followed by puddled direct seeding (8.32% WE). Gall midge incidence was significantly high in puddled direct seeding (19.23% SS) followed by the normal transplanting method (12.24% SS). Gall midge incidence was very low (<3% SS) in the direct-seeded rice, semi-dry rice, and aerobic rice.

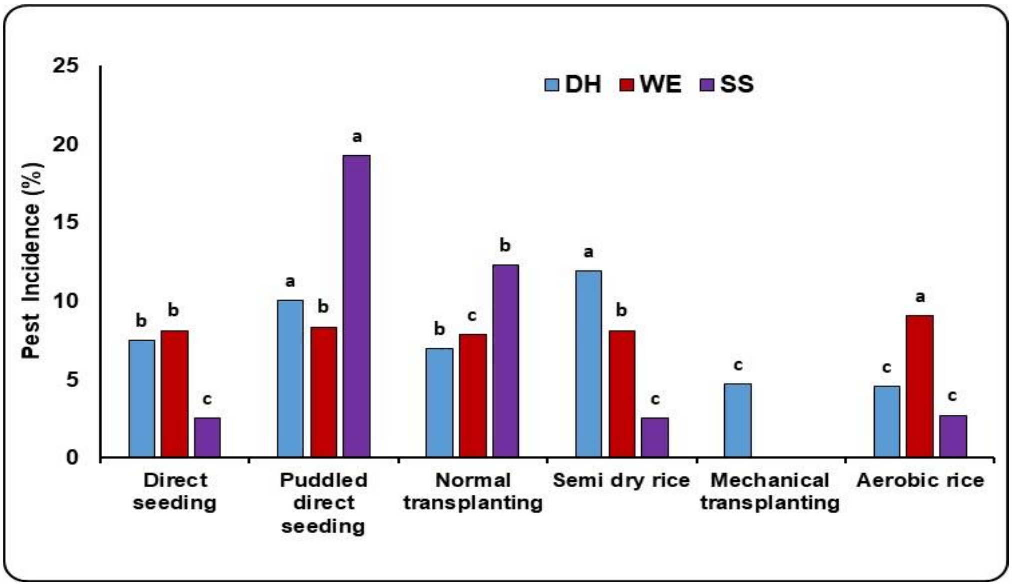


Fig 2.5.1.1 Incidence of stem borer and gall midge in different crop establishment methods across locations

Among the foliage-feeding insects, leaf folder incidence was significantly high in semi-dry rice (14.78% LFDL) and was at par in all the other establishment methods **(Figure 2.5.1.2)**. In the puddled direct-seeding method, the incidence of whorl maggot (11.48% WMDL) and caseworm (15.98% CWDL) was significantly high compared to the other methods. The incidence of hispa and thrips was very low (<5%) in all the crop establishment methods.

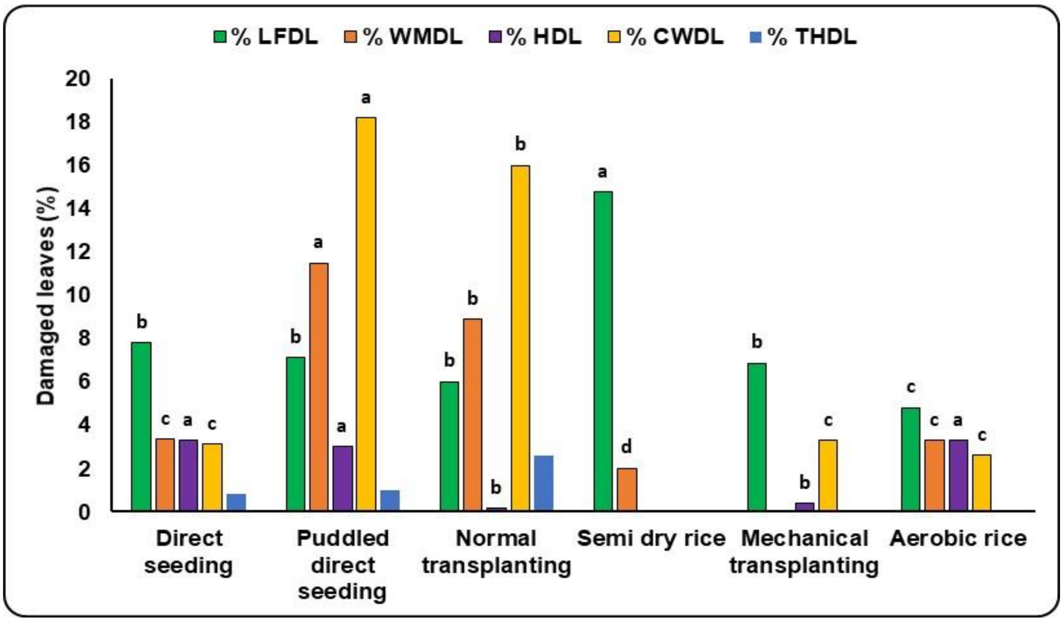


Figure 2.5.1.2 Incidence of foliage-feeding insects in different crop establishment methods across locations

In general, the incidence of sucking pests like BPH and WBPH was low in all the crop establishment methods (**Figure 2.5.1.3)**. However, BPH incidence was relatively high in puddled direct-seeded rice (16/5 hills).

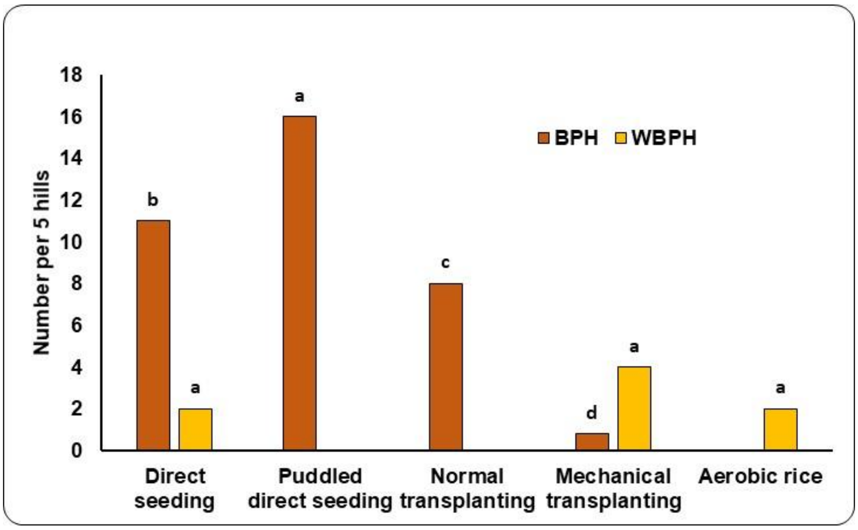


Figure 2.5.1.3 Incidence of sucking pests in different crop establishment methods across locations

Influence of crop establishment methods (IEMP), a collaborative trial with Agronomy, was conducted at 11 locations during Kharif 2022. Across the locations, the incidence of dead hearts caused by stem borer and leaf folder was significantly high in semi-dry rice followed by puddled direct-seeded rice while white ears were high in aerobic rice. Gall midge incidence was significantly high in puddled direct-seeded rice followed by the normal transplanting method. The incidence of whorl maggot, caseworm, and BPH was also significantly high in puddled direct-seeded rice. Overall, the incidence of insect pests was significantly high in puddled direct-seeded rice followed by the normal *transplanting method while the incidence was low in direct-seeded rice, semi-dry rice, mechanical transplanting, and aerobic rice.*

2. Cropping Systems Influence on Pest Incidence (CSIP)

Cropping systems play a major role in the incidence of insect pests, their carry over and further spread. In India, rice-based cropping systems are the major systems in rotation with cereals, pulses, cotton, and vegetables. Due to the constraints in water and labour resources, farmers are adopting water-saving technologies like wet direct seeding, dry direct seeding and aerobic rice. Similarly, the incorporation of crop residues is known to help *Rabi* crops in rice-based cropping systems. As rice straw contains about 1-2% of Potassium, the incorporation of rice straw acts as a good source of nutrients for crops grown after rice. Keeping these in view, a trial on cropping system's influence on pest incidence (CSIP) was initiated last year in collaboration with the Agronomy section (CA/SM 1- Conservation Agriculture/ System based management practices in rice and rice-based cropping systems to utilise resources and enhance the productivity and profitability) to evaluate the influence of different rice crop establishment methods under different residue management strategies with an aim to improve the overall productivity of the rice-based cropping system.

The field trial was laid out in a split-plot design with three replications. Main plot treatments comprised three different crop establishment methods (M1: Transplanting, M2: Wet seeding (line sowing under puddled conditions), and M3: Aerobic rice – Dry rice cultivation). The subplot treatments comprised three different Residue/straw management techniques (S1: No residue, S2: Incorporation of 15 cm height of rice straw from the ground, S3: Incorporation of 30 cm height of rice straw from the ground) to be superimposed for *Rabi* crops. During *Kharif* 2022, the trial was conducted at two locations: Karjat and Titabar. The results are summarized below.

At **Karjat,** Karjat -3 variety was grown in this trial. The incidence of stem borer and leaf folder was low in all the treatments and were at par with each other **(Table 2.5.2.1).**

Table 2.5.2.1 Influence of cropping systems on pest incidence at Karjat, *Kharif* 2022

Treatments	% DH	% WE	% LFDL
	60 DAT	Pre har	30 DAT
Main plots			
M1= Transplanting	6.7(2.6)a	5.9(2.3)a	5.4(2.4)a
M2 = Wet seeding	4.9(2.3)a	5.1(2.3)a	5.5(2.4)a
M3 = Aerobic rice	7.0(2.7)a	4.2(2.1)a	5.5(2.4)a
LSD (0.05)	**0.53**	**1.35**	**0.57**
CV (%)	**16.00**	**15.57**	**17.86**
Sub plots			
S1 = No residue	6.7(2.6)a	4.9(2.2)a	4.9(2.3)a
S2 = 15 cm ht. of rice straw	6.1(2.5)a	4.9(2.2)a	6.1(2.6)a
S3 = 30 cm ht of rice straw	5.8(2.4)a	5.3(2.3)a	5.4(2.4)a
LSD (0.05)	**0.29**	**0.53**	**0.41**

CV (%)		**10.89**	**22.70**	**16.32**
M1= Transplanting	S1	7.3(2.7)a	5.1(2.1)a	5.1(2.4)a
	S2	7.0(2.7)a	5.1(2.1)a	6.1(2.6)a
	S3	6.0(2.4)a	7.4(2.8)a	5.0(2.3)a
M2 = Wet seeding	S1	5.5(2.4)a	4.7(2.3)a	5.3(2.4)a
	S2	4.6(2.3)a	4.7(2.3)a	6.0(2.5)a
	S3	4.6(2.3)a	5.9(2.5)a	5.4(2.4)a
M3 = Aerobic rice	S1	7.4(2.8)a	5.0(2.3)a	4.3(2.2)a
	S2	6.8(2.7)a	5.0(2.3)a	6.3(2.6)a
	S3	6.9(2.7)a	2.7(1.7)a	5.8(2.5)a
LSD (0.05)	**M in S**	**0.49**	**0.92**	**0.70**
	S in M	**0.66**	**1.54**	**0.80**

At **Titabar,** Ranjit Sub-1 was grown in this trial. The incidence of stem borer, leaf folder, whorl maggot, and caseworm was observed low and at par with each other in all the treatments **(Table 2.5.2.2)**. The incidence of coccinellids, spiders and mirids was observed in all the main plots and sub-plot treatments.

Table 2.5.2.2 Influence of cropping systems on pest incidence at Titabar, *Kharif* 2022

Treatments		**% DH**	**% WE**	**% LFDL**	**%WMDL**	**%CWDL**
Main plots		**45 DAT**	**Pre har**	**30 DAT**	**30 DAT**	**45 DAT**
M1= Transplanting		5.2(2.2)a	3.3(1.9)a	3.7(1.9)a	3.6(1.8)a	2.8(1.7)a
M2 = Wet seeding		3.6(1.8)a	2.4(1.6)a	3.2(1.7)a	2.6(1.6)a	3.0(1.8)a
M3 = Aerobic rice		4.7(2.1)a	3.3(1.8)a	4.0(2.0)a	3.4(1.8)a	3.3(1.8)a
LSD (0.05)		**0.96**	**0.75**	**0.57**	**1.02**	**0.70**
CV (%)		**14.59**	**21.04**	**19.63**	**26.59**	**28.09**
Sub plots						
S1 = No residue		5.0(2.2)a	3.5(1.9)a	4.2(2.0)a	3.5(1.8)a	3.2(1.8)a
S2 = 15 cm ht. of rice straw		3.6(1.8)a	3.0(1.8)a	3.5(1.8)a	2.6(1.6)a	2.6(1.6)a
S3 = 30 cm ht of rice straw		4.9(2.2)a	2.6(1.6)a	3.3(1.7)a	3.5(1.8)a	3.3(1.9)a
LSD (0.05)		**0.80**	**0.57**	**0.87**	**0.74**	**0.49**
CV (%)		**12.47**	**25.52**	**22.06**	**26.72**	**20.82**
M1= Transplanting	S1	4.7(2.1)a	3.0(1.7)a	3.4(1.8)a	3.4(1.8)a	2.4(1.6)a
	S2	4.0(1.9)a	3.9(2.1)a	2.8(1.6)a	2.8(1.6)a	2.2(1.5)a
	S3	6.9(2.7)a	3.2(1.8)a	5.0(2.2)a	4.6(2.1)a	3.6(1.9)a
M2 = Wet seeding	S1	3.3(1.8)a	2.2(1.5)a	4.3(2.0)a	2.6(1.6)a	3.4(1.9)a
	S2	3.2(1.7)a	3.0(1.7)a	3.4(1.8)a	2.2(1.4)a	2.4(1.6)a
	S3	3.6(1.8)a	2.0(1.5)a	2.0(1.3)a	3.0(1.7)a	3.0(1.8)a
M3 = Aerobic rice	S1	6.9(2.7)a	5.4(2.4)a	5.0(2.2)a	4.6(2.1)a	3.6(1.9)a
	S2	3.6(1.8)a	2.2(1.6)a	4.2(2.0)a	2.8(1.6)a	3.0(1.7)a
	S3	3.6(1.8)a	2.5(1.6)a	3.0(1.7)a	2.8(1.6)a	3.3(1.9)a
LSD (0.05)	**M in S**	**1.88**	**1.35**	**2.06**	**1.74**	**1.16**
	S in M	**2.05**	**1.53**	**1.87**	**2.03**	**1.37**

Cropping system influence on insect pest incidence (CSIP), a collaborative trial with Agronomy was conducted at two locations, Karjat and Titabar, during Kharif 2022. Low incidence of stem borer, leaf folder, whorl maggot, and case worm was observed in different main plots of crop establishment methods and sub-plots of straw incorporation techniques.

3. Evaluation of Pheromone Blends for Insect pests of Rice (EPBI)

A crucial step in devising strategies for Integrated Pest Management in Rice is the monitoring of insect pests. Pheromones have a lot of potential for managing and monitoring insect pests in rice. Pheromones are very compatible with other application techniques in an IPM plan due to their pest-specificity and safety against natural enemies. A trial on the evaluation of pheromone blends for insect pests of rice was continued with the main aim of assessment of normal and slow-release pheromone blends against yellow stem borer, leaf folder, and multiple species.

The trial was conducted at 9 locations in *Kharif* 2022. The field trial was constituted with two formulations: normal and slow-release formulations of rice leaf folder (RLF), yellow stem borer (YSB), and the multispecies blend of both RLF and YSB pheromone combination. All the lures were placed randomly in delta traps, and installed in the field and each blend was replicated five times. Observations were recorded on adult catches in each trap at the weekly interval, after the installation of traps. Simultaneously, field population counts were taken through visual count for stem borers, disturb and count method (DCM) for leaf folder, sweep net catches and light trap (LT) catches. The results were summarised below:

The adult catches of YSB was high in slow release blend compared to the normal blend in all the locations except at Coimbatore and Jagdalpur **(Figure 2.5.3.1)**. The peak mean catch was 69 moths/ week, at Ludhiana followed by IIRR (36/week) and Jagtial (27/week). Visual count (33) was high at Coimbatore while the sweep net counts (26) were high at Ludhiana compared to all other locations.

The leaf folder peak catches were reported from the slow release blend at Ludhiana (89/ week) followed by IIRR (66/week), and Jagtial (50/week) which was significantly different from other locations **(Figure 2.5.3.2)**. The catches recorded in Aduthurai, Chinsurah, and Jagdalpur were at par with each other. The catches were very low in both the formulations at Aduthurai, Coimbatore, Chinsurah, and Jagdalpur. However, the field population of the leaf folder was high with high adult counts in disturb and count method (DCM - 39) and sweep nets.

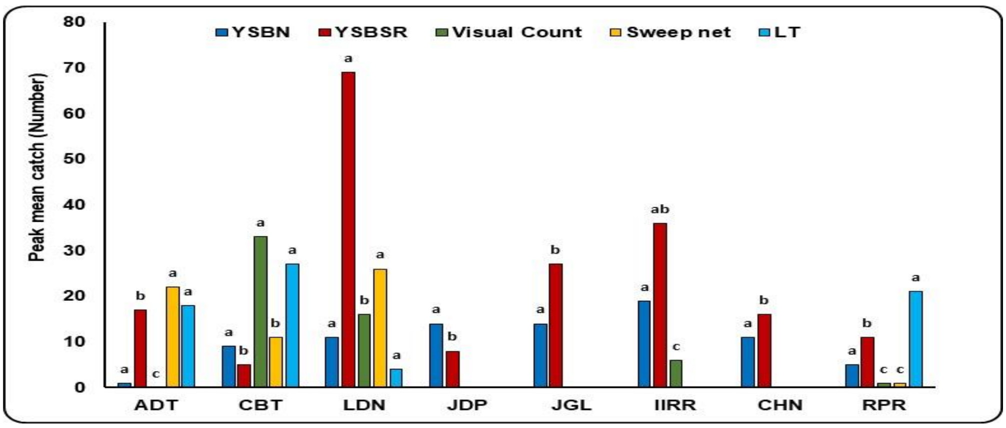


Figure 2.5.3.1 Evaluation of Yellow stem borer pheromone formulations at different locations, *Kharif* 2022

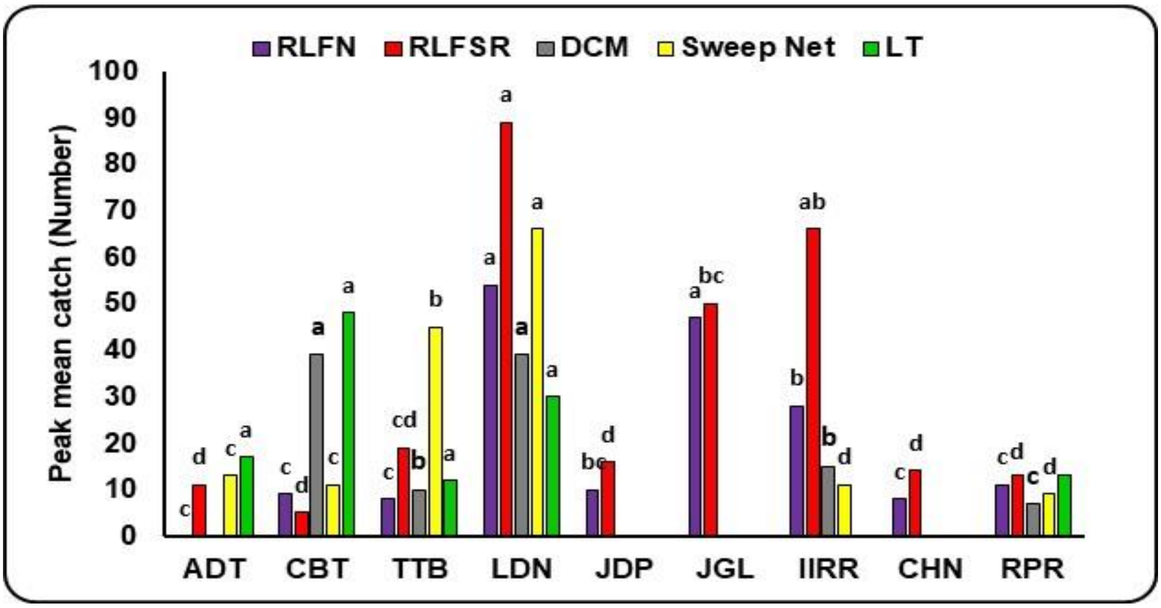


Figure 2.5.3.2. Evaluation of rice leaf folder, *Cnaphalocrocis medinalis* pheromone formulations at various locations, *Kharif* 2022

Evaluation of multispecies pheromone blends at 5 locations revealed that more stem borer adults were caught in traps compared to leaf folders at all the locations. Catches were high in the slow-release formulation at Ludhiana (45/week) and IIRR (34/week) compared to the normal formulation (12-14/week). At all the locations, higher catches were recorded in the slow-release formulation compared to the normal formulation.

2.6 EVALUATION OF ENTOMOPATHOGENS AGAINST SUCKING PESTS OF RICE

The trial was initiated in 2022 with the objective of evaluating effective entomopathogens against sucking pests of rice identified though the AICRP on biocontrol programme, at multi-locations and hotspots.

During kharif 2022, the trial was taken up at nine locations *viz.*, Brahmavar, Chatha, Coimbatore, Gangavati, Karjat, Mandya, Moncompu, Navasari and Raipur with a susceptible variety of the location. Three entomopathogens *viz.*, *Lecanicillium saksenae* (1x10^8 spores/g) @ 5 g/l), *Beauveria bassiana* (1x10^8 spores/g) @ 5 g/l and *Metarhizium anisopliae* (1x10^8 spores/g) @ 5 g/l) were compared with Thiamethoxam 0.2 g/l and untreated Control. The five treatments were replicated four times in a randomized block design. Foliar sprays of various treatments were taken up at fortnightly intervals twice during the reproductive phase for ear head bugs or during active tillering phase for hopper pests. Observations on population of ear head bugs and hopper pests one day before and 7 and 15 days after each spray was recorded from 25 hills selected at random. Data on natural enemies in 10 hills or per plot was also recorded.

Statistical analysis: Data was transformed appropriately and subjected to two-way ANOVA. Treatment effects across the locations (treatment*location interaction) were estimated to draw overall conclusions. Means were separated by LSD at five per cent level of significance.

1. *Brahmavar*

The number of ear head bugs at seven days after first spray was significantly lower with *Lecanicillium saksenae* treatment (4.00/ 25 hills) followed by *Beauveria bassiana* (4.50) compared with 18.00 bugs in untreated control **(Table 2.6.1).** At 15 days after first spray, the least number of ear head bugs were observed in *L. saksenae* sprayed plots (2.00/ 25 hills). Seven days after second spray, all the treatments showed significantly lesser number of ear head bugs compared to control (16.50), the least being observed with *L. saksenae* (1.25/25 hills). *Metarhizium anisopliae* with a population of 11.00/25 hills was the least effective among the bioagents tested. Similar trend was observed 15 days after second spray wherein all treatments showed significantly decreased number of ear head bugs, as compared to untreated control (16.25/25 hills). Overall, *L. saksenae* was the most effective treatment.

The number of mirid bugs did not differ significantly among the treatments. However, the highest number of mirids were observed in the control and *M. anisopliae* treated plots whereas the lowest number of mirids was found in thiamethoxam treatment. The number of spiders per plot was significantly higher in control (3.25). Among the other treatments *L. saksenae* recorded highest number of spiders per plot (2.00) while thiamethoxam treated plots did not register any spider count. The number of coccinellids was also significantly higher per plot in untreated control (2.25). Overall, the natural enemy count was significantly higher in control followed by *L. saksenae*, *B. bassiana* and *M. anisopliae* treatments. Thiamethoxam registered lowest number of natural enemies. The highest yield was observed with *L. saksenae* treatment (2166.25 kg/ha) followed by thiamethoxam (2131.25 kg/ha. The least yield was observed in the control plot with 1996.88 kg/ha.

2. *Chatha*

Observations were recorded on populations of stink bugs, white leafhopper, green leafhopper and gundhi bug. The population was low and did not differ among treatments. Population of natural enemies *viz.*, spiders and coccinellids were also recorded and ranged from 1-2 individuals per plot in all treatments. The yield was significantly higher in the plots with *M anisoplea* treatment (3350 kg/ha) and the least was seen in untreated control (2887 kg/ha).

3. *Coimbatore*

The number of ear head bugs at seven days after first spray was significantly lower with *L. saksenae* treatment (5.00/ 25 hills) which was on par with thiamethoxam (4.75/25 hills) **(Table 2.6.2).** Similar trend was observed at 15 days after first spray. At seven days and 15 days after second spray, *L. saksenae and* thiamethoxam gave significantly better control of ear head bugs (1.5-2.0/ 25 hills) while other treatments were on par. Overall, *L. saksenae* was the most effective treatment among the bioagents. The number of mirid bugs was highest in the control (12.00/plot) and *L. saksenae* treated plots (13.75/plot) whereas significantly lower number of mirids were found in thiamethoxam treatment (4.75/plot). Similar trend was observed for number of spiders per plot. The number of spiders ranged from 4.00 in thiamethoxam treatment to 11.00/plot in untreated control **(Table 2.6.2)**.

The yields were on par among treatments and ranged from 6649.13 to 6966.06 kg/ ha.

4. *Gangavathi*

The population of hoppers was on par in all treatments and significantly lower (5.03 to 9.41/ 25 hills) as compared to untreated control (14.53 and 18.35/ 25 hills) after the first spray **(Table 2.6.3)**. *L. saksenae* performed on par with thiamethoxam 7 days after second spray while both *L. saksenae* and *Beauveria bassiana* were as effective against hoppers as chemical control 15 days after second spray. The least effective bioagent against hoppers was *M anisopliae* **(Table 2.6.3)**.

The number of ear head bugs after first spray was significantly lower in all treatments as compared to untreated control, but the chemical thiamethoxam recorded significantly lowest population of bugs (2.44 and 1.54/ 25 hills) at 7 and 15 days after spraying **(Table 2.6.3)**. Similar trend was observed after second spray though at 15 days after second spray, *L. saksenae and* thiamethoxam were on par (0.96-1.10/ 25 hills). The population of mirids, spiders and coccinellids were significantly lower in thiamethoxam treated plots (3.09, 1.06 and 0.62/ m^2 respectively) **(Table 2.6.3)** while they were on par in all other treatments including untreated control

(11.99, 5.40 and 3.03/ m^2 respectively) indicating minimal or no impact on natural enemy population **(Table 2.6.3)**.

The yields were on par among treatments and ranged from 5845 to 7155 kg/ ha and significantly higher than untreated control (2570 kg/ ha) **(Table 2.6.3).**

5. *Karjat*

The number of ear head bugs at five days after first spray was significantly lower with thiamethoxam and *L. saksenae* treatments (1.35 and 2.40/ 25 hills respectively) **(Table 2.6.4).** At seven days after first spray, the least number of ear head bugs were observed in thiamethoxam and *L. saksenae* sprayed plots (0.25 and 1.30/ 25 hills). The other two bio-agents *B bassiana* and *M anisopliae* were ineffective in reducing pest population. After second spray, all the treatments showed significantly lesser number of ear head bugs compared to untreated control (1.5-2.70/ 25 hills), with no bugs observed in thiamethoxam treatment. Overall, *L. saksenae* was the most effective treatment among bioagents.

6. *Mandya*

At seven days after first spray significantly lower population of bugs were observed with all treatments (2.16-3.24/ 25 hills)) except *B. bassiana* (3.75/ 25 hills) and untreated control **(Table 2.6.5).** At 15 days after first spray, the least number of ear head bugs were observed in thiamethoxam sprayed plots (1.16/ 25 hills) followed by *L. saksenae* treated plots (1.92/25 hills). Similar trend was observed after second spray, wherein all the treatments showed significantly lesser number of ear head bugs compared to the control (2.48-2.53/25 hills). The least number of bugs was observed in chemical treatment followed by *L. saksenae* **(Table 2.6.5)**

The number of natural enemies *viz.*, spiders and coccinellids were lowest in thiamethoxam treatment (8.50 and 2.50 /plot respectively). All other treatments were on par with spiders ranging from 27.50 – 36.00/plot and coccinellids ranging from 13.75-15.00/ plot among the control and bioagent treated plots. The highest yield was observed with thiamethoxam treatment (7120 kg/ha). But two bioagent treatments were on par with chemical control *viz.*, *L. saksenae* and *M. anisopliae* (6153 and 5824 kg/ha respectively). The least yield was observed in the control plot with 2296 kg/ha.

7. Moncompu

Observations were recorded on population of green leafhopper, brown planthopper and ear head bug after imposing treatments. The population of leafhoppers ranged from 14.65-26.25/ 25 hills in untreated control. Population of green leafhoppers was on par (6.75 to 11.00/ 25 hills) in all treatments and significantly lower as compared to untreated control seven days after the first spray **(Table 2.6.6)**. Similar trend was observed 7 days after second spray. On the other hand, 15 days after first and second spray thiamethoxam had significantly lower population (1.25 and 2.25/ 25 hills respectively) while the bioagent treated plots were on par, but superior to untreated control. *L. saksenae* was the second most effective treatment after thiamethoxam, with population ranging from 7.25- 11.00 / 25 hills **(Table 2.6.6)**.

The population of brown planthopper ranged from 208.25 – 318.75/ 25 hills in untreated control. Population of planthoppers was on par and significantly lower in thiamethoxam and *L. saksenae* treated plots seven days after (73.5 and 58.75/ 25 hills respectively) and fifteen days after (6.97 and 6.59/ 25 hills) spray **(Table 2.6.6)**. On the other hand, after second spray, thiamethoxam had significantly lower population (25.25 and 9.00/ 25 hills respectively) while the bioagent treated plots were on par but superior to untreated. *L. saksenae* was second most effective treatment with population ranging from 42.25 -87.25 / 25 hills after second spray **(Table 2.6.6)**.

The treatments did not vary significantly in reducing ear head bug population after first spray including the chemical thiamethoxam **(Table 2.6.7)**. 15 days after second spray, lower population (2.5/ 25 hills) was observed in *M anisopliae* treatment followed by thiamethoxam (4.5/ 25 hills). The yields were very low in all treatments and ranged from 1031 to 1425 kg/ ha). The highest yield was observed in thiamethoxam followed by *L. saksenae* treatment which were on par **(Table 2.6.7)**.

8. *Navsari*

All treatments were significantly more effective than untreated control which recorded 13.25 - 20.93 bugs per 10 hills. The number of ear head bugs was significantly lower with thiamethoxam treatment (4.00 – 5.75/ 10 hills) after first and second spray. The three bioagents did not differ significantly in their effectiveness **(Table 2.6.8)**.

The population of natural enemies were highest in untreated control 9.75, 7.75 and 8.50 mirids, spiders and coccinellids per plot. Thiamethoxam registered lowest number of natural enemies. The three bioagent treatments were on par, with the highest population recorded in *L. saksenae* treatment with 9.25, 6.25 and 6.75 mirids, spiders and coccinellids per plot. The highest yield was observed in thiamethoxam treatment (5339 kg/ha) and least in untreated control (4488 kg/ha). The three bioagents treatments were on par with a yield range of 4789 – 4948 kg/ha **(Table 2.6.8)**.

9. *Raipur*

All treatments were significantly more effective than untreated control which recorded 4.25 – 6.00 ear head bugs per 25 hills. The number of ear head bugs were on par in all other treatments though the population of bugs was slightly lower in the bioagent treated plots. Among the bioagents the least population was observed in *L. saksenae* treated plots which reached 1.5/ 25 hills fifteen days after second spray **(Table 2.6.9)**.

The highest population of natural enemies was observed in untreated control with 3.00, 3.25 and 2.5 ground beetles, spiders and coccinellids per plot respectively **(Table 2.6.9)**. The number of spiders and coccinellids in *L. saksenae* treatment was on par with untreated control with 2.00 spiders and coccinellids per plot.

Thiamethoxam registered lowest number of natural enemies. The lowest yield was observed in the control plot with 6275 kg/ha, while all other were on par with a yield range of 6963 – 7138 kg/ha **(Table 2.6.9)**.

Evaluation of entomopathogens against sucking pests of rice was taken up in nine locations to test the effectiveness of entomopathogens Lecanicillium saksenae, Beauveria bassiana and Metarhizium anisopliae against sucking pests especially the ear head bug in rice. ***The results indicated L. saksenae to be the most effective of the three pathogens tested in seven locations with no detrimental impact on natural enemies.***

Table 2.6.1 Effect of entomopathogens on sucking pests and their natural enemies at Brahmavar, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills						Natural enemies No./ plot			Yield (kg/ha) *
	I SPRAY			II SPRAY			Mirid	Spider	Coccinellid	
	PC	7DAS	15DAS	21DAS/PC						
Lecanicillium saksenae @ 1 x 107 cfu ml $^{-1}$ KAU 7714 (20 g talc formulation/ L)	13.25	4.00 (2.11)	2.00 (1.56)	3.50 (2.00)	1.25 (1.31)	1.00 (1.22)	0.75 (1.10)	2.00 (1.56)	0.75 (1.10)	2166.25
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	10.25	4.50 (2.20)	3.75 (2.06)	5.50 (2.45)	2.50 (1.70)	1.75 (1.49)	0.75 (1.10)	1.00 (1.18)	0.75 (1.10)	2084.38
Metarhizium anisopliae @ 1 x 108 cfu ml $^{-1}$ NBAIR Ma 4 (20 g talc formulation / L)	11.75	7.25 (2.73)	9.75 (3.20)	11.50 (3.46)	9.50 (3.16)	11.00 (3.39)	1.00 (1.22)	0.25 (0.84)	0.50 (0.97)	2028.13
Thiamethoxam	11.50	6.50 (2.68)	4.75 (2.29)	6.50 (2.64)	3.50 (2.00)	2.75 (1.80)	0.50 (0.97)	0.00 (0.71)	0.25 (0.84)	2131.25
Control	11.00	18.00 (4.34)	17.00 (4.18)	19.00 (4.42)	16.50 (4.12)	16.25 (4.09)	1.00 (1.22)	3.25 (1.92)	2.25 (1.65)	1996.88
SED		0.32	0.12	0.07	0.13	0.09		0.14	0.19	
CD (0.05)	NS	0.71	0.27	0.16	0.29	0.19		0.30	0.41	

Figures in parenthesis are square root transformed values; PC- pre-count; DAS- days after spraying;

Table 2.6.2 Effect of entomopathogens on sucking pests and their natural enemies at Coimbatore, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills					Natural enemies No./ plot		Yield (kg/ha) *
	I SPRAY			II SPRAY		Mirid	Spider	
	PC	7DAS	15DAS	7DAS	15DAS			
Lecanicillium saksenae @ 1 x 107 cfu ml -1 KAU 7714 (20 g talc formulation/ L)	13.75 (3.74)	5.00 (2.33)	5.50 (2.44)	3.75 (2.05)	2.00 (1.56)	12.00 (3.53)	8.00 (2.90)	6966.06
Beauveria bassiana @1 x 108 cfu ml-1 NBAIR Bb 5 (20 g talc formulation / L)	18.25 (4.32)	10.25 (3.27)	9.75 (3.19)	5.50 (2.44)	3.25 (1.92)	9.50 (3.16)	7.25 (2.75)	6766.19
Metarhizium anisopliae @ 1 x 108 cfu ml -1 NBAIR Ma 4 (20 g talc formulation / L)	17.25 (4.20)	11.25 (3.42)	9.75 (3.19)	5.00 (2.32)	3.50 (1.98)	9.25 (3.11)	6.25 (2.56)	6708.88
Thiamethoxam	13.50 (3.69)	4.75 (2.27)	7.75 (2.86)	2.50 (1.70)	1.50 (1.40)	4.75 (2.27)	4.00 (2.08)	6962.31
Control	14.50 (3.84)	17.50 (4.23)	21.00 (4.63)	9.00 (3.07)	6.50 (2.64)	13.75 (3.76)	11.00 (3.38)	6649.13
SED		0.19	0.21	0.25	0.20	0.22	0.32	
CD (0.05)	NS	0.40	0.46	0.54	0.44	0.49	0.70	

Figures in parenthesis are square root transformed values; PC- pre-count; DAS- days after spraying;

Table 2.xxx Effect of entomopathogens on sucking pests and their natural enemies at Gangavathi, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills					NO. of hoppers/ 25 hills						No. of natural enemies/m^2			Yield (kg/ha)
	I SPRAY			II SPRAY		I SPRAY			II SPRAY						
	PC	7 DAS	15 DAS	7 DAS	15 DAS	PC	7 DAS	15 DAS	PC	7 DAS	15 DAS	Mirid	Spider	Coccinellid	
Lecanicillium saksenae @ 1 x 107 cfu ml $^{-1}$ KAU 7714 (20 g talc formulation/ L)	3.88 2.09	3.31 1.95	2.62 1.76	2.01 1.58	1.10 1.26	11.20 3.42	8.70 3.03	8.09 2.93	8.97 3.08	5.81 2.51	1.50 1.41	10.58 3.33	4.68 2.27	2.89 1.84	7155 84.56
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	3.81 2.07	3.62 2.03	3.05 1.88	2.27 1.66	2.18 1.64	11.63 3.48	9.41 3.15	8.45 2.99	8.95 3.07	6.34 2.61	5.04 2.35	10.22 3.27	4.5 2.24	2.81 1.82	6065 77.79
Metarhizium anisopliae @ 1 x 108 cfu ml $^{-1}$ NBAIR Ma 4 (20 g talc formulation / L)	3.92 2.10	3.15 1.91	2.46 1.72	1.99 1.58	1.46 1.40	12.15 3.56	8.81 3.05	7.99 2.91	8.78 3.05	5.42 2.43	2.03 1.59	10.53 3.32	4.58 2.25	2.86 1.83	6935 83.26
Thiamethoxam	3.99 2.12	2.44 1.71	1.54 1.43	1.24 1.32	0.96 1.21	11.90 3.52	5.78 2.50	5.03 2.35	8.50 3.00	3.12 1.90	5.92 2.52	3.09 1.88	1.06 1.25	0.62 1.06	5845 76.40
Control	3.91 2.10	4.24 2.18	4.85 2.31	5.32 2.41	5.54 2.46	11.55 3.47	14.53 3.87	18.35 4.34	25.26 5.07	32.29 5.73	39.21 6.30	11.99 3.54	5.40 2.43	3.03 1.88	2570 50.57
SED		0.03	0.07	0.05	0.05		0.07	0.07	0.11	0.09	0.10	0.08	0.07	0.05	2.69
CD (0.05)	NS	0.07	0.15	0.10	0.11	NS	0.15	0.15	0.24	0.21	0.21	0.16	0.15	0.10	5.86

Table 2.6.4 Effect of entomopathogens on sucking pests at Karjat, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills				
	I SPRAY			II SPRAY	
	PC	5 DAS	7 DAS	3 DAS	5 DAS
Lecanicillium saksenae @ 1 x 107 cfu ml $^{-1}$ KAU 7714 (20 g talc formulation/ L)	9.45 (3.15)	2.40 (1.70)	1.30 (1.34)	0.65 (1.07)	0.45 (0.97)
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	11.10 (3.40)	4.30 (2.17)	3.35 (1.95)	1.60 (1.44)	1.05 (1.24)
Metarhizium anisopliae @ 1 x 108 cfu ml $^{-1}$ NBAIR Ma 4 (20 g talc formulation / L)	10.30 (3.28)	4.50 (2.22)	2.85 (1.83)	1.55 (1.43)	1.05 (1.24)
Thiamethoxam	10.90 (3.37)	1.35 (1.36)	0.25 (0.86)	0.00 (0.71)	0.00 (0.71)
Control	11.75 (3.50)	6.50 (2.63)	5.60 (2.45)	2.70 (1.78)	1.75 (1.49)
SED		0.19	0.17	0.12	0.10
CD (0.05)	NS	0.41	0.36	0.26	0.21

Figures in parenthesis are square root transformed values; PC- pre-count; DAS- days after spraying; *extrapolated

Table 2.6.5 Effect of entomopathogens on sucking pests and their natural enemies at Mandya, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills						Natural enemies No./ plot		Yield (kg/ha) *
	I SPRAY			II SPRAY			Spider	Coccinellid	
	PC	7 DAS	15 DAS	21 DAS/PC	7 DAS	15 DAS			
Lecanicillium saksenae @ 1 x 107 cfu ml^{-1} KAU 7714 (20 g talc formulation/ L)	4.70 (2.28)	2.89 (1.84)	1.92 (1.55)	2.49 (1.73)	1.73 (1.49)	1.28 (1.33)	28.25 (5.29)	13.75 (3.63)	6153 (78.12)
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	3.97 (2.11)	3.75 (2.06)	3.27 (1.94)	4.22 (2.17)	3.86 (2.09)	3.45 (1.99)	27.50 (5.21)	16.50 (4.08)	4168 (64.21)
Metarhizium anisopliae @ 1 x 108 cfu ml^{-1} NBAIR Ma 4 (20 g talc formulation / L)	3.82 (2.08)	3.24 (1.93)	2.68 (1.78)	3.04 (1.88)	2.24 (1.65)	2.07 (1.60)	31.75 (5.64)	14.75 (3.84)	5824 (76.16)
Thiamethoxam	4.23 (2.17)	2.16 (1.63)	1.16 (1.29)	1.87 (1.54)	1.05 (1.24)	0.82 (1.14)	8.50 (2.94)	2.50 (1.70)	7120 (84.32)
Control	3.32 (1.95)	3.96 (2.11)	4.63 (2.26)	5.31 (2.41)	5.68 (2.48)	5.90 (2.53)	36.00 (5.96)	15.00 (3.87)	2296 (47.63)
SED		0.06	0.06	0.06	0.09	0.08	0.61	0.58	4.21
CD (0.05)	NS	0.12	0.14	0.13	0.19	0.17	1.32	1.26	9.18

Figures in parenthesis are square root transformed values; PC- pre-count; DAS- days after spraying; *extrapolated

Table 2.6.6 Effect of entomopathogens on hoppers at Moncompu, EESP, *kharif* 2022

Treatment	No. of GLH / 25 hills						No. of BPH/ 25 hills					
	I SPRAY			II SPRAY			I SPRAY			II SPRAY		
	PC	7 DAS	15 DAS	PC	7 DAS	15 DAS	PC	7 DAS	15 DAS	PC	7 DAS	15 DAS
Lecanicillium saksenae @ 1 x 107 cfu ml^{-1} KAU 7714 (20 g talc formulation/ L)	19.50 (4.46)	11.00 (3.37)	8.00 (2.89)	13.75 (3.76)	9.50 (3.15)	7.25 (2.77)	140.00 (11.80)	73.50 (8.55)	48.50 (6.97)	87.25 (9.31)	59.50 (7.72)	42.25 (6.48)
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	14.00 (3.80)	10.00 (3.23)	8.00 (2.88)	13.25 (3.69)	9.75 (3.19)	9.00 (3.05)	164.50 (12.74)	128.50 (11.25)	71.25 (8.37)	133.75 (11.58)	94.75 (9.75)	71.50 (8.47)
Metarhizium anisopliae @ 1 x 108 cfu ml^{-1} NBAIR Ma 4 (20 g talc formulation / L)	16.00 (4.02)	10.50 (3.27)	9.25 (3.09)	11.75 (3.50)	8.50 (2.98)	5.75 (2.49)	192.50 (13.72)	158.00 (12.48)	96.25 (9.79)	153.50 (12.39	111.75 (10.58)	91.50 (9.57)
Thiamethoxam	20.25 (4.53)	6.75 (2.68)	1.25 (1.27)	16.00 (4.05)	6.50 (2.63)	2.25 (1.57)	222.25 (14.84)	58.75 (7.65)	43.25 (6.59)	48.50 (6.93)	25.25 (5.00)	9.00 (2.81)
Control	14.25 (3.80)	22.25 (4.74)	22.00 (4.71)	19.00 (4.38)	22.75 (4.80)	26.50 (5.19)	208.25 (14.38)	235.00 (15.23)	318.75 (17.76)	223.75 (14.95)	256.25 (16.00)	285.00 (16.88)
SED		0.36	0.38	0.31	0.29	0.31		1.04	1.00	0.63	0.57	0.68
CD (0.05)	NS	0.77	0.83	0.67	0.63	0.68	NS	2.27	2.18	1.37	1.25	1.48

Figures in parenthesis are square root transformed; PC- pre-count; DAS- days after spraying; *extrapolated

Table 2.6.7 Effect of entomopathogens on earhead bugs and their natural enemies at Moncompu, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills						Natural enemies No./ plot			Yield (kg/ha) *
	I SPRAY			II SPRAY			Mirid	Spider	Coccinellid	
	PC	7DAS	15DAS	21DAS/PC	7 DAS	15 DAS				
Lecanicillium saksenae @ 1 x 107 cfu ml $^{-1}$ KAU 7714 (20 g talc formulation/ L)	25.00 (5.03)	19.75 (4.48)	14.75 (3.89)	17.50 (4.22)	13.75 (3.76)	10.50 (3.31)	37.75	12.25	19.25	1350 (36.67)
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	16.75 (4.12)	13.25 (3.64)	8.25 (2.71)	12.25 (3.55)	7.00 (2.72)	4.50 (2.03)	45.50	10.25	14.75	1185 (34.35)
Metarhizium anisopliae @ 1 x 108 cfu ml $^{-1}$ NBAIR Ma 4 (20 g talc formulation / L)	19.50 (4.41)	13.50 (3.67)	7.75 (2.76)	10.25 (3.25)	4.50 (2.22)	2.50 (1.59)	36.75	12.75	14.50	1087 (32.95)
Thiamethoxam	23.50 (4.87)	14.75 (3.89)	10.50 (3.30)	12.50 (3.57)	9.50 (3.14)	4.25 (2.13)	36.50	11.25	21.00	1425 (37.73)
Control	15.00 3.91	18.50 (4.35)	17.75 (4.25)	14.00 (3.80)	12.75 (3.60)	15.50 (3.97)	45.75	9.50	19.75	1031 (32.05)
CD (0.05)	NS	NS	NS	NS	NS	1.15	36.75	12.75	14.50	3.63

Figures in parenthesis are square root transformed; PC- pre-count; DAS- days after spraying; *extrapolated

Table 2.6.8 Effect of entomopathogens on sucking pests and their natural enemies at Navsari, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 10 hills			Natural enemies No./ plot			Grain Yield (kg/ha) *	Straw yield Kg/ha
	PC	I SPRAY	II SPRAY	Mirid	Spider	Coccinellid		
Lecanicillium saksenae @ 1 x 107 cfu ml $^{-1}$ KAU 7714 (20 g talc formulation/ L)	9.77 (3.20)	8.00 (2.90)	10.25 (3.28)	9.25 (3.12)	6.25 (2.60)	6.75 (2.69)	4789 (69.20)	7093 (84.22)
Beauveria bassiana @1 x 108 cfu ml^{-1} NBAIR Bb 5 (20 g talc formulation / L)	9.21 (3.11)	8.25 (2.95)	11.25 (3.42)	9.00 (3.08)	6.00 (2.55)	7.00 (2.74)	4884 (69.88)	7184 (84.76)
Metarhizium anisopliae @ 1 x 108 cfu ml $^{-1}$ NBAIR Ma 4 (20 g talc formulation / L)	8.90 (3.06)	6.75 (2.69)	9.75 (3.20)	8.50 (2.99)	6.75 (2.69)	6.75 (2.69)	4948 (70.34)	7154 (84.58)
Thiamethoxam	8.96 (3.07)	4.00 (2.11)	5.75 (2.49)	4.25 (2.18)	3.00 (1.86)	3.00 (1.86)	5339 (73.07)	7261 (85.21)
Control	8.92 (3.07)	13.25 (3.70)	20.93 (4.62)	9.75 (3.20)	7.75 (2.87)	8.50 (3.00)	4488 (66.99)	7384 (85.93)
SED		0.16	0.17	0.13	0.10	0.12	0.79	
CD (0.05)	NS	0.35	0.37	0.28	0.22	0.26	1.72	NS

Figures in parenthesis are square root transformed; PC- pre-count; DAS- days after spraying; *extrapolated

Table 2.6.9 Effect of entomopathogens on sucking pests and their natural enemies at Raipur, EESP, *kharif* 2022

Treatment	No. of Ear head bugs / 25 hills					Natural enemies No./ plot			Yield (kg/ha) *
	I SPRAY			II SPRAY		Ground beetles	Spider	Coccinellid	
	PC	7 DAS	15 DAS	7 DAS	15 DAS				
Lecanicillium saksenae @ 1 x 107 cfu ml -1 KAU 7714 (20 g talc formulation/ L)	4.25 (2.17)	4.00 (2.11)	2.75 (1.79)	2.50 (1.73)	1.50 (1.40)	1.25 (1.31)	2.00 (1.56)	2.00 (1.56)	7100 (84.24)
Beauveria bassiana @1 x 108 cfu ml-1 NBAIR Bb 5 (20 g talc formulation / L)	4.25 (2.17)	3.25 (1.92)	3.50 (1.98)	2.50 (1.73)	2.00 (1.58)	1.00 (1.22)	1.50 (1.40)	1.75 (1.49)_	6963 (83.43)
Metarhizium anisopliae @ 1 x 108 cfu ml -1 NBAIR Ma 4 (20 g talc formulation / L)	4.25 (2.17)	2.50 (1.73)	2.50 (1.73)	2.25 (1.65)	1.50 (1.40)	2.00 (1.56)	1.50 (1.40)	2.50 (1.73)	7075 (84.10)
Thiamethoxam	4.25 (2.17)	2.25 (1.63)	4.00 (2.10)	3.25 (1.920	2.50 (1.73)	1.00 (1.22)	1.25 (1.31)	1.00 (1.22)	7138 (84.46)
Control	5.25 (2.38)	4.75 (2.28)	4.25 (2.17)	5.50 (2.440	6.00 (2.54)	3.00 (1.86)	3.25 (1.92)	2.50 (1.73)	6275 (79.20)
SED		0.18		0.13	0.14	0.13	0.17	0.14	1.54
CD (0.05)	NS	0.38	NS	0.28	0.30	0.27	0.36	0.30	3.35

Figures in parenthesis are square root transformed values; PC- pre-count; DAS- days after spraying; *extrapolated

2.7 INTEGRATED PEST MANAGEMENT STUDIES

Integrated Pest Management Special Trial (IPM)

Biotic constraints like insect pests, diseases, and weeds ravage rice crop throughout the crop growth period, and holistically managing these pests are of significant concern to the farmers. Although IPM is an established concept that all the stakeholders universally acknowledge, IPM implementation at the farmer level is constrained due to its knowledge-intensive nature and the need for specific skills for making judgements and choosing IPM solutions for the sustainable management of pests. To overcome these limitations, a participatory IPMs trial was continued in collaboration with agronomists and plant pathologists to validate IPM practices from a basket of available options and demonstrate to farmers the management of pests (including insects, diseases) weeds) in a holistic way.

During *Kharif* 2022, the IPMs trial was conducted zone-wise in 19 locations and 40 farmers' fields. The pest management practices followed in IPM and farmers' practice (FP) at these locations are given in Tables. The details of pest incidence zone-wise are discussed below:

Zone I – Hilly areas

The IPMs trial was conducted in three farmers' fields at two locations in this zone. Location-wise details of the village, district and farmers are given below:

S.No	State	Location	Village/District	Farmer Name
1	Jammu & Kashmir	Khudwani	Hiller village, Anantnag district	Sri Nazir Ahmad Teeli
2	Jammu & Kashmir	Khudwani	Brazloo	Sri. M Abbas Malik
3	Himachal Pradesh	Malan	Jia Haar village, Kangra district	Sri Santokh Singh

1) **Khudwani, Jammu and Kashmir:** The incidence of grasshoppers alone was reported from both IPM and FP plots in Shalimar rice-3 and Shalimar rice-5 at this location. The damage was relatively low in IPM plots compared to FP plots **(Table 2.7.1)**. Grain yield was high in IPM plots resulting in high gross returns and BC ratio.

Table 2.7.1 Pest incidence, grain yield and BC ratio in IPMs trial at Khudwani, *Kharif* 2022

Farmer Name	Treatments	% GHDL		Yield (kg/ ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC Ratio
		30 DAT	80 DAT					
Sri. Nazir Ahmad Teeli	IPM	6.0 ± 0.4	7.0 ± 0.1	8768	122752	61450	61302	2.00
	FP	6.8 ± 0.6	10.7 ± 0.3	7050	98700	62250	36450	1.59
Sri M Abbas Malik	IPM	4.7 ± 0.4	7.9 ± 0.1	7518	105245	58500	46745	1.80
	FP	5.9 ± 0.4	11.6 ± 0.4	5050	70700	61750	8950	1.14

Price of Paddy = Rs. 1400/q

2) **Himachal Pradesh, Malan:** IPMs trial was conducted in Sri Singh's field at Jia Haar village, Kangra district, Himachal Pradesh State. Kasturi Basmati was grown in IPM field and Jheni, a local variety was grown in FP plot.

Practices followed in IPMs trial at Malan, *Kharif* 2022

	IPM Practices	Farmers Practices
Area	10 ha	10 ha
Variety	Kasturi Basmati	Jheni, a local variety
Nursery	• Line sowing • Application of FYM	• Broadcast nursery • Application of urea @ 30 kg
Main field	• Application of 90 kg N, 40 kg P and 40 kg K. • Application of herbicide – Bispyribac sodium salt • Sprayed Chlorpyriphos • Application of Bavistin	• Applied of 30 kg urea • Manual weeding

Dead hearts caused by black beetle was significantly higher in FP plot (31.8%) compared to IPM plot (24.2%). Leaf folder damage was significantly low in IPM plot (11.5%) compared to farmer's practices (16.9%). The incidence of hispa and BPH was low in both the treatments. High grain yield was recorded in IPM plot (36.40 q/ ha) resulting in higher gross returns and BC ratio compared to farmers' practices (**Table 2.7.2)**. The weed population at 30 DAT and 60 DAT in IPM plots was lower than farmers practice by 30.6 and 27.6%, respectively. The dry weed biomass was lower in IPM implemented fields by 49.7 and 18.2%, respectively (**Table. 2.7.3**). The mean grain yield advantage was 51.05 in IPM adopted plots.

Table 2.7.2 Pest incidence, grain yield and BC ratio in IPMs trial at Malan, *Kharif* 2022

Treatments	% DH due to black beetle		% LFDL	% HDL	BPH (No./5 hills)	Yield (kg/ ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC Ratio
	29 DAT	36 DAT	43 DAT	57 DAT	43 DAT					
IPM	24.2 ± 3.7b	20.9 ± 4.7b	11.5 ± 1.2b	0.0 ± 0.0a	4.0 ± 0.4a	3640 ± 123a	145600	46080	99520	3.16
FP	31.8 ± 3.2a	34.3 ± 4.0a	16.9 ± 2.8a	3.1 ± 0.4a	7.0 ± 0.8a	2208 ± 60b	88320	34968	53352	2.53

Price of Paddy = Rs. 4000/q

Table 2.7.3. Weed population and weed dry mass at Malan, Kharif 2022

Treatments	Weed population no/m²		Weed dry biomass g/m²	
	30 DAT	60 DAT	30 DAT	60 DAT
IPM	4.8(2.3)	11.2(3.3)	1.0	7.8
FP	14.0(3.7)	31.2(5.6)	6.1	29.9
Mean	3.0	4.5	3.6	18.9
CD (0.05)	**0.89**	**0.86**	**2.26**	**5.25**

Zone II – Northern areas

In this zone, IPMs trial was conducted in seven farmers' fields across three locations. Location wise details of village/district and farmers are provided in table below.

S. No	State	Location	Village/district	Farmer Name
1	Haryana	Kaul	Karsa Dod village/ Kaithal district	Sri. Dalsher Singh
2	Haryana	Kaul	Rsina village/ Kaithal district	Sri Mahender
3	Punjab	Ludhiana	Sudhar village/ Ludhiana district	Sri Inderjeet Singh
5	Uttarakhand	Pantnagar	Panchananpur, Dineshpur/Udham Singh Nagar	Sri Ganesh Bairagi
6	Uttarakhand	Pantnagar	Panchananpur, Dineshpur/Udham Singh Nagar	Sri Prabhash Sarkar
7	Uttarakhand	Pantnagar	Durgapuri No.1,, Dineshpur mandal/Udham Singh Nagar	Sri Vimal Bairagi

The package of practices followed in IPM and FP plots are given hereunder:

Practices followed in IPMs trial in Zone II (Northern areas*), Kharif* 2022

Practices followed in IPMs trial at Kaul, *Kharif* 2022		
1) Sri Dalsher Singh, village – Karsa Dod, Kaithal district, Haryana 2) Sri Mahender, village – Rasina, Kaithal district, Haryana		
	IPM Practices	**Farmer Practices**
Area	0.4 ha	0.4 ha
Variety	CSR 30	CSR 30
Nursery	• Seed treatment with Bavistin 10 g + Streptocycline 1g / 10 kg seed • Application of 1 kg DAP, 1 kg urea and FYM 40 kg • Sprayed Bispyribacsodium 10% SC @ 0.4 ml/ liter water at 15 – 20 DAS	• Seed treatment with Bavistin 10 g + Streptocycline 1g / 10 kg seed • Application of 1 kg DAP and 2 kg urea
Main Field	• Cutting of leaf tips before transplanting • Application of 25 kg DAP, 40 kg Urea, Zinc 10 kg • Application of Pretilachlor @ 1200 – 1500 ml/ ha • Release of *Trichogramma chilonis* @ 40000/ acre, 3-4 times starting at 31 DAT • Installation of bird perches @ 10/ acre • Mid-season drainage of the field • Sprayed Flubendiamide 20 WG @ 50 g/ acre • Applied Lustre (flusilazole + carbendazim) @ 400 ml/ acre for sheath blight control • Application of Triflumezopyrim 10 SC @ 94 ml/ acre at 55 DAT	• Application of 150 kg urea as top dressing • Application of Pretilachlor @ 1200 – 1500 ml/ ha • Application of cartap hydrochloride @ 7.5 kg/ acre • Two sprays of mixture of insecticides • Spray a mixture of insecticide and fungicide • Applied Streptocycline @ 15g/ha + Copper oxycloride @ 500g/ha, Propiconazole 25 EC @ 1000ml/ha
Practices followed in IPMs trial at Ludhiana, *Kharif* 2022		
3) Sri Inderjeet Singh, village Sudhar, Ludhiana district, Punjab		
Area	Half acre	Half acre
Variety	PR 126	PR 126
Nursery	• Application of urea @ 1.0 kg and Zinc sulphate @ 1 kg/ acre nursery	• Application of urea @ 1.0 kg/ acre nursery and Zinc sulphate @ 1 kg/ acre nursery
Main field	• Alley ways of 30 cm after every 2 m • Application of Butachlor @ 1.2 L/ acre • Sprayed Fame (flubendiamide) 480 SC @ 20 ml/acre • Sprayed Triflumezopyrim 10% SC (Pexalon) @ 94 ml/ acre & Tilt @ 200ml/ acre • Recommended dose of neem coated urea-90 kg/ acre • Growing flowering plants like marigolds, soybean, cowpea, moong, and sesamum on bunds • Water management for planthoppers	• Applied neem coated urea 120 kg and zinc sulphate 25 kg/ acre • Application of Butachlor @ 1.2 L/ acre • Application of Mortar @ 170 g/ acre • Sprayed Chess @ 140g/ acre • Sprayed Tilt + Nativo (tebuconazole and trifloxystrobin) @ 200 + 80 ml/ acre
Practices followed in IPMs trial at Pantnagar, *Kharif* 2022		

4) Sri Ganesh Bairagi, Panchananpur, Dineshpur village, Udhamsingh nagar district, Uttarakhand		
Area	2500 sq.m	2500 sq.m
Variety	HKR 47	HKR 47
Main Field	• Application of NPK @ 100 kg/ ha, Zinc @ 25 kg/ ha, urea @ 120 kg/ ha • Application of Bispyribac Sodium @250 ml/ha • Sprayed Cartap hydrocloride 50% SP@ 600g/ha • Sprayed Triflumezopyrim 10% SC(Pexalon) @ 94 ml /acre • Applied streptocycline @15 g/ha + copper oxycloride @ 500 g/ha; Hexaconazole 5% EC@ 2 ml/litre • Installed pheromone traps for YSB @ 8/ ha	• Application of NPK @ 120 kg/ acre, Chelated Zinc @ 6 kg/ha and urea 120 kg/ ha, mono sulphur 8 kg/ acre • Application of Pretilachlor 50 EC @ 1.5 liter/ ha; Nominee gold @ 200 ml/ ha • Applied Cartap Hydrocloride 4.0 GR @ 19kg/ha, Chlorantrniliprole 18.5%(Coragen) @ 150 ml/ha, Buprofezin 25 SP @1000 ml /ha, Triflumezopyrim 10% SC(Pexalon) @ 94 ml /acre • Applied Streptocycline @ 15g/ha + Copper oxycloride @ 500g/ha, Propiconazole 25% EC(Tilt) @ 500 ml/ha
5) Sri Prabhash Sarkar, Panchananpur, Dineshpur village, Udhamsingh nagar district, Uttarakhand		
Area	2500 sq.m	2500 sq.m
Variety	PR 121	PR 121
Main Field	• Application of NPK 100 kg/ ha, Zinc 25 kg and Urea 120 kg • Application of Bispyribac Sodium 10% SC@ 250 ml/ha • Sprayed Cartap hydrocloride50% SP @ 600g/ha- two times and Triflumezopyrim 10% SC(Pexalon) @ 94 ml /acre • Applied streptocycline @15 g/ha + copper oxicloride @ 500g/ha, Hexaconzole 5%EC @ 2ml/litre • Installed pheromone traps for YSB @ 8/ ha	• Application of NPK 120 kg/ ha, Chelated Zinc @ 6 kg/ ha and Urea 120 kg/ha, mocronutrient granules @ 10 kg/ ha • Applied Pretilachlor @1.5 liter/ha, Nominae gold 200 ml/ha • Application of Cartap Hydrocloride 4.0 GR @ 19kg/ha, Chlorpyriphos 50% + Cypermethrin 5% EC @ 800 ml/ha, Buprofezin 25 SP @1000 ml /ha, Triflumezopyrim 10% SC(Pexalon) @ 94 ml /acre • Applied Streptocycline @ 15g/ha + Copper oxycloride @ 500g/ha, Propiconazole 25 EC @ 500ml/ha
6) Sri Vimal Bairagi, Durgapuri No.1, Dineshpur village, Udhamsingh nagar district, Uttarakhand		
Area	2500 sq.m	2500 sq.m
Variety	PR 121	PR 121
Main Field	• Application of NPK 100 kg/ ha, Zinc 25 kg and Urea 120 kg • Application of Bispyribac Sodium 10% SC@ 250 ml/ha • Applied Cartap Hydrocloride 50% SP @ 600 g/ha, Triflumezopyrim 10% SC(Pexalon) @ 94 ml /acre • Applied streptocycline @15 g/ha + copper oxicloride @ 500g/ha, Hexaconazole 5% EC@ 2 ml/litre • Installed pheromone traps for YSB @ 8/ ha	• Application of NPK 120 kg/ ha, Chelated Zinc @ 6 kg/ ha and Urea 120 kg/ha, Mono sulphur @ 8 kg/ acre • Applied Pretilachlor @ 1.5 L/ ha, Nominee gold 200 ml/ ha • Fertera@ 10 kg/ha, Fipronil 5% SC @ 1000 ml/ha, Chlorpyriphos 20% @1000 ml /ha, Imidachloprid 17.8% SL@ 150ml/ha, Triflumezopyrim 10% SC(Pexalon) @ 94 ml /acre • Applied Streptocycline @ 15g/ha + copper oxycloride @ 500g/ha, Propiconazole 25% EC @ 500 ml/ha

Incidence of stem borer, leaf folder, BPH, and WBPH was observed in both IPM and FP plots at all the farmers' fields in this zone **(Table 2.7.4)**. The incidence of leaf folder was significantly low in IPM plots (2.4-2.6% LFDL) compared to FP plots of both the farmers (22.3–23.9% LFDL) at Kaul. BPH numbers were significantly low in Sri Mahender's IPM plot (6/5 hills) at Kaul compared to the FP plot (59/5 hills). At all other farmer fields, the incidence of different pests was low.

Table 2.7.4 Insect Pest incidence in IPMs trial in Zone II (Northern), *Kharif* 2022

Treatments			% DH/WE	% LFDL	BPH	WBPH	Yield kg/ha
KUL	F1- Sri. Dalsher Singh	IPM	4.6(2.2)b	2.6(1.7)b	19(4)b	19(4)a	3880(62)a
		FP	7.1(2.7)a	22.3(4.6)a	45(6)a	14(4)a	3648(61)a
LSD(0.05,36 df)			**0.22**	**0.08**	**0.36**	**0.32**	**2.69**
KUL	F2 - Sri Mahender	IPM	3.7(2.0)b	2.4(1.7)b	6(3)b	4(2)b	3817(62)a
		FP	6.5(2.6)a	23.9(4.8)a	59(7)a	10(3)a	3376(58)b
LSD(0.05,36 df)			**0.19**	**0.09**	**0.32**	**0.31**	**3.44**
LDN	F3 - Sri Inderjeet Singh	IPM	3.7(1.9)b	2.6(1.6)a	12(4)b	12(4)b	7060(84)a
		FP	4.9(2.3)a	2.7(1.6)a	17(4)a	14(4)a	6844(83)a
LSD(0.05,36 df)			**0.29**	**0.06**	**0.31**	**0.35**	**1.61**
PNT	F4 = Sri Ganesh Bairagi	IPM	5.4(2.3)a	0.1(0.8)a	16(4)b	1(1)a	5942(77)a
		FP	5.7(2.4)a	0.2(0.8)a	20(4)a	2(2)a	5570(75)b
LSD(0.05,36 df)			**0.25**	**0.07**	**0.36**	**0.31**	**1.88**
PNT	F5 = Sri Prabhash Sarkar	IPM	4.6(2.2)b	0.3(0.8)a	19(4)a	2(1)b	6146(78)a
		FP	7.6(2.8)a	0.3(0.8)a	21(4)a	4(2)a	5788(76)b
LSD(0.05,36 df)			**0.29**	**0.10**	**0.54**	**0.33**	**2.25**
PNT	F6 = Sri Vimal Bairagi	IPM	4.8(2.2)a	0.3(0.9)a	14(4)a	1(1)b	5926(77)a
		FP	5.2(2.4)a	0.3(0.8)a	13(4)a	2(2)a	5420(74)a
LSD(0.05,36 df)			**0.26**	**0.06**	**0.37**	**0.23**	**5.07**
Treatments							
T1 = IPM			4.4(5.3)b	3.2(9.3)b	15(30)b	6(2)b	5462(73)a
T2 = FP			6.2(6.2)a	18.2(13.5)a	29(35)a	8(3)a	5108(71)b
LSD(0.05,180 df)			**0.28**	**0.25**	**1.28**	**0.12**	**0.93**
DAT							
D1 = 50 DAT			5.7(5.9)a	6.0(12.5)a	16(12)a	9(3)a	
D2 = 64 DAT			5.0(5.6)ab	11.5(12.8)a	36(13)a	12(3)a	
D3 = 71 DAT			4.5(5.4)b	13.9(12.6)a	26(13)a	5(2)a	
D4 = 85 DAT			5.6(5.9)a	11.6(9.6)b	10(10)b	2(1)a	
D5 = PH			5.7(6.0)a	10.6(9.5)b			
LSD(0.05180 df)			**0.44**	**0.39**	**0.39**	**0.20**	

At Pantnagar, the trial was evaluated for the management of sheath blight, brown spot and bacterial blight. Adoption of IPM practices effectively reduced the disease progression of sheath blight (243 - 258 AUDPC units) when compared to Farmers practices (420 to 453 AUDPC units). Similar trend was observed with respect to brown spot disease development. At Pantnagar the same IPM practices were not effective against bacterial blight disease. At Kaul, the trial was conducted for the management of leaf blast, neck blast, bacterial blight and sheath blight. The leaf blast AUDPC value of 210 and 182 units were reduced to 146 and 147 units, respectively due to the adoption of IPM practices as against farmer practices. In case of sheath blight disease, adoption of IPM practices reduced the AUDPC units from 120 to 89 in IPM plots and 116 to 87 in FP plots. With respect to bacterial blight there is no significant difference between IPM and Farmer practices **(Table 2.7.5)**.

Table 2.7.5 AUDPC values based on disease severity in Zone II in IPMs trial, *Kharif* 2022

Farmers	Treatment	AUDPC Values						
		Pantnagar			Kaul			
		Sheath blight	BS	BB	LB	NB	BB	Sheath blight
F 1	IPM	243	28	2	146	23	10	89
	FP	422	96	24	210	27	26	120
F2	IPM	258	33	2	147	25	23	87
	FP	420	89	3	182	17	24	116
F 3	IPM	244	30	2				
	FP	453	98	2				

BS = Brown spot, BB = Bacterial blight, LB = Leaf blast, NB = Neck blast

Across locations, the incidence of dead hearts, leaf folder damaged leaves, BPH and WBPH numbers was significantly low in IPM plots compared to FP plots (**Figure 2.7.1**).

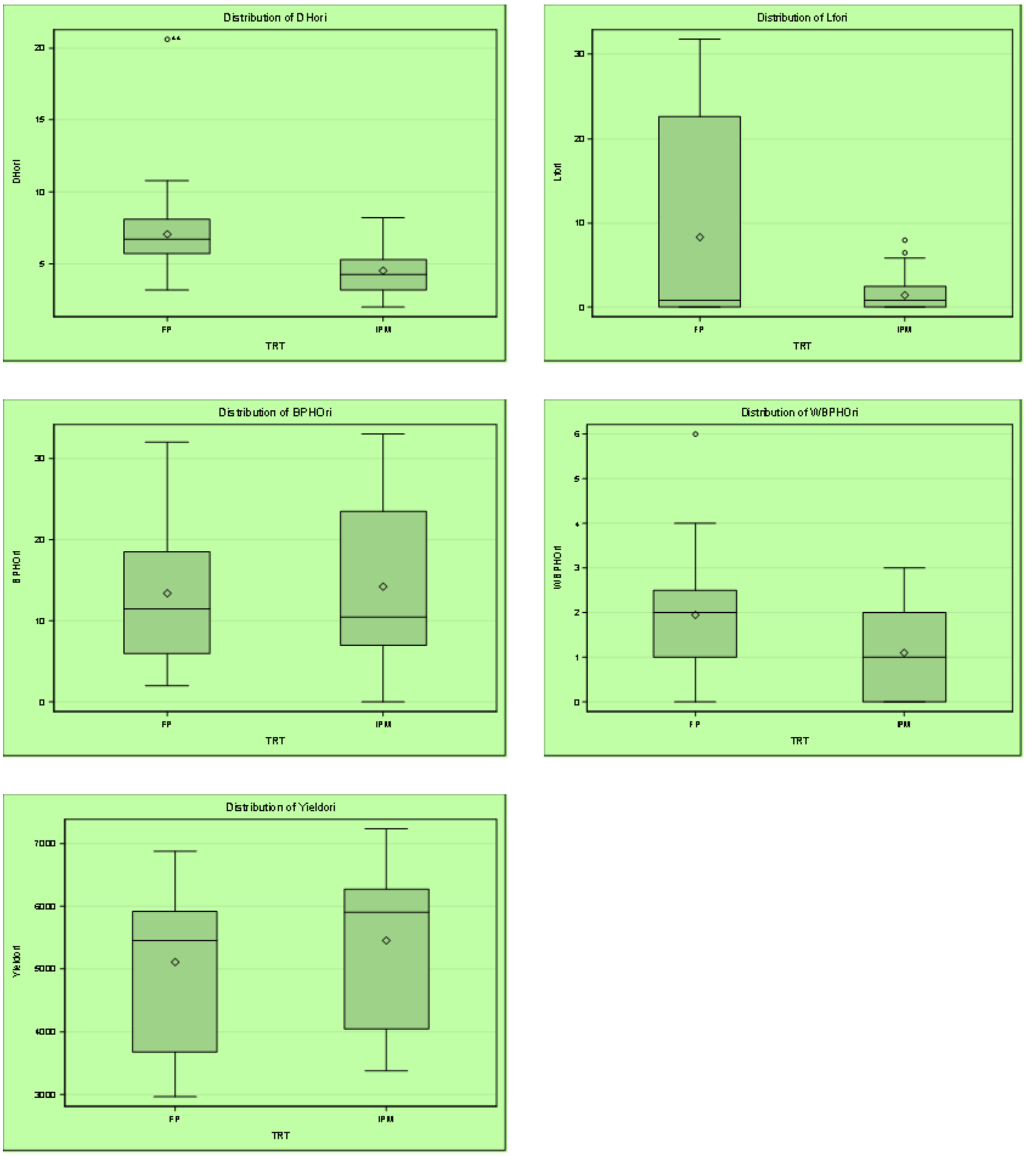


Figure 2.7.1 Incidence of dead hearts, leaf folder damage, BPH, WBPH, and grain yield in IPM and FP plots across locations in Zone II (Northern areas)

Grain yield was significantly high in IPM plots (5462 kg/ha) across locations resulting in higher gross returns and BC ratio (**Table 2.7.6**).

Table 2.7.6 Returns and BC ratio in IPMs trial in Zone II (Northern), *Kharif* 2022

Location	Farmers	Treatm ents	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
KUL	F1- Sri. Dalsher Singh	IPM	38.80	149962	41000	108962	3.66
		FP	36.48	140995	53900	87095	2.62
KUL	F2 - Sri Mahender	IPM	38.17	145046	40500	104546	3.58
		FP	33.76	128288	50150	78138	2.56
LDN	F3 - Sri Inderjeet Singh	IPM	70.60	136964	56746	80218	2.41
		FP	68.44	132774	60646	72128	2.19
PNT	F4 = Sri Ganesh Bairagi	IPM	59.42	121217	45318	75899	2.67

		FP	55.70	113628	48663	64965	2.33
PNT	F5 = Sri Prabhash Sarkar	IPM	61.46	125378	45418	79960	2.76
		FP	57.88	118075	47423	70652	2.49
PNT	F6 = Sri Vimal Bairagi	IPM	59.26	120890	44418	76472	2.72
		FP	54.20	110568	48733	61835	2.27
	IPM		**54.62**				**2.97**
	FP		**51.08**				**2.41**

Price of Paddy: F1 = Rs.3865/q; F2 = Rs. 3800/q; F3 = Rs. 1940/q; F4, F5 & F6 = Rs.2040/q

Zone III – Eastern areas

IPMs trial was conducted in four farmer's fields at four locations and details are given below:

S. No	State	Location	Village/district	Farmer Name
1	Odisha	Chiplima	Garmunda village, Sambalpur	Sri. Tarakanta Pradhan
2	West Bengal	Chinsurah	Bele, Radhanagar post, Pandua block, Hooghly district	Sri Narayan Chandra Mondal
3	Uttar Pradesh	Masodha	Kura Keshvpur village, Sadar, Pura Bazar, Ayodhya district	Sri Ram Dheeraj
4	Bihar	Pusa	Ladaura village, Kalyanpur block, Samastipur district	Sri Laxman Singh

The package of practices followed in both IPM and FP plots are given below:

Practices followed in IPMs trial in Zone III (Eastern areas), *Kharif* 2022

Practices followed in IPMs trial at Chiplima, *Kharif* 2022		
	IPM practices	**Farmers practices**
Area/ variety	1600 sq.m ; Swarna (MTU 7029)	1600 sq.m ; Swarna (MTU 7029)
Nursery	• Seed treatment with Trichoderma @ 10g/kg	
Main field	• Transplanted at a spacing of 20 x 15 cm. • Applied fipronil 0.3 G @ 10 kg/ acre, 5 days before transplantation • Alleyways of 30 cm after every 2 m. • Fertilizers (NPK) applied @ 100:50:50. • Applied NeemAzal @ 2 ml/ liter water at 40 DAT • Applied Rynaxypyr (chlorantraniliprole) 20 SC @ 150 ml /ha at 55 DAT • Sprayed CM75 @ 1000 g/ha at 60 DAT for brown spot management • Applied Triflumezopyrim 10% SC @ 94 ml/ acre at 65 DAT	• Fertilizers (NPK) applied 100:50:50 • Applied Cartap hydrochloride 4 G @ 20 kg /ha at 20 DAT. • Sprayed Cartap hydrochloride 50 SP @ 750 g/ha during transplanting • Sprayed Acephate 75 SP @ 1000 g /ha + Fipronil 5 SC @ 1250 ml /ha at 30 DAT • Sprayed Isoprothiolane 40 EC @ 1000 ml/ha at 55 DAT • Sprayed Pymetrozine 50 WP @ 300 g /ha at 75 DAT
Practices followed in IPMs trial at Chinsurah, *Kharif* 2022		
Area/ variety	0.5 acre; IET 4786 (Satabdi)	0.5 acre; IET 4786 (Satabdi)
Nursery	• Application of 8 kg of 10:26:28 complex • Application of mustard cake @ 1.5 kg	• Application of mustard cake @ 5 kg
Main field	• Application of 31 kg 10-26-26 and 28 kg Urea • Application of Butachlor + one hand weeding • Application of Ferterra (chlorantraniliprole) @ 4 kg/ acre • Application of Coragen (chlorantraniliprole) @ 60 ml/ acre • Application of carbendazim • Installation of pheromone traps @ 6/acre for stem borer mass trapping	• Application of 30 kg10-26-26; 23 KG MOP; Urea 30 kg • Application of Butachlor + one hand weeding • Application of Phorate 10 G @ 4.5 kg/ acre • Triazophos @ 750 ml/ acre two times • Application of Carbendazim
Practices followed in IPMs trial at Masodha, *Kharif* 2022		
Area/	1 acre	1 acre
Variety	Sambha Mahsuri-Sub 1	Sambha Mahsuri-Sub 1

Nursery	• Seed treatment with Trichoderma@10kg/ha. Presoak the seed in water for 12 hrs. Application of FYM	• Only presoak the seed in water for 12 hrs.
Main field	• Application of 100:50:50:10: N: P: K: ZnSo410 t/ha FYM • Transplant seedlings at a spacing of 20 x 15 cm. • Alleyways of 30 cm after every 2 m • Fertilizer dose 80:40:40:25 N: P: K: ZnSo4. • Applied Butachlor 1.5 kg a.i./ ha within one week after transplanting the crop. • Installed pheromone traps with 5 mg lure @ 8 traps/ ha for stem borer monitoring. • One spray of Cartap hydrochloride 50 WP @ 600 g / ha at 60 DAT	• Applied 150:40 N: P and 5 t/ha FYM • Applied Nominigold @ 100 ml/ acre
Practices followed in IPMs trial at Pusa, *Kharif* 2022		
Area	1 acre	1 acre
Variety	Rajendra Mahsuri	Rajendra Mahsuri
Nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed	
Main Field	• Transplanting at 20 x 15 cm spacing • Application of RDF • Application of Butachlor @ 1.5 kg ai/ ha Installed pheromone traps for YSB @ 3/ acre • Application of Bispyribac sodium 20 g ai/ ha at 20 DAT • Application of cartap hydrochloride 50 WP @ 600g / ha at 50 DAT	• Transplanting at 20 x 15 cm spacing • Application of RDF • Hand weeding at 30 DAT • Application of butachlor @ 1.5 kg a.i. / ha after one week of transplanting • Hand weeding at 30 DAT • Application of Padan (cartap hydrochloride) soluble powder @ 2 kg formulation / ha

Stem borer, leaf folder, gall midge, whorl maggot, and BPH incidence was recorded in this zone. Stem borer damage was significantly low in IPM plots at Masodha and Pusa (6.0% DH) compared to FP plots at respective locations (**Table 2.7.7**). However, the leaf folder damage was significantly high in IPM plot at Masodha (15.8% LFDL) than in the FP plot (4.1% LFDL) while the damage was low at other locations in both treatments. The incidence of gall midge (<5% SS) and whorl maggot (<5% WMDL) was low in both IPM and FP plots in all the locations. Across locations, dead heart damage was significantly low in IPM plots while the leaf folder damage in FP plots (**Figure 2.7.2**).

Table 2.7.7 Insect Pest incidence in IPMs trial in Zone III (Eastern), *Kharif* 2022

Treatments			%DH/WE	%LFDL	Yield kg/ha
Location	**Farmer**				
CHP	F1 = Sri Tarakanta Pradhan	IPM	0.4(0.8)b	0.1(0.8)b	5358(73)a
		FP	1.8(1.4)a	1.2(1.3)a	4620(68)b
LSD (0.05; 28df)			**0.19**	**0.07**	**3.89**
CHN	F2 = Sri Narayan Chandra Mondal	IPM	5.1(2.3)b	0.5(1.0)a	5528(74)a
		FP	7.1(2.7)a	0.4(1.0)a	4872(70)b
LSD (0.05; 28df)			**0.28**	**0.12**	**1.67**
MSD	F3 = Sri Ram Dheeraj	IPM	6.0(2.5)b	15.8(4.0)a	5588(75)a
		FP	12.6(3.5)a	4.1(2.1)b	4292(66)b
LSD (0.05; 28df)			**0.34**	**0.16**	**4.30**
PUS	F4 = Sri Laxman Singh	IPM	6.0(2.5)b	3.1(1.6)b	5894(77)a
		FP	10.6(3.3)a	4.3(1.9)a	4039(63)b
LSD (0.05; 28df)			**0.11**	**0.10**	**7.58**
Treatments					
IPM			4.3(2.0)b	4.9(1.9)a	5592(75)a
FP			8.0(2.7)a	2.5(1.5)b	4456(67)b
LSD (0.05,112)			**0.12**	**0.06**	**1.85**
DAT					

D1 = 29/45 DAT	7.7(2.6)a	5.3(2.0)a	
D2 = 50/60 DAT	6.5(2.5)a	5.0(2.0)a	
D3 = 71/75 DAT	5.4(2.3)b	2.4(1.4)b	
D4 = Pre har	5.1(2.3)b	2.1(1.3)b	
LSD (0.05,112)	**0.17**	**0.08**	

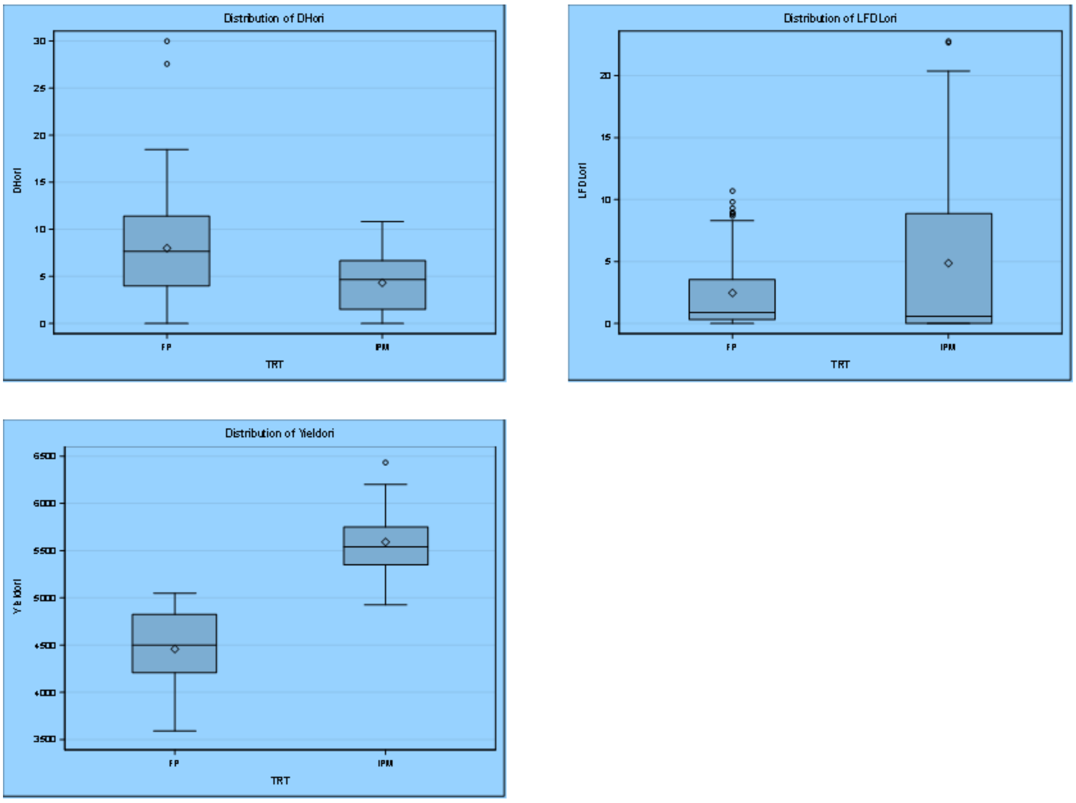


Figure 2.7.2 Incidence of dead hearts, leaf folder damage, and grain yield in IPM and FP plots across locations in Zone III (Eastern areas)

At Chinsurah, significant decrease in weed population by 43.5 and 33.6% and weed dry biomass by 44.6 and 36.8% respectively in IPM implemented fields, resulted in higher growth, yield attributes and grain yield advantage increase by 25.1% of the variety Swarna **(Table 2.7.8)**. At Pusa, the weed population at 30 DAT & 60 DAT in IPM plots was lower than farmers practice by 18.1 and 16.7 %, respectively. The dry weed biomass also was lower in IPM implemented fields by 18.0 and 13.2 %, respectively. The mean grain yield advantage was 25% in IPM adopted plots. Overall, in the eastern zone, yield advantage of 25 % was recorded in IPM implemented fields. The weed population was reduced by 38.8% at 30 DAT and 31.1% at 60 DAT in IPM fields. The reduction in weed biomass was 26.8% at 30 DAT and 22.7% at 60 DAT.

Table 2.7.8 Weed population and weed dry mass at Zone III, *Kharif* 2022

Location	Treatments	Weed population no/m^2		Weed dry biomass g/m^2	
		30 DAT	60 DAT	30 DAT	60 DAT
Chinsurah	IPM	34.4(5.9)	56.0(7.5)	4.4	7.4
	FP	60.8(7.8)	84.4(9.2)	7.9	11.7
	Mean	6.8	8.3	6.1	9.5

	CD (0.05)	**0.93**	**1.01**	**1.30**	**1.93**
Pusa	IPM	11.1(3.4)	12.3(3.6)	12.9	14.9
	FP	13.6(3.8)	14.7(3.9)	15.8	17.2
	Mean	3.6	3.7	14.3	16.0
	CD (0.05)	**0.18**	**0.16**	**1.34**	**1.17**

Disease incidence was recorded at Chiplima and Masodha in this zone. Adoption of IPM Practices like seed treatment with *Trichoderma* @10g/kg recorded low disease severity (6.3 %) at 30 DAT for leaf blast as compared to farmers practices (without the seed treatment & fungicide spray) where in the disease severity was 17.3%. In case of brown spot disease, disease severity was reduced from 15.3 to 12.2% at 60 DAT. Significant reduction in the disease development of leaf blast, neck blast and bacterial blight was recorded at Masodha. Adoption of IPM practices reduced the disease severity of leaf blast and sheath blight to almost nil as compared to farmers practices. With respect to neck blast, bacterial blight, the AUDPC values *viz.*, 287 and 274 were reduced to 172 and 78 respectively **(Table 2.7.9**).

Grain yield was significantly high in IPM plots (5592 kg/ ha) as compared to FP plots (4456 kg/ ha. BC ratio was high in IPM plots (2.13) due to high grain yield resulting in high gross returns and low cost of cultivation compared to FP plots **(Table 2.7.10).**

Table 2.7.9 AUDPC values based on disease severity (%) in Zone III, *Kharif* 2022

Treatment	Chiplima		Masodha			
	Disease severity (%)	AUDPC values	AUDPC Values			
	Leaf Blast	Brown spot	Leaf blast	Neck blast	Bacterial Blight	Sheath blight
IPM	6.3	12.2	0	172	78	0
FP	17.3	15.3	245	287	274	131.6

Table 2.7.10 Returns and BC ratio in IPMs trial in Zone III (Eastern areas), *Kharif* 2022

Location	Farmer's Name	Treat ments	Yield (q/ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs)	Net Returns (Rs.)	BC Ratio
CHP	F1 = Sri Tarakanta Pradhan	IPM	53.58	103945	50470	53475	2.06
		FP	46.20	89628	48290	41338	1.86
CHN	F2 = Sri Narayan Chandra Mondal	IPM	55.28	107243	64205	43038	1.67
		FP	48.72	94517	65820	28697	1.44
MSD	F3 = Sri Ram Dheeraj	IPM	55.88	108407	51860	56547	2.09
		FP	42.92	83265	32810	50455	2.54
PSA	F4 = Sri Laxman Singh	IPM	58.94	120238	44220	76018	2.72
		FP	40.39	82396	35310	47086	2.33
		IPM	**55.92**				**2.13**
		FP	**44.56**				**2.04**

Price of paddy at CHP, CHN & MSD= 1940 Rs/ q; at PSA = Rs. 2040/q

Zone IV – North-Eastern areas

Assam – Titabar: In zone IV, IPMs trial was conducted at Sri Ranjan Das field at Dihingia village, Titabar/Jorhat district of Assam. Ranjit sub-1 variety was grown in both IPM and FP plots. Practices followed in IPM and farmers' practices are given in the table.

Low incidence of stem borer, gall midge, leaf folder, and whorl maggot was observed in both IPM and FP plots (**Table 2.7.11)**. However, grain yield was relatively high in IPM plot resulting in high net returns and better BC ratio (1.97) as against FP plot (1.67) (**Table 2.7.12**).

Practices followed in IPMs trial at Titabar in Zone IV (North Esatern), *Kharif* 2022

	IPM Practices	Farmers Practices
Variety	Ranjit Sub-1	Ranjit Sub-1
Nursery	• Seed treatment with Bavistin @ 2 g/ kg seed	
Main field	• Fertilizer application @ 20, 10, 10 kg NPK/ha • Applied Pretilachlor within a week of transplanting • Applied paddy weeder to lessen weeds • Installed pheromone traps @ 12/ ha for stem borer • Applied Cartap hydrochloride 50% SC for stem borer management • Placed tricho cards for stem borer and leaffolder management • Sprayed fresh cowdung solution @200g/L water at mid tillering stage against BLB	• Fertilizer application @ 60,20,40 kg NPK/ha • Manual weeding done two times

Table 2.7.11 Insect pest incidence in IPMs trial at Titabar in Zone IV (North Eastern), *Kharif 2022*

Treatments	% DH		% WE	% SS	%LFDL	% WMDL
	22 DAT	36 DAT	Pre har	50 DAT	22 DAT	57 DAT
IPM	8.1 ± 3.4	3.4 ± 0.6	3.4 ± 0.9	2.3 ± 1.0	4.2 ± 2.6	1.3 ± 0.5
FP	9.8 ± 2.5	8.3 ± 1.5	7.1 ± 0.6	4.6 ± 0.7	3.6 ± 1.5	6.0 ± 0.6

In this Zone, weed population and biomass were reported for 30 DAT only. Significant reduction in weed population (44.3%) and dry weed biomass (40%) at 30 DAT in IPM fields were observed with the Ranjit Sub1 variety **(Table 2.7.12)**. Significant improvement in grain yield was noticed with 21.4 % higher in IPM-adopted fields.

Table 2.7.12 Weed parameters, Gross returns and BC ratio in IPMs trial at Titabar, *Kharif* 2022

Treatments	Weed population no/m^2	Weed dry biomass g/m^2	Yield (Q/Ha)	Gross Returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC ratio
	30 DAT	30 DAT					
IPM	38.2(6.2)	17.9	45.62	88503	45000	43503	1.97
FP	68.6(8.3)	29.8	32.68	63399	38000	25399	1.67
Mean	7.3	23.8					
CD (0.05)	**0.79**	**9.02**					

Price of paddy = Rs. 1940/q

Zone V – Central areas

In this zone, IPMs trial was conducted at three farmer's fields each in two locations, *viz.*, Jagdalpur and Raipur and details are given below:

S. No	State	Location	Village/district	Farmer Name
1	Chattisgarh	Jagdalpur	Chokar /Bastar	Sri. Sonu Kashyap
2	Chattisgarh	Jagdalpur	Marlenga/ Bastar	Sri Lachin Kashyap
3	Chattisgarh	Jagdalpur	Chokar/Bastar	Sri Sonsingh Nisad
4	Chattisgarh	Raipur	Bhothali/Arang/Raipur	Sri Bhagwat Yadav
5	Chattisgarh	Raipur	Bhothali/Arang/Raipur	Sri Yogendra Yadav
6	Chattisgarh	Raipur	Bhothali/Arang/Raipur	Sri Vedprakash Yadav

The package of practices followed in IPM and FP plots is given in the table below. The incidence of stem borer, gall midge, leaf folder, whorl maggot, and thrips was reported from all the locations **(Table 2.7.13).**

Practices followed in IPMs trial at Zone V (Central), *Kharif* 2022

	IPM Practices	Farmers Practices
Practices followed by three farmers at Jagdalpur		
Area	1 acre each farmer	1 acre each farmer
Variety	Swarna (MTU 7029)	Swarna (MTU 7029)
Nursery	• Application of 5 kg N, 3 kg P, 1.2 kg K / 400m^{2}nursery	• Application of 2 kg N, 1 kg P / 400m^2 nursery
Main field	• Application of 50 kg DAP, 50 kg Urea, 10 kg MOP • Seedlings transplanted at spacing of 20/15 cm; Left alleyways of 30 cm after 10 rows. • Applied Pyrazosulfuron ethyl 10 wp 500gm./ha+ 1 hand weeding • Nitrogen top dressing at 45 DAT	• Application of 50 kg DAP, 100 kg Urea • Applied Carbofuran 3G @ 5kg/acre • Hand weeding twice
Practices followed by three farmers at Raipur		
Area	3 acres (1 acre each farmer)	1 acre
Variety	• MTU 1001	• MTU 1001
Nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed and seedling treatment with carbofuran • Application of 10 kg urea	• Application of 10 kg urea
Main field	• Application of 50 kg DAP, 15 kg MOP & 50 kg Urea • Alley ways of 30 cm after every 2 m • Early stage weed control (Sathi - pyrazosulfuron ethyl & Nominee Gold – bispyriback sodium) Regular monitoring • Installation of pheromone traps • Need based application of cartap hydrochloride and hexaconazole	• Application of 50 kg DAP, 50 kg Urea / acre • Random planting • Application of Profenophos + Cypermethrin • Spraying of Propiconazole 25 EC @ 1ml/ liter •

Table 2.7.13 Insect Pest incidence in IPMs trial in Zone V (Central), *Kharif* 2022

Location	Farmer Name	Treat	%DH/WE	% SS	% LFDL	% WMDL	%THDL	Yield kg/ha
JDP	F1 = Sri Sonu Kashyap	IPM	3.7(1.9)b	11.3(3.4)b	3.5(2.0)b	7.3(2.7)a	8.2(2.9)b	4444(67)a
		FP	9.8(3.1)a	37.2(6.1)a	8.4(2.9)a	7.7(2.8)a	12.6(3.6)a	3666(61)a
LSD (0.05, 44df)			**0.32**	**0.39**	**0.18**	**0.26**	**0.21**	**6.39**
JDP	F2 = Sri Lachin Kashyap	IPM	3.8(1.9)b	10.3(3.0)b	3.2(1.8)b	5.0(2.2)b	6.8(2.7)b	4304(66)a
		FP	17.3(4.0)a	27.5(5.2)a	7.4(2.8)a	11.2(3.4)a	14.3(3.8)a	3380(58)a
LSD (0.05,44 df)			**0.38**	**0.46**	**0.18**	**0.29**	**0.25**	**7.73**
JDP	F3 = Sri Sonsingh Nisad	IPM	6.1(2.4)b	9.9(3.1)b	2.9(1.8)b	3.4(1.9)b	2.2(1.6)b	3847(62)a
		FP	16.9(4.0)a	15.3(3.9)a	3.7(2.0)a	5.5(2.4)a	8.9(3.0)a	3432(58)a
LSD (0.05,44 df)			**0.38**	**0.45**	**0.17**	**0.24**	**0.21**	**6.17**
RPR	F4 = Sri Bhagwat Yadav	IPM	6.1(2.3)b		1.7(1.4)b			7108(84)a
		FP	20.0(4.4)a		6.6(2.6)a			6328(79)a
LSD (0.05,44 df)			**0.56**		**0.28**			**5.93**
RPR	F5 = Sri Yogendra Yadav	IPM	8.4(2.8)b		1.8(1.5)b			
		FP	20.0(4.3)a		6.6(2.6)a			
LSD (0.05,44 df)			**0.47**		**0.22**			
RPR	F6 = Sri Vedprakash Yadav	IPM	11.2(3.3)b		1.0(1.2)b			
		FP	20.1(4.4)a		6.6(2.6)a			
LSD (0.05,44 df)			**0.46**		**0.23**			
Treatments								
T1 = IPM			6.5(2.4)b	10.5(3.2)b	2.3(1.6)b	5.3(2.3)b	5.7(2.4)b	5653(74)a
T2 = FP			17.4(4.0)a	26.7(5.0)a	6.6(2.6)a	8.1(2.9)a	11.9(3.5)a	4910(69)b
LSD (0.05,264)			**0.17**	**0.24**	**0.08**	**0.15**	**0.12**	**1.94**
DAT								
D1 = 30 DAT			5.2(2.1)d			3.6(1.9)b		
D2 = 45 DAT			9.0(2.9)c	14.7(3.7)b	3.4(1.9)c	7.8(2.8)a	8.1(2.8)b	
D3 = 60 DAT			10.5(3.1)c	21.3(4.5)a	5.5(2.3)a	8.6(3.0)a	9.7(3.1)a	
D4 =75 DAT			12.5(3.4)b	22.8(4.7)a	4.8(2.2)a		8.6(2.9)b	

D5 = 90 DAT	14.6(3.6)b	15.5(3.6)b	4.2(2.0)b			
D6 = Pre har	19.9(4.3)a					
LSD (0.05,264 df)	**0.30**	**0.34**	**0.12**	**0.18**	**0.15**	

Stem borer incidence was significantly high in all the farmers' fields in FP plots compared to IPM plots and the mean of all the locations indicated 17.4% damage in farmer practices as compared to IPM plots (6.5%) (**Figure 2.7.3**). The incidence of gall midge, whorl maggot and thrips was observed in three farmers' fields at Jagdalpur alone and not at Raipur. Gall midge incidence was very high in FP plots in all the three farmers' fields (15.3 – 37.2% SS) as against IPM plots (9.9-11.3% SS). Thrips incidence was significantly high in farmer practices plots (11.9% THDL) compared to IPM plots (5.7% THDL) across locations **(Figure 2.7.3).**

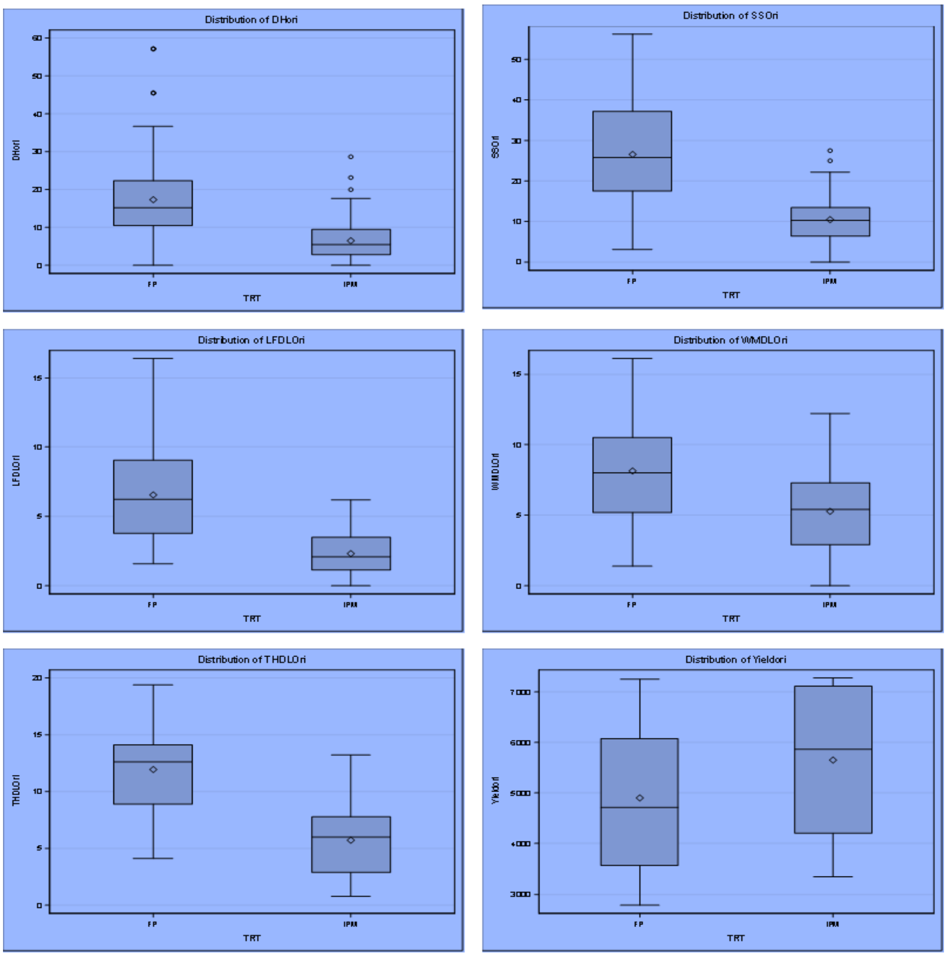


Figure 2.7.3 Incidence of stem borer, gall midge, leaf folder, whorl maggot, thrips damage and grain yield in IPM and FP plots across locations in Zone V (Central areas)

In this Zone, weed parameters were recorded only at Raipur. In IPM plots, the weed population was lower than farmers practice by 22.5 & 22.7% at 30 and 60 DAT, respectively. The dry weed biomass also was lower in IPM implemented fields by 15.7 and 18.2%, respectively (**Table 2.7.14**). The mean grain yield advantage was 10.97% in IPM adopted plots.

Table 2.7.14 Weed population and weed dry mass at Raipur in Zone V, *Kharif* 2022

Treatments	Weed population (no/m²)		Weed dry biomass (g/m²)	
	30 DAT	60 DAT	30 DAT	60 DAT
IPM	13.28(3.69)	23.90(4.93)	8.78	35.99
FP	17.14(4.16)	30.92(5.59)	10.41	43.98
Mean	3.93	5.26	9.59	39.99
CD (0.05)	**0.24**	**0.29**	**0.51**	**3.27**

Under Central zone, disease incidence was recorded only at Jagdalpur**,** wherein IPM practices and Farmers practices were compared for the management of leaf blast, neck blast and sheath blight. In general, the disease progress was significantly low in the IPM adopted field compared to the farmers practices. With respect to leaf blast, the AUDPC values ranged from 0 to 141 in the IPM adopted field, whereas the values varied from 84 to 426 in the farmers practices. Similar trend was also observed in case of neck blast wherein the AUDPC values ranged from 0 to 135 as against 135 to 411 in farmers adopted practices. Similarly, sheath blight disease severity also reduced significantly wherein the AUDPC values reduced from 225 to 42, 444 to 279 and 363 to 219 (**Table 2.7.15**).

Table 2.7.15 AUDPC values at Jagdalpur in Zone V in IPMs trial , *Kharif* 2022

Location	Treatment	AUDPC Values		
		Leaf Blast	Neck blast	Sheath blight
Location 1	IPM	0	48	42
	FP	173	159	225
Location 2	IPM	141	0	279
	FP	426	411	444
Location 3	IPM	0	135	219
	FP	84	213	363

Grain yield was significantly high in IPM plots as compared to FP plots resulting in higher gross returns and better BC ratio (**Table 2.7.16**).

Table 2.7.16 Returns and BC ratio in IPMs trial at Zone V (Central), *kharif* 2022

Location	Name of the Farmer	Treat ments	Yield (q/ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC ratio
JDP	F1 = Sri Sonu Kashyap	IPM	44.44	93324	20750	72574	4.50
		FP	36.66	76986	26750	50236	2.88
JDP	F2 = Sri Lachhin Kashyap	IPM	43.04	90384	20750	69634	4.36
		FP	33.8	70980	27500	43480	2.58
JDP	F3 = Sri Sonsingh Nisad	IPM	38.47	80787	20750	60037	3.89
		FP	34.32	72072	27500	44572	2.62
RPR	F4 = Sri Bhagwat Prasad	IPM	71.08	145003	25450	119553	5.70
		FP	63.28	129091	30075	99016	4.29
		IPM	**49.26**				**4.61**
		FP	**42.02**				**3.09**

Price of Paddy = F1, F2 & F3 = Rs. 2100/q; F4 = Rs. 2040/q

Zone VI – Western areas

IPMs trial was conducted in nine farmers' fields representing 3 locations in this zone as given under:

S. No	State	Location	Village/district	Farmer Name
1	Maharashtra	Karjat	Vadap village	F1- Sri Kailash Dalvi
2	Maharashtra	Karjat	Gourkamat/Raigad	F2 - Sri Ashok Thamane
3	Maharashtra	Karjat	Salokh/Raigad	F3- Sri Ashok Mokashi
4	Gujarat	Navasari	Eru,Abrama, Hanspur/Navsari	F4 = Sri Eru
5	Gujarat	Nawagam	Nawagam/ Kheda	F5 - Sri Shaileshbhai Bhulabhai Patel
6	Gujarat	Nawagam	Kathwada/ Kheda	F6 - Sri Vipulbhai Jayantibhai Bharwad
7	Gujarat	Nawagam	Kathwada/ Kheda	F7 - Sri Rakeshbhai Ramsangbhai Chunara

The package of practices followed are given in the following table.

Package of practices followed in IPMs trial in Zone VI (Western), *Kharif* 2022		
Practices followed by three farmers in IPMs trial at Karjat, *Kharif* 2022		
	IPM practices	**Farmers practices**
Area	1 acre	1 acre
Varieties	F1- Sri Kailash Dalvi - Karjat 7 F2 - Sri Ashok Thamane - Karjat 7 F3- Sri Ashok Mokashi – Karjat 7	
Nursery	Seed treatment with carbendazim @ 10 g/ 10 kg seed Raised bed 3x1m treated with rice husk (hull) ash @3kg/bed	Land burned with waste materials
Main field	• Deep ploughing • Application of FYM 4 T, Suphala 215 Kg, Urea 87 Kg • 2-3 seedlings transplanted at a spacing 20 x15 cm. • Alleyways of 40cm left after every 10 rows • Bispyribasodium 250ml/ha (Nomini gold). • Pheromone traps @ 8 / acre • Use of bird perches in the field • Use Vaibhav sickle for harvesting • Application of Cartap hydrochloride 18 kg/ha (one application)	• Deep ploughing • Application of FYM 2 T, Urea 180 kg, Suphala 75 kg • 4-5 seedlings transplanted randomly • Hand weeding once • Phorate 10 kg/ha (two applications)
Practices followed by three farmers in IPMs trial at Nawagam, *Kharif* 2022		
Area	1250 sq.m	1250 sq.m
Variety	Gurjari	Gurjari
Farmers	F5 - Sri Shaileshbhai Bhulabhai Patel F6 - Sri Vipulbhai Jayantibhai Bharwad F7 - Sri Rakeshbhai Ramsangbhai Chunara	
Nursery	• Seed treatment with Trichoderma @ 10 g/kg seed • Applied Bispyribacsodium 10% SC @ 0.4ml/L	• Application of Chlorantraniliprole 0.4 GR @ 10 kg/ha
Main field	• Application of 80 kg urea, 54 kg DAP and 20 kg Zinc sulphate • 2-3 seedlings transplanted at a spacing 20 x15 cm. • Alleyways of 40cm left after every 10 rows • Bispyribasodium 10% SC @ 0.4 ml/ liter water (Nomini gold). • Applied Neemazal @ 3 ml/ liter waterUse of bird perches in the field • Sprayed Chlorantraniliprole 18.5 SC @ 150 ml/ ha • Applied Carbendazim + mancozeb @ 2-2.5 g/lit • Applied Triflumezopyrim 10% SC @ 94 ml/ acre	• Application of 160 kg urea, 160 kg DAP and 20 kg Zinc sulphate • 4-5 seedlings transplanted randomly • Applied Pendimethalin 30% EC @ 50 ml/ 10 liter water • Hand weeding • Applied Bispyribasodium 10% SC @ 0.4 ml/ liter water (Nomini gold). • Applied Cartap hydrochloride 4 G @ 20 kg/ha

The incidence of stem borer, leaf folder, and WBPH was observed in this zone. The overall pest incidence was very low in both treatments across locations in this zone.

However, the damage was significantly lower in IPM compared to FP plots (**Table 2.7.17and Figure 2.7.4**).

Table 2.7.17 Insect Pest incidence in IPMs trial in Zone VI (Western), *Kharif* 2022

Treatments			%DH/WE	% LFDL	WBPH	Yield kg/ha
KJT	F1- Sri Vadap	IPM	3.4(1.8)b	1.0(1.2)b		3298(58)a
		FP	5.3(2.2)a	1.5(1.4)a		2700(52)b
LSD (0.05, 36df)			**0.13**	**0.16**		**1.88**
KJT	F2 - Sri Gourkamat	IPM	2.7(1.6)b	1.9(1.5)a		3348(58)a
		FP	3.6(1.9)a	2.0(1.5)a		2748(52)b
LSD (0.05, 36df)			**0.21**	**0.25**		**1.11**
KJT	F3- Sri Salokh	IPM	3.1(1.8)b	2.6(1.7)a		3100(56)a
		FP	4.4(2.1)a	1.7(1.5)b		2548(51)b
LSD (0.05, 36df)			**0.22**	**2.00**		**1.36**
NVS	F4- Sri Bhanubhai Patel	IPM	3.2(1.7)b	2.6(1.7)b		4792(69)a
		FP	5.8(2.4)a	5.1(2.3)a		3656(60)b
LSD (0.05, 36df)			**0.47**	**0.45**		**4.73**
NWG	F5 - Sri Shaileshbhai Bhulabhai Patel	IPM	4.4(2.1)b	2.6(1.7)b	14(4)b	5158(72)a
		FP	6.3(2.5)a	4.2(2.1)a	23(5)a	4154(64)a
LSD (0.05, 36df)			**0.13**	**0.18**	**0.39**	**9.27**
NWG	F6 - Sri Vipulbhai Jayantibhai Bharwad	IPM	5.0(2.3)b	3.5(1.9)b	16(4)b	4934(70)a
		FP	6.8(2.6)a	5.2(2.2)a	23(3)a	4297(65)a
LSD (0.05, 36df)			**0.13**	**0.24**	**0.24**	**8.75**
NWG	F7 - Sri Rakeshbhai Ramsangbhai Chunara	IPM	5.5(2.4)b	2.9(1.8)b	17(4)b	4920(70)a
		FP	6.7(2.6)a	4.3(2.1)a	20(4)a	4015(63)b
LSD (0.05, 36df)			**0.13**	**0.12**	**0.22**	**2.69**
Treatments						
T1 = IPM			3.9(7.0)b	8.4(6.2)b	16(9)b	4221(45)a
T2 = FP			5.6(8.1)a	11.9(7.1)a	22(10)a	3445(41)b
LSD (0.05,252)			**0.21**	**0.27**	**0.36**	**0.49**
DAT						
D1 = 29 DAT			6.6(5.7)d	2.0(5.7)c	5(2)b	
D2 = 36 DAT			10.5(7.1)c			
D3 = 50 DAT			18.7(9.3)a	2.5(6.3)b	29(5)a	
D4 = 71 DAT			11.4(7.9)b	4.3(7.9)a	37(2)b	
D5 = 85 DAT			10.5(7.7)b			
LSD (0.05,252)			**0.33**	**0.33**	**0.23**	

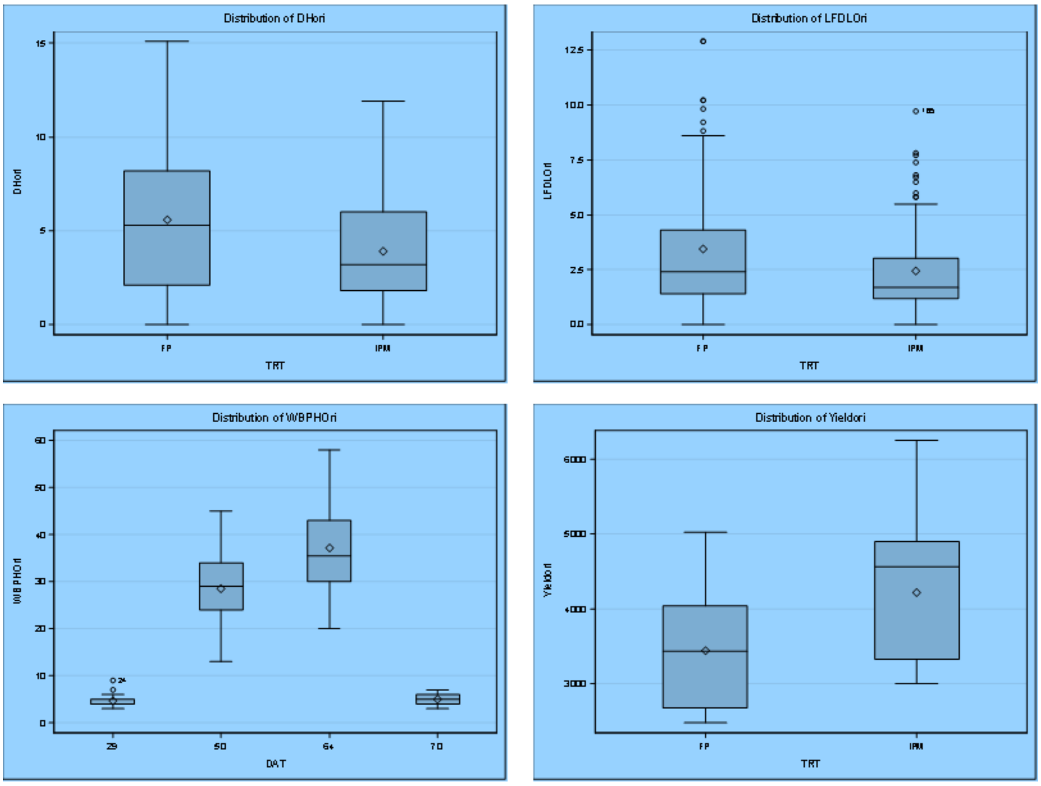


Figure 2.7.4 Incidence of dead hearts, leaf folder damage, WBPH, and grain yield in IPM and FP plots across locations in Zone VI (Western areas)

Weed parameters were recorded from three locations, Karjat, Navsari and Nawagam. At Karjat, the weed population in IPM plots was lower than farmers practice by 18.8 at 30 DAT. The dry weed biomass was also lower in IPM implemented fields by 100%. The mean grain yield advantage was 17.1 % in IPM adopted plots. Significant reduction in weed population (51.5 and 39.5%) and dry weed biomass (48.3 and 35.4%) at 30 and 60 DAT in IPM implemented fields was experienced with variety GNR3 at Navsari. Significant improvement in grain yield advantage was noticed with 5.2% higher in IPM adopted fields. At Nawagam, significant reduction in weed population (62.4 and 54.8%) and dry weed biomass (68.7 and 59.6%) was observed at 30 and 60 DAT in IPM implemented fields with Gurjari variety (**Table 2.7.18**). Significant grain yield advantage noticed with 16.8% higher in IPM adopted fields.

Overall, in this Western Zone, adoption of IPM package resulted in yield advantage of 21.0% over the farmers practice. The weed population in IPM implemented fields was lower by 63.3% at 30 DAT and 56.1% at 60 DAT. The reduction in weed dry biomass was 69.7% at 30 DAT and 60.0 at 60 DAT.

Table 2.7.18 Weed population and weed dry mass in Zone VI in IPMs, *Kharif* 2022

Location	Treatments	Weed population (no/m²)		Weed dry biomass (g/m²)	
		30 DAT	60 DAT	30 DAT	60 DAT
Navsari	IPM	6.6(2.6)	15.6(4.0)	9.2	20.5
	FP	13.6(3.7)	25.8(5.1)	17.7	31.7
	Mean	3.2	4.6	13.4	26.1
	CD (0.05)	**0.54**	**0.25**	**4.41**	**2.79**
Nawagam	IPM	102.2(10)	79.64(8.84)	48.9	39.9
	FP	271.5(16.2)	176.34(13.08)	156.4	98.9
	Mean	13.1	11.0	102.6	69.4
	CD (0.05)	**2.16**	**1.40**	**33.52**	**15.67**
Karjat	IPM	2.6(1.7)		0.0	
	FP	3.2(1.9)		3.1	
	Mean	1.8		1.6	
	CD (0.05)	**0.13**		**0.69**	

Under this zone, disease incidence was reported only from Nawagam from three different locations for the management of sheath rot and grain discolouration. The AUDPC value was reduced due to the adoption of IPM practices (IPM = 308 – 311; FP = 349 - 366). Similarly, disease progress was low in case of grain discoloration (AUDPC units in IPM = 119 - 128; FP = 145 - 153) in the IPM practices adopted field (**Table2.7.19**).

Table 2.7.19 AUDPC values based on disease severity (%) at Nawagam in IPMs, *Kharif* 2022

Treatment	Nawagam							
	AUDPC Values							
Location 1	Sheath rot	GD	Location 2	Sheath rot	GD	Location 3	Sheath rot	GD
IPM	311	122	IPM	308	119	IPM	322	128
FP	349	146	FP	346	153	FP	366	145

GD = Glume Discolouration

IPM practices have resulted in grain yield that was significantly high (4221 kg/ha) compared to FP plots (3445 kg/ha). The higher gross returns and low cost of cultivation in IPM plots led to a high BC ratio across the locations (**Table 2.7.20**).

Table 2.7.20 Returns and BC ratio in IPMs trial at Zone VI (Western), *Kharif* 2022

Location	Farmers	Treat ments	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
KJT	F1- Sri Vadap	IPM	32.98	89046	58637	30409	1.52
		FP	27.00	72900	62200	10700	1.17
KJT	F2 - Sri Gourkamat	IPM	33.48	90396	59337	31059	1.52
		FP	27.48	74196	63200	10996	1.17
KJT	F3- Sri Salokh	IPM	31.00	83700	57337	26363	1.46
		FP	25.48	68796	60200	8596	1.14
NVS	F4- Sri Bhanubhai Patel	IPM	47.92	81464	39000	42464	2.09
		FP	36.56	62152	24000	38152	2.59
NWG	F5 - Sri Shaileshbhai Bhulabhai Patel	IPM	51.58	95423	63488	31935	1.50
		FP	41.54	76849	52928	23921	1.45
NWG	F6 - Sri Vipulbhai Jayantibhai Bharwad	IPM	49.34	91279	63728	27551	1.43
		FP	42.97	79495	46608	32887	1.71
NWG	F7 - Sri Rakeshbhai Ramsangbhai Chunara	IPM	49.20	91020	63368	27652	1.44
		FP	40.15	74278	52528	21750	1.41
		IPM	**42.21**				**1.57**
		FP	**34.45**				**1.52**

Price of Paddy = F1, F2, F3 = Rs. 2700/q; F4 = Rs. 1700/q; F5, F6 & F7 = Rs. 1850/q

Zone VII – Southern areas

IPMs trial was conducted at 8 farmers' fields in 4 locations in this zone and the details of farmers and villages are given below:

Zone VII				
S. No	**State**	**Location**	**Village/district**	**Farmer Name**
1	Karnataka	Mandya	Ganadalu/ Mandya	F1 – Sri Mahadevu
2	Karnataka	Mandya	Ganadalu/ Mandya	F2 - Sri Jayaramu
3	Karnataka	Mandya	Mallanayakanakatte/ Mandya	F3 – Sri Puttaswamy
4	Tamil Nadu	Aduthurai	Melamaruthuvakudi/Thanjavur	F4- Sri K Marimuthu
5	Tamil Nadu	Aduthurai	Thiruneelakudi/Thanjavur	F5 - Sri Manoharan
6	Tamil Nadu	Aduthurai	Aduthurai/Thanjavur	F6- Sri Rajavel
7	Karnataka	Gangavathi	Sharanabasaveshwar camp/ Koppal	F7 – Sri Surya Rao
8	Telangana	Rajendranagar	Peddashapur/ Ranga Reddy	F8 – Sri Krishna Patel
9	Telangana	Rajendranagar	Peddashapur/ Ranga Reddy	F9 – Sri Eshwariah

The IPM practices followed by various farmers is given below:

Practices followed in IPMs trial at Aduthurai, *Kharif* 2022

	IPM practices	Farmers practices
Area/ variety	1 ha; CR 1009, ADT 54, ADT 51	1 ha; CR 1009, ADT 54, ADT 51
Nursery	• Seed treatment with carbendazim @ 2g / kg seed	
Main field	• Transplanting the seedlings at a spacing of 20 x 15 cm. • Leaving alleyways of 30 cm after every 2 m or 10 rows. • Fertilizers applied as per local recommended fertilizer dose. • Application of Butachlor 1.5 kg a.i./ ha within one week after transplanting the crop. • At 15 DAT, installed pheromone traps with 5 mg lure @ 8 traps/ha for stem borer monitoring • One spray of Cartap hydrochloride 50 WP @ 600 g /ha at 60 DAT • Application of Propiconazole	• Five rounds of insecticides followed due to gall midge, stem borer, leaf folder and BPH incidence. • Thiamethoxam 100 g/ha at 25 DAT for thrips • Chlorantraniliprole 18.5 SC @ 150 ml/ha at 45 DAT for stem borer and leaf folder • Profenophos 20 EC @ 1000ml/ha at 70 DAT for stem borer and leaf folder • Applied Cartap hydrochloride 10kg/ha • Sprayed Copper oxy chloride, Mancozeb+ carbendazim (saaf), Propiconozole

Practices followed in IPMs trial at Gangavathi, *Kharif* 2022		
Area	1 acre	1 acre
Variety	BPT 5204	BPT 5204
Main field	• Seed treatment with Carbandezim @ 2g / kg seed • Fertilizer application @ 60:30:30 kg NPK /ha • Forming alleyways of 30 cm • Grown marigold on bunds • Installation of pheromone traps @ 8 traps/ ha • Sprayed Chlorpyriphos 20 EC @ 2ml / liter at 45 DAT • Followed alternate wetting and dring • Sprayed Tilt (Propiconazole) @ 1ml / liter water • Sprayed Metarhizium @ 2 g/ liter water at 60 DAT • Application of Triflumezopyrim @ 94 ml / acre at 60 DAT	• Fertilizer application @ 120:60:60 kg NPK /ha • Application of weedicide, Butachlor @ 400 ml/ac • Application of Ferterra @ 4 kg at 25 DAT • Sprayed Chlorpyriphos 20 EC @ 2ml / liter at 50 DAT • Application of Triflumezopyrim @ 94 ml / acre at 60 DAT • Sprayed Merger (Tricyclazole + Mancozeb) @ 2 g / liter water at 45 DAT • Sprayed Tilt (Propiconazole) @ 1ml / liter water at 65 DAT • Sprayed Nativo (Trifloxystrobin + Tebiconazole) at 85 – 90 DAT

Practices followed in IPMs trial at Mandya, *Kharif* 2022		
Sri Mahadevu, Ganadalu village, Mandya district, Karnataka		
Area	1 acre	1 acre
Variety	Sowbhagya	Sowbhagya
Nursery	• Seed treatment with Carbandezim @ 2g / kg seed	

Main field	• Urea 45 kg/ acre, SSP 125 kg/ acre, MOP 35 kg/ acre, Top dressing 45 kg urea • Transplanting with 20 x 15cm spacing • Forming alleyways of 30 cm • Londax power @ 4kg/ac - herbicide at 3 DAT + one hand weeding • Installation of pheromone traps 5 mg lure for monitoring stem borer @ 8 traps / ha • Application of Cartap hydrochloride 50 WP @ 240 g/ acre at 60 DAT • Zinc sulphate @ 8 kg/ acre and Tricyclazole 75WP @ 0.6g/lit • Followed alternate wetting and drying	• Urea 50 kg/ acre, 10:26:26 complex fertilizer 100 kg/ ac, MOP 25 kg/ acre • Random transplanting • Applied Butachlore @ 1.2lit/ace @ 400 ml/ acre (Refit) + two hand weedings • Carbofuran 4G application @ 8 kg/ acre • Chlorpyriphos 20 EC@ 2ml/l • Propiconazole 25 EC @ 1 ml/ litre • Dinotefuran 20 SG @ 250 g/ ha at 70 DAT
Sri Jayaramu, Ganadalu village, Mandya district, Karnataka		
Area	1 acre	1 acre
Variety	Jyothi	Jyothi
Nursery	• Seed treatment with Carbandezim @ 2g / kg seed	
Main field	• Urea 45 kg/ acre, SSP 125 kg/ acre, MOP 35 kg/ acre, Top dressing 45 kg urea • Transplanting with 20 x 15cm spacing • Forming alleyways of 30 cm • Londax power @ 4kg/ac - herbicide at 3 DAT + one hand weeding • Installation of pheromone traps for monitoring stem borer @ 8 traps / ha • Application of Fipronil 0.3G @ 10 kg/acre • Sprayed Tricyclazole 75 WP @ 0.6g/ liter water • Zinc sulphate @ 8 kg/ acre • Alternate wetting and drying	• Randomly transplanted • Londax power @ 4 kg/ acre + 2 hand weedings • Chlorantraniliprole 0.4 GR @ 4kgl/acre • Cartap hydrochloride 50SP @ 2gm/l (400g/ acre) • Azoxystrobin + Difenconazole (amistar top) @1ml/lit • Imidacloprid17.8SL@0.3ml/lit • Continuous irrigation
Sri Puttaswamy, Mallanayakanakatte village, Mandya district Karnataka		
Area	1 acre	1 acre
Variety	Jaya	Jaya
Nursery	• Seed treatment with Carbandezim @ 2g / kg seed	
Main field	• Urea 45 kg/ acre, SSP 125 kg/ acre, MOP 35 kg/ acre, Top dressing 45 kg urea • Transplanting with 20 x 15cm spacing • Forming alleyways of 30 cm • Londax power @ 4kg/ac - herbicide at 3 DAT + one hand weeding • Installation of pheromone traps for monitoring stem borer @ 8 traps / ha • Application of Fipronil 5SC@1.5ml/lit • Sprayed Tricyclazole 75 WP @ 0.6g/ liter water • Zinc sulphate @ 8 kg/ acre • Alternate wetting and drying	• Randomly transplanted • Urea 50 kg/ acre, 10:26:26 complex fertilizer 100 kg/ ac, MOP 25 kg/ acre • Pretilachlor 50EC (Refit) @400ml/acre + 2 hand weedings • Chlorantraniliprole 18.5SC (Coragen) @ 60ml/acre • Fipronil 0.3G@10kg/acre • Tebuconozole @0.4gm/lit • Buprofezin25EC (Applaud)@1.4ml/lit • Continuous irrigation
Practices followed in IPMs trial at Rajendranagar, *Kharif* 2022		
Variety	BPT 5204	BPT 5204
Nursery	• Applied 4.4 kg urea, 6.25 kg SSP and 1.75 kg MOP • Applied Carbofuran 3G in nursery @800g/nursery sufficient to 1 acre	• Application of 6 kg urea, 8 kg SSP and 3 kg MOP
Main field	• Applied 80 kg N,90 kg P and 15 kg K • Adopted alleyways • Applied weedicide Cyhalofop butyl + Penoxulam (Vivaya) @ 1000ml/acre + one hand weeding • Applied Chlorantraniliprole @ 0.3 ml/ liter water (60ml/ acre) at panicle initiation stage • Applied fungicide Picoxystrobin + Trycyclazole (Galelio Sensa) @400ml/acre	• Application of 120 kg N, 80 kg P and 20 kg K. • Applied weedicide: Bensulfuron Methyl + Pretilachlor (Londax Power T) @ 4kg/acre at 3-5 DAT • Sprayed Chlorpyriphos @ 2.5 ml/ liter water or Sprayed Acephate 75SP @ 300g/acre in main field at tillering • Hand weeding • Sprayed Cartap hydrochloride 50SP @ 2g/l (400g/ acre) • Sprayed Tricyclazole @120g/acre or Sprayed Tebuconazole + trixystrobin (Nativo) @ 80g/acre

Incidence of stem borer, gall midge, leaf folder, caseworm, and BPH was observed in both IPM and FP plots at different locations (**Table 2.7.21**). At Aduthurai, stem borer incidence was significantly high in all three farmers' practices (35.3 – 46.1% DH) than in IPM plots (5.4 – 15.6% DH). Similarly, gall midge incidence was also initially high in IPM plots but reduced after the IPM interventions. The mean gall midge damage was significantly low in IPM plots (8.0% SS) as compared to FP plots (20.2% SS) (**Figure 2.7.5**). Leaf folder incidence was low at Mandya and Gangavathi but was significantly high at Aduthurai in FP plots (21.4 – 23.8% LFDL) than in IPM plots. A low incidence of caseworm was recorded in both IPM and FP plots at Mnadya. BPH incidence was also low across locations and treatments. Overall, in this zone, IPM plots showed significantly low stem borer, gall midge, and leaf folder damage as compared to FP plots (**Figure 2.7.5).**

Table 2.7.21 Insect Pest incidence in IPMs trial in Zone VII (Southern), *Kharif* 2022

Location	Farmer Name	Treatments	%DH/WE	% SS	% LFDL	%CWDL	BPH	Yield kg/ha
MND	F1 = Sri Mahadevu	IPM	5.2(2.2)b		1.2(1.2)b	0.8(1.1)b	3(2)b	6572(81)a
		FP	13.7(3.5)a		3.1(1.8)a	2.1(1.6)a	11(4)a	5852(77)a
LSD (0.05,28)			**0.57**		**0.21**	**0.21**	**0.41**	**8.80**
MND	F2 = Sri Jayaramu	IPM	4.9(2.1)b		2.0(1.5)b	1.6(1.4)b	3(2)b	6292(79)a
		FP	13.8(3.6)a		5.8(2.4)a	4.2(2.1)a	10(3)a	5380(73)a
LSD (0.05,28)			**0.61**		**0.22**	**0.21**	**0.30**	**14.76**
MND	F3 = Sri Puttaswamy	IPM	5.7(2.3)b		2.8(1.8)b	1.2(1.2)b	2(2)b	5900(77)a
		FP	15.7(3.9)a		6.2(2.6)a	4.2(2.1)a	6(3)a	4836(69)a
LSD (0.05,28)			**0.64**		**0.35**	**0.31**	**0.36**	**3.58**
ADT	F4 = Sri Marimuthu	IPM	8.4(2.3)b	10.9(3.0)b	6.4(2.1)b		2(1)b	6280(79)a
		FP	46.1(6.6)a	20.3(4.4)a	21.4(4.1)a		9(3)a	5174(72)b
LSD (0.05,28)			**1.21**	**0.76**	**0.41**		**0.54**	**1.04**
ADT	F5 = Sri Manoharan	IPM	15.6(6.3)b	7.2(2.5)b	6.8(2.3)b		1(1)b	
		FP	35.3(5.6)a	23.1(4.5)a	22.1(4.1)a		12(4)a	
LSD (0.05,28)			**1.21**	**0.90**	**0.57**		**0.32**	
ADT	F6 = Sri Rajavel	IPM	5.4(2.1)b	5.9(2.3)b	7.0(2.3)b		5(2)b	
		FP	43.6(6.2)a	17.2(3.9)a	23.8(4.2)a		18(4)a	
LSD (0.05,28)			**1.41**	**0.86**	**0.62**		**0.72**	
GNV	F6 = Sri Surya Rao	IPM	1.0(1.2)b		1.7(1.5)a		9(5)a	6057(77)a
		FP	3.2(1.9)a		0.6(1.0)b		21(3)b	5968(78)a
LSD (0.05,28)			**0.24**		**0.16**		**0.36**	**2.42**
RNR	F7 = Sri Krishna Patel	IPM	0.5(0.9)b					8738(93)a
		FP	2.0(1.2)a					8369(91)a
LSD (0.05,28)			**0.08**					**5.89**
RNR	F8 = Sri Eshwaraiah	IPM	0.9(1.1)b					8307(91)a
		FP	2.7(1.4)a					7489(86)b
LSD (0.05,28)			**0.25**					**4.17**
Treatments								
T1 = IPM			5.5(2.9)b	8.0(3.3)b	4.0(3.7)b	1.4(1.5)b	5(3)b	6865(46)a
T2 = FP			19.3(4.2)a	20.2(5.4)a	11.9(5.3)a	4.1(2.4)a	11(5)a	6165(43)b
LSD (0.05,252)			**0.21**	**0.59**	**0.24**	**0.17**	**0.24**	**0.49**
DAT								
D1 = 36 DAT			10.2(2.8)c	9.0(3.5)b	1.7(3.2)c	1.3(1.5)c		
D2 = 50 DAT			14.7(3.5)b	17.9(5.2)a	5.5(4.6)b	2.5(1.9)b	4(3)b	
D3 = 71 DAT			11.9(3.0)c	18.6(4.8)a	10.7(5.1)a	3.2(2.1)a	8(4)a	
D4 = Pre har			12.9(5.1)a	10.8(3.9)b	13.8(5.1)a		10(5)a	
LSD (0.05,252)			**0.29**	**0.83**	**0.33**	**0.24**		

In this zone, weed data was recorded at four locations, Coimbatore, Gangavathi, Mandya and Puducherry. At Coimbatore, the weed population in IPM plots was lower than farmers practice by 60.0 and 55.0% at 30 and 60 DAT, respectively. The weed dry biomass at 30 and 60 DAT in IPM plots was lower than farmers practice by 58.4 and 48.7%, respectively and contributed to the mean grain yield advantage of 18.2 % in IPM adopted plots with CO 52 variety. At Gangavathi, the weed population in IPM plots was lower than farmers practice by 87.0 and 62.7% at 30 and 60 DAT, respectively. Similarly, the weed dry biomass in IPM plots was lower than farmers practice by 74.2 and 55.4% at 30 and 60 DAT and contributed to the mean grain yield advantage of 6.2 % in IPM adopted plots.

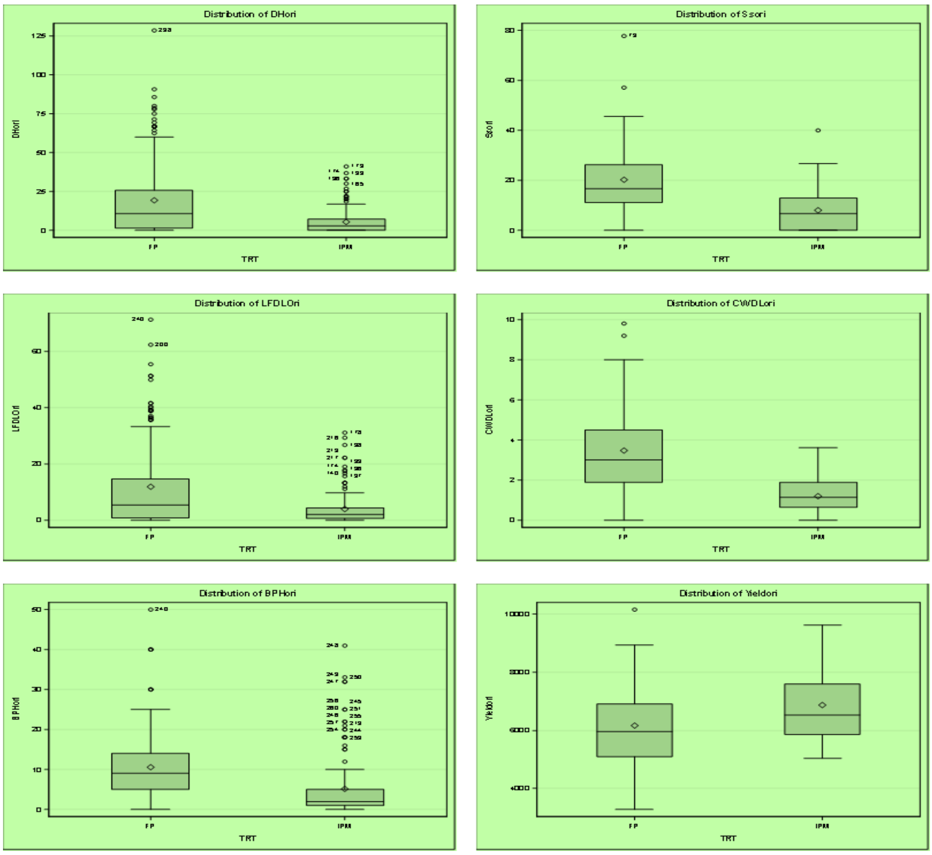


Figure 2.7.5 Incidence of dead hearts, gall midge, leaf folder, caseworm, damage, BPH, and grain yield in IPM and FP plots across locations in Zone VII (Southern areas)

At Mandya also, the weed population in IPM plots was lower than farmers practice by 65.7 and 64.1% at 30 and 60 DAT, respectively. The weed dry biomass in IPM plots was lower than farmers practice by 83.4 and 73.8% at 30 and 60 DAT, respectively and contributed to the mean grain yield advantage of 14.5 % in IPM adopted plots. At Puducherry**,** the weed population was lower than farmers practice in IPM plots by 24.9 and 27.7% at 30 and 60 DAT, respectively with lower weed biomass in IPM implemented fields (24.1 and 39.1%). The mean grain yield advantage was 4.9% in IPM adopted plots (**Table 2.7.22**).

Overall, in the Southern Zone, the yield advantage of 11.0% was recorded in IPM implemented fields. The weed population reduction in IPM fields was 66.7% at 30 DAT and 48.1% at 60 DAT. The percentage reduction in weed biomass in IPM implemented fields was 67.6% at 30 DAT and 54.1% at 60 DAT.

Table 2.7.22 Weed population and weed dry mass in Zone VII in IPMs, *Kharif* 2022

Location	Treatments	Weed population (no/m²)		Weed dry biomass (g/m²)	
		30 DAT	60 DAT	30 DAT	60 DAT
Coimbatore	IPM	6.4(2.6)	13.4(3.7)	4.6	9.6
	FP	16.0(4.0)	29.8(5.5)	11.1	18.7
	Mean	3.3	4.6	7.9	14.2
	CD (0.05)	**0.28**	**0.23**	**1.40**	**1.10**
Gangavathi	IPM	19.5(4.3)	12.2(3.5)	62.3	40.9
	FP	149.9(12.2)	32.8(5.7)	241.3	91.9
	Mean	8.3	4.6	151.8	66.4
	CD (0.05)	**1.23**	**0.98**	**67.97**	**15.37**
Mandya	IPM	4.8(2.3)	11.2(3.3)	1.0	7.8
	FP	14.0(3.7)	31.2(5.6)	6.1	29.9
	Mean	3	4.5	3.6	18.9
	CD (0.05)	**0.89**	**0.86**	**2.26**	**5.25**
Puducherry	IPM	52.5(7.3)	42.0(6.5)	27.4	25.0
	FP	69.9(8.4)	58.2(7.7)	36.0	41.0
	Mean	7.8	7.1	31.7	33.0
	CD (0.05)	**0.07**	**0.07**	**0.63**	**0.65**

Disease incidence was reported from two locations, Aduthurai and Mandya. At Aduthurai, adoption of IPM practices reduced the disease severity of bacterial blight. In all the three locations disease severity was significantly reduced compared to farmers practices (L1 = IPM - 95; FP-258; L2 = IPM – 28; FP – 220; L3 = IPM – 53; FP – 225). In case of false smut disease, among the three locations, application of IPM practices were effective at two locations, wherein the disease was reduced from 119 to 41 AUDPC units (L1) and 64 to 11 AUDPC units (L2) **(Table 2.7.23)**. At Mandya, the IPM practices were evaluated against leaf blast wherein the AUDPC values reduced significantly (L1: IPM-77, FP-225; L2: IPM-83, FP-202 IPM-71, FP-179)

Grain yield in IPM plots was relatively high as compared to FP plots. However, high gross returns along with the low cost of cultivation in IPM practices resulted in a superior BC ratio compared to FP plots, at all the locations **(Table 2.7.24)**.

Table 2.7.23 AUDPC values of rice diseases at Aduthurai and Mandya in IPMs, *Kharif* 2022

Location	Treatments	Aduthurai		Mandya
		AUDPC Values		AUDPC Values
		Bacterial Blight	False smut	Leaf Blast
Location 1	IPM	95	41	77
	FP	258	119	225
Location 2	IPM	28	11	83
	FP	220	64	202
Location 3	IPM	53	22	71
	FP	225	0	179

Table 2.7.24 Returns and BC ratio in IPMs trial at Zone VII (Southern), *Kharif* 2022

Location	Name of the Farmer	Treatments	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
MND	F1 = Sri Mahadevu	IPM	65.72	141298	55225	86073	2.56
		FP	58.52	125818	63375	62443	1.99
MND	F2 = Sri Jayaramu	IPM	62.92	138424	54475	83949	2.54
		FP	53.80	118360	62250	56110	1.90
MND	F3 = Sri Puttaswamy	IPM	59.00	109150	54100	55050	2.02
		FP	48.36	89466	62125	27341	1.44
ADT	F4 = Sri K Marimuthu	IPM	62.80	116808	32925	83883	3.55
		FP	51.74	96236	43900	52336	2.19
ADT	F5 = Sri Manoharan	IPM	62.80	116808	33725	83083	3.46
		FP	51.74	96236	45580	50656	2.11
ADT	F6 = Sri Rajavel	IPM	62.80	116808	33225	83583	3.52
		FP	51.74	96236	44610	51626	2.16
GNV	F7 = Sri Surya Rao	IPM	60.57	117506	55125	62381	2.13
		FP	59.68	115779	60750	55029	1.91
RNR	F8 = Sri Krishna Patel	IPM	87.38	178255	56628	121627	3.15
		FP	83.69	170728	64000	106728	2.67
RNR	F9 = Sri Eshwaraiah	IPM	83.07	169463	56628	112835	2.99
		FP	74.89	152776	63750	89026	2.40
		IPM	**67.45**				**2.88**
		FP	**59.35**				**2.08**

Price of Paddy: F1= Rs. 2150/q; F2 = Rs.2200/q; F3 = Rs.1850/q; F4, F5 & F6= Rs. 1860/q; F7 = Rs. 1940/q; F8 & F9 = Rs. 2040/q

Among the zones, stem borer and leaf folder incidence was observed in all the zones while gall midge incidence was observed in three zones, Zone IV, V & VII **(Table 2.7.25)**. In two zones, the incidence of whorl maggot (Zone IV & V), BPH (Zone II & VII), and WBPH (Zone II & VI) were reported. Caseworm and thrips incidence was observed only at Zone VII and Zone V, respectively.

Table 2.7.25 Incidence of various insect pests in different treatments at various zones

Zones	Treatments	% DH/WE	% SS	% LFDL	%WMDL	%CWDL	%THDL	BPH	WBPH	Yield kg/ha	BC ratio
Zone I	IPM			11.5						3640	3.16
	FP			16.9						2208	2.53
Zone II	IPM	4.4		3.2				15	6	5462	2.97
	FP	6.2		18.2				29	8	5108	2.41
Zone III	IPM	4.3		4.9						5592	2.13
	FP	8.0		2.5						4456	2.04
Zone IV	IPM	8.1	2.3	4.2	1.3					4562	1.97
	FP	9.8	4.6	3.6	6.0					3268	1.67
Zone V	IPM	6.5	10.5	2.3	5.3		5.7			4926	4.61
	FP	17.4	26.7	6.6	8.1		11.9			4202	3.09
Zone VI	IPM	3.9		8.4					16	4221	1.57
	FP	5.6		11.9					22	3445	1.52
Zone VII	IPM	5.5	8.0	4.0		1.4		5		6745	2.88
	FP	19.3	20.2	11.9		4.1		11		5935	2.08

Integrated Pest Management special (IPMs) trial was conducted with zone-wise practices at 19 locations in 40 farmers' fields during Kharif 2022. In Zone I (Hilly areas, dead hearts caused by black beetle was predominant in both IPM (24.2%) and FP plots (31.8%) followed by leaf folder in FP plots (16.9%). In Zone II (Northern areas), the incidence of stem borer, leaf folder, BPH, and WBPH was observed. Leaf folder incidence (> 20 % LFDL) was higher in FP plots at Kaul. In Zone III (Eastern areas) and Zone IV (North Eastern areas), stem borer, gall midge, leaf folder, whorl maggot, and

BPH were observed but the incidence was low. In Zone V (Central areas), a high incidence of gall midge was observed in all the FP plots (15.3 – 37.2% SS) compared to IPM plots (9.9-11.3% SS) at Jagdalpur. Thrips damage was also high in FP plots at Jagdalpur (8.9-14.3% THDL) as against IPM plots (8.9-14.3% THDL). However, the incidence of stem borer, leaf folder, whorl maggot, and BPH was low. In Zone VI (Western areas), the incidence of stem borer, leaf folder, and WBPH was low in both IPM and FP plots across locations. In Zone VII (Southern areas), stem borer incidence was high in FP plots at Aduthurai (35.3-46.1% DH) compared to IPM plots (5.4 -15.6% DH). Similarly, gall midge and leaf folder incidence were high in FP plots and low in IPM plots in all three farmers' fields at Aduthurai.

IPM implemented plots resulted in mean grain yield advantage of 51.0, 25.0, 21.4, 10.9, 45.0 and 11.0% in Zone-I, III, IV, V, VI and VII, respectively over the farmer practices. In IPM adopted fields, the mean weed population reduction over the Zones ranged from 22.5 % in Zone-V (Central areas) to 66.7 % in Zone-VII at 30 DAT; and from 27.6 % in Zone-I (Hilly areas) to 56.1 % in Zone-I at 60 DAT. The dry weed biomass reported from 13 locations showed that, both at 30 and 60 DAT, biomass was reduced significantly by 15.7 % in Zone-V (Central areas) to 69.7% in Zone-VI (Western areas); 18.2 % in Zone-V (Central areas) to 54.1% in Zone-VI (Western areas).

Adoption of IPM practices effectively reduced the disease progression of leaf blast, neck blast, bacterial blight, sheath blight, and brown spot in Zone II (Northern areas), leaf blast, neck blast, bacterial blight and sheath blight in Zone III (Eastern areas). There was significant reduction in the disease development of leaf blast, neck blast and sheath blight in Zone V (central areas), sheath rot and glume discolouration in Zone VI (Western areas), bacterial blight, false smut and leaf blast in Zone VII (Southern areas) due to the adoption of IPM practices.

Grain yields were significantly high in IPM-implemented plots resulting in high gross returns. Overall, BC ratios of IPM plots were superior to that of FP mainly due to better yields, lower input costs, and better returns.

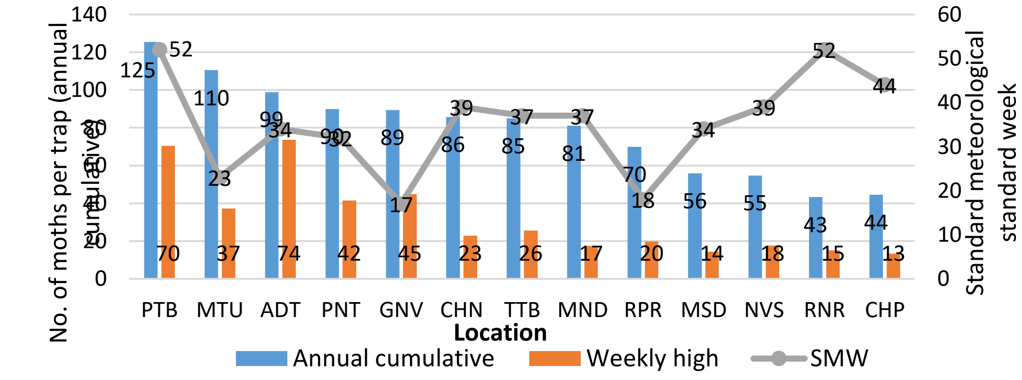
2.8 POPULATION DYNAMICS OF RICE INSECT PESTS ASSESSED THROUGH LIGHT TRAP CATCHES

The population dynamics of insect pests and their natural enemies vary with the geographic location and cropping system. Insect pest populations, during the crop season are always a function of abiotic and biotic factors. Besides biotic potential, to a large extent, abiotic factors like temperature, rainfall, relative humidity, sun shine hours, etc. and biotic factors such as predators, parasitoids, entomopathogenic organisms, etc. determine the abundance of insect pests in a crop ecosystem. Therefore, to design any effective location specific pest management strategies, knowledge of population dynamics of insect pests in relation to abiotic and biotic factors becomes vital. Since rice is grown in diverse agro-climatic zones in India, concerted efforts are being made under AICRIP to study the population dynamics of insect pests of rice at different locations across the country to understand short- and long-term changes in rice pest scenario.

During year 2022, insect populations in rice ecosystems were recorded daily, throughout the year using light traps (Chinsurah/Robinson type) in 29 locations. These locations are namely; ADT, CHN, CHP, BMV, GNV, KRK, KJT, KUL, LDN, MLN, MND, MTU, MSD, MNC, KHD, NVS, NWG, NLR, PNT, PTB, RNR, RPR, CBT, JDP, TTB, CHT, RGL, GGT and WGL. Corresponding weather data on temperature, rainfall, relative humidity, sunshine hours, etc. were also collected. Weekly cumulative catches of insects and weekly averages of weather parameters were worked out on standard week (SW) basis. Highlights and trends of the data collected during the year 2022 are presented hereunder:

Yellow stem borer: Yellow stem borer was recorded in 23 locations, except in KHD and CHT. Annual cumulative catches were highest at PTB (15728), followed by MTU (12200) and ADT (9776). Highest weekly catch was at ADT, PTB, and GNV in 34th, 52nd, and 17th SW respectively. Whereas, in the previous year annual cumulative catches were highest at MTU (16755) followed by ADT (15607) and PNT (13168) and weekly highest catch was in PNT (2950) in 37th SW followed by NLR (2635) in 37th and ADT (2019) in 33rd SW **(Table 2.8.1 and Fig. 2.8.1).**

Fig. 2.8.1. Seasonal incidence of Yellow stem borer



(Catches>1000, sqrt transformed)

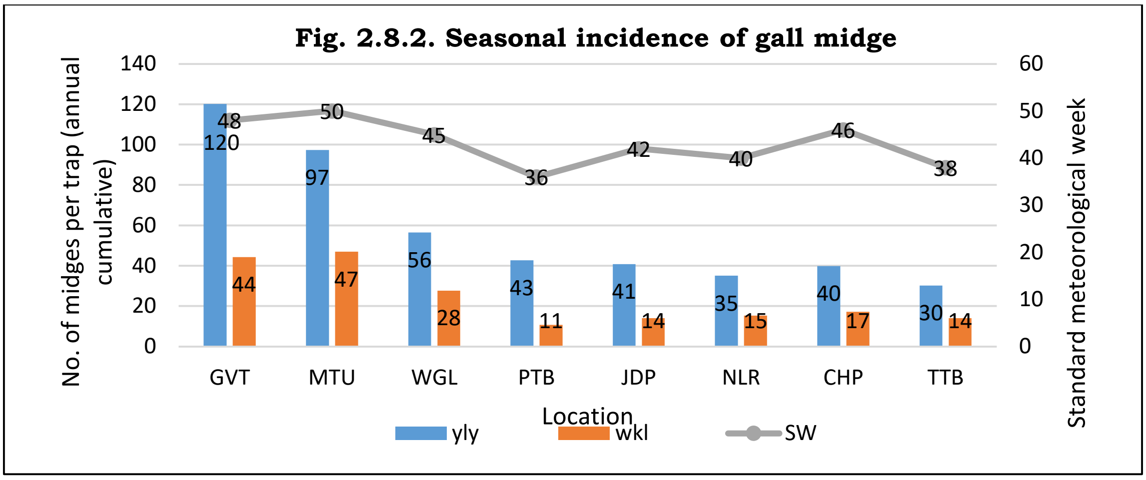
Table 2.8.1. Seasonal incidence of yellow stem borer based on light trap catches

S. No.	Zone	Location	Annual cumulative	Weekly high	SW
1	Zone-II North	PNT	8091	1723	32
2		LDN	76	14	37
3		KUL	589	61	23
4	Zone-III East	CHP	1978	181	44
5		TTB	7224	655	37
6		CHN	7344	523	39
7	Zone-V Central	JDP	544	37	45
8		RPR	4886	393	18
9		MSD	3119	208	34
10	Zone-VI Western	KJT	239	15	28
11		NWG	272	24	39
12		NVS	2997	310	39
13	Zone-VII: Sothern	CBT	565	48	16
14		GNV	7995	2006	17
15		KRK	781	62	52
16		NLR	847	80	37
17		MTU	12200	1386	23
18		MND	6565	304	37
19		MNC	190	15	1
20		PTB	15728	4966	52
21		RNR	1871	227	52
22		WGL	926	178	45
23		ADT	9776	5427	34

Gall midge: Gall midge occurrence was observed at 11 locations. It was not recorded from Hills, Northern and Western Zone. Annual cumulative catches were highest in GNV (14436) followed by MTU (9483) and WGL (3186) and in terms of weekly cumulative catch, it was most active in MTU (2201) in 50th SW, followed by GNV (1962) in 48th SW and WGL (765) in 45th SW (Fig. 2.16). In the previous year annual cumulative catches were highest in GNV (8829) followed by WGL (4129) and MTU (3470). In terms of weekly cumulative catch, it was most active in GNV (774) in 49th SW, followed by WGL (746) in 43rd SW and SKL (538) in 41st SW **(Table 2.8.2 and Fig. 2.8.2).**

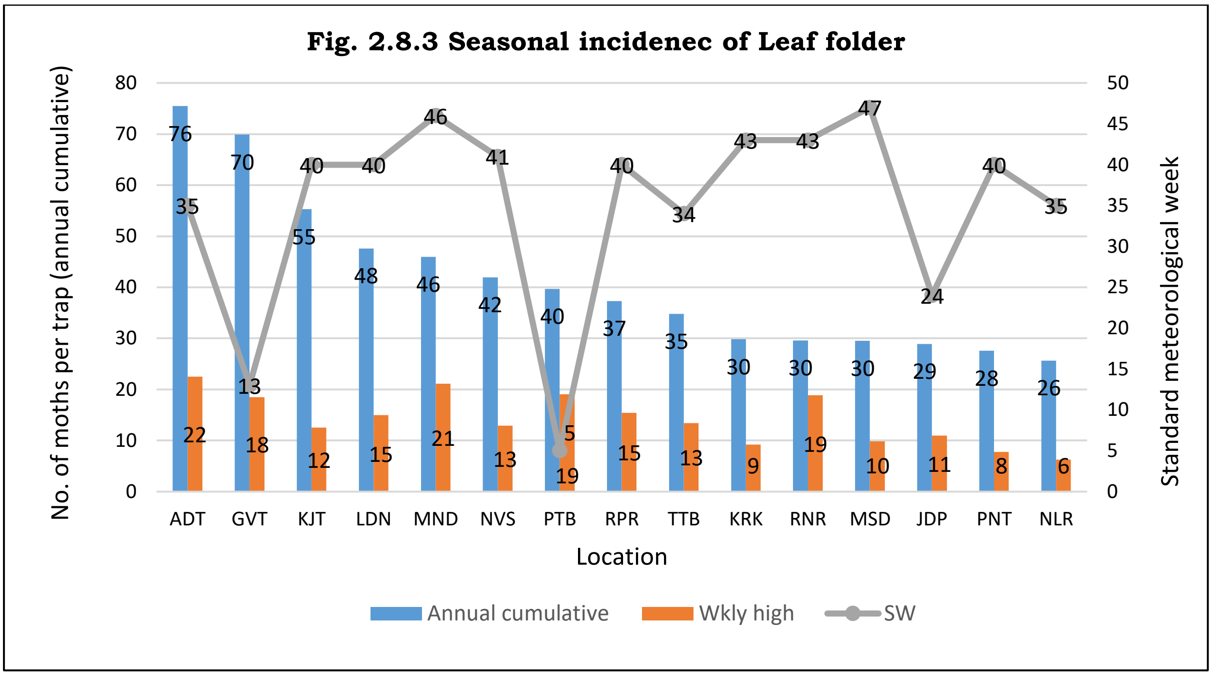
Table 2.8.2. Seasonal incidence of gall midge based on light trap catches

Zone	Location	Annual cumulative	Weekly high	SW
Zone-VII: Sothern	GNV	14436	1962	48
	MTU	9483	2201	50
	WGL	3186	765	45
	PTB	1819	116	36
	NLR	1227	235	40
	MNC	27	8	5,6
	KRK	7	6	32
	RNR	1	1	39
Zone V: Central	JDP	1667	196	42
Zone III: Eastern	CHP	1589	296	46
	TTB	915	195	38



(Catches>900, sqrt transformed)

Leaf folder: Leaf folder also was recorded at 25 locations across the zones. It was most active in ADT, GNV, and KJT in terms of annual cumulative catches. Whereas, weekly cumulative catches were highest at ADT, MND, followed by PTB during 35th, 46th, and 5th SWs respectively. In the previous year it was most active in MSD (17661), MND (2871), MTU (2683) in terms of annual cumulative catches. Whereas, weekly cumulative catches were highest at MSD (3753) in 41th SW, MTU (999) in 45th SW followed by RNR (962) in 16th SW **(Table 2.8.3 and Fig. 2.8.3).**



(Catches>600, sqrt transformed)

Table 2.8.3. Seasonal incidence of leaf folder based on light trap catches

S. No.	Zone	Location	Annual cumulative	Weekly high	SW
1	Zone I: Hills	MLN	32	11	19
2	Zone-II North	PNT	760	60	40
3		LDN	2267	224	40
4		KUL	246	14	22
5	Zone-III East	CHP	196	18	43
6		TTB	1210	180	34
7		CHN	251	26	42
8	Zone-V Central	JDP	835	120	24
9		RPR	1392	237	40
10		MSD	871	97	47
11	Zone-VI Western	KJT	3060	156	40
12		NWG	58	15	44
13		NVS	1759	166	41
14	Zone-VII: Sothern	CBT	114	19	18
15		GNV	4886	342	13
16		KRK	890	84	43
17		NLR	658	39	35
18		RGL	7	3	33
19		MTU	82	13	16
20		MND	2110	445	46
21		MNC	232	16	44
22		PTB	1573	363	5
23		RNR	876	356	43
24		WGL	264	34	11
25		ADT	5701	506	35

Brown planthopper: Brown plant hopper was recorded in 25 locations. BPH was most abundant at MTU and PTB on yearly cumulative basis. Weekly cumulative catches were also highest at MTU, PNT, and WGL during 45th, 18th and 16th SW respectively. However, data reveals that in the rainy season during 40th-45th SWs, brown planthopper was most abundant. Synchrony between the crop phenological stage with favourable weather factors could be responsible for high population build-up. In 2021, brown plant hopper was recorded in 22 locations. BPH was most abundant in CHP (294262), followed by RPR (158186) and PNT (76419) on yearly cumulative basis **(Table 2.8.4 and Fig. 2.8.4).**

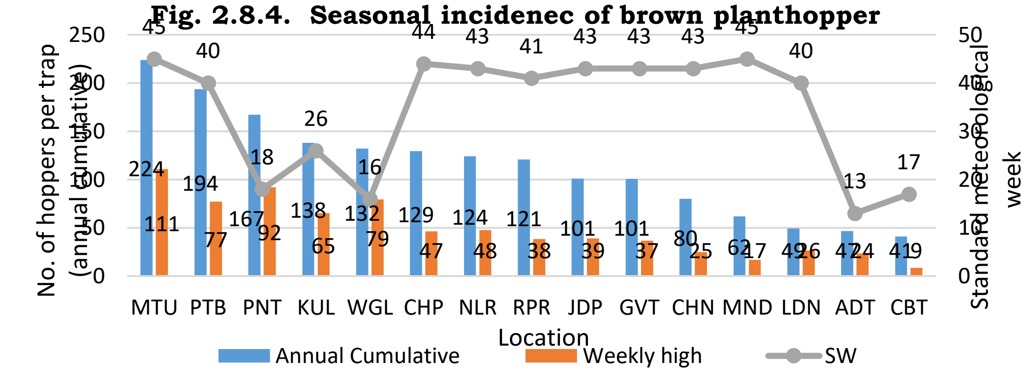


Fig. 2.8.4. Seasonal incidenec of brown planthopper

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(Catches>1000, sqrt transformed)

Table 2.8.4. Seasonal incidence of brown planthopper based on light trap catches

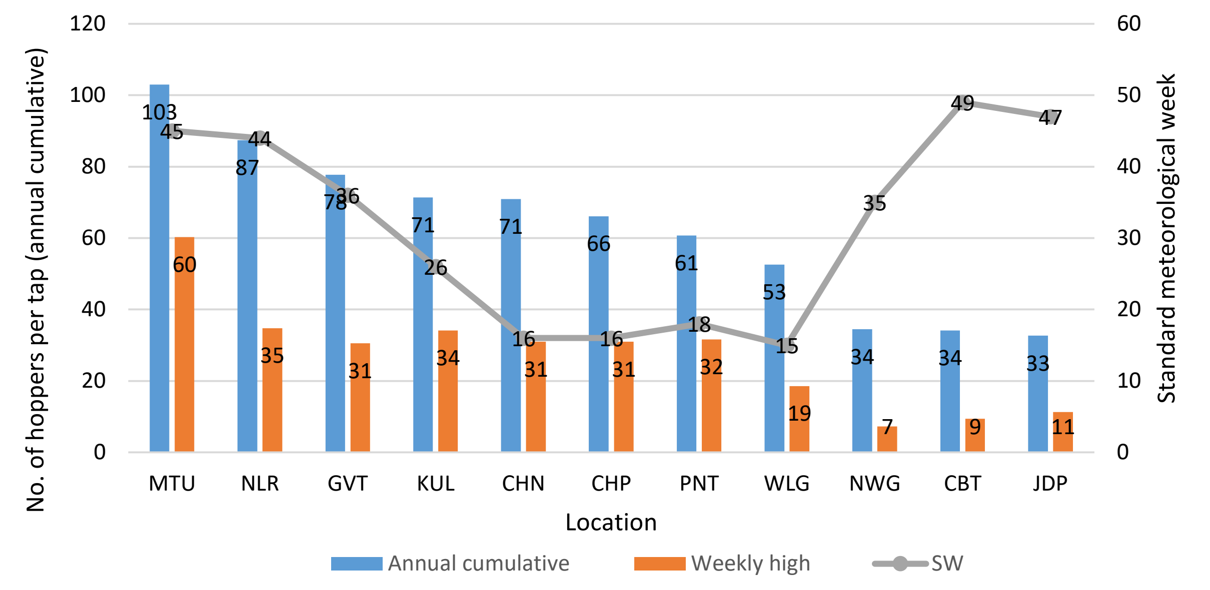
S.No.	Zone	Location	Annual cumulative	Weekly high	SW
1	Zone I: Hills	MLN	276	41	20
2	Zone-II: North	PNT	27992	8509	18
3		LDN	2434	700	40
4		KUL	19062	4270	26
5	Zone-III: East	CHP	16766	2169	44
6		TTB	31	31	39
7		CHN	6425	629	43
8	Zone-V: Central	JDP	10197	1545	43
9		RPR	14654	1476	41
13	Zone VI: Western	NVS	563	63	45
14	Zone-VII: Sothern	CBT	1686	77	17
15		GNV	10145	1369	43
16		KRK	39	19	52
17		NLR	15434	2285	43
19		MTU	50083	12290	45
20		MND	3864	286	45
21		MNC	739	61	39
22		PTB	37555	5968	40
23		RNR	816	402	44
24		WGL	17482	6319	16
25		ADT	2183	556	13

Whitebacked planthopper: Whitebacked planthopper was recorded in 18 locations spread across all the zones. Highest annual cumulative catches were recorded at MTU, NLR, and GNV. Whereas, population was most active during 45th, 26th, and 35th SWs at MTU, NLR and KUL respectively. In KUL, CHN, CHP, PN and WGL it was most active during the *Rabi* season. In year 2021, annual cumulative catches were highest in MTU (15935), followed by GNV (7193) and SKL (6074). Whereas, weekly cumulative catches were highest in MTU (3300) in 44th SW followed by GNV (2163) in 46th SW and PNT (1560) in 43rd SW (Table 2.7.5 and Fig. 2.7.5).

Table 2.8.5. Seasonal incidence of whitebacked planthopper based on light trap catches

S.No	Zone	Location	Annual cumulative	Weekly high	SW
1	Zone I: Hills	MLN	134	24	19
2	Zone-II North	PNT	3688	1002	18
3		LDN	464	128	39
4		KUL	5092	1162	26
5	Zone-III East	CHP	4373	960	16
6		TTB	27	27	31
7		CHN	5029	960	16
8	Zone-V Central	JDP	1067	128	47
9		RPR	740	210	42
10	Zone VI-Western	NWG	1190	53	35
11		NVS	476	66	42
12	Zone-VII: Sothern	CBT	1162	88	49
13		GNV	6041	934	36
14		KRK	10	4	49
15		NLR	7644	1210	44
16		MTU	10603	3632	45
17		MNC	84	8	37
18		WGL	2765	345	15

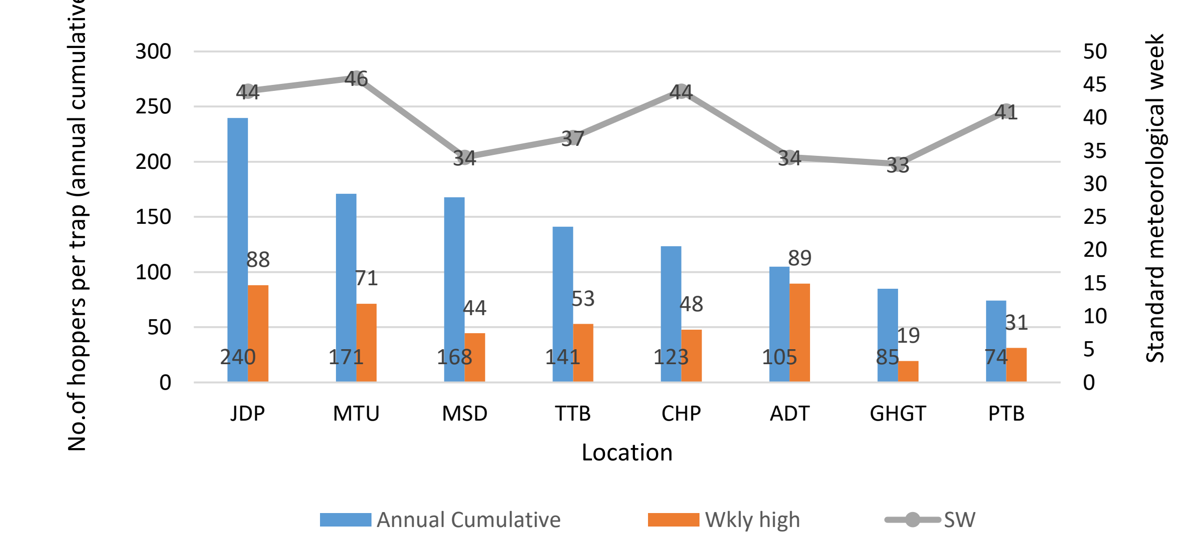
Fig. 2.8.5. Seasonal incidenece of whitebacked planthopper



(Catches>1000, sqrt transformed)

Green leafhopper: Green leafhopper was recorded from 24 locations. Highest annual cumulative population was found at JDP, MTU, and MSD. It was most active during 44th, 46th and 37th SWs at JDP, MTU and TTB respectively. Data reveals that GLH is mainly a rainy season pest. In 2022, at JDP (92815) annual cumulative catches were highest followed by PTB (65651) and MSD (35393). Weekly cumulative catches were highest in PTB (10516) in 2nd SW, followed by JDP (9206) in 40th SW and MSD (7941) in 40th SW **(Table 2.8.6 and Fig. 2.8.6).**

Fig. 2.8.6. Seasonal incidenec of green leafhopper



(Catches>5000, sqrt transformed)

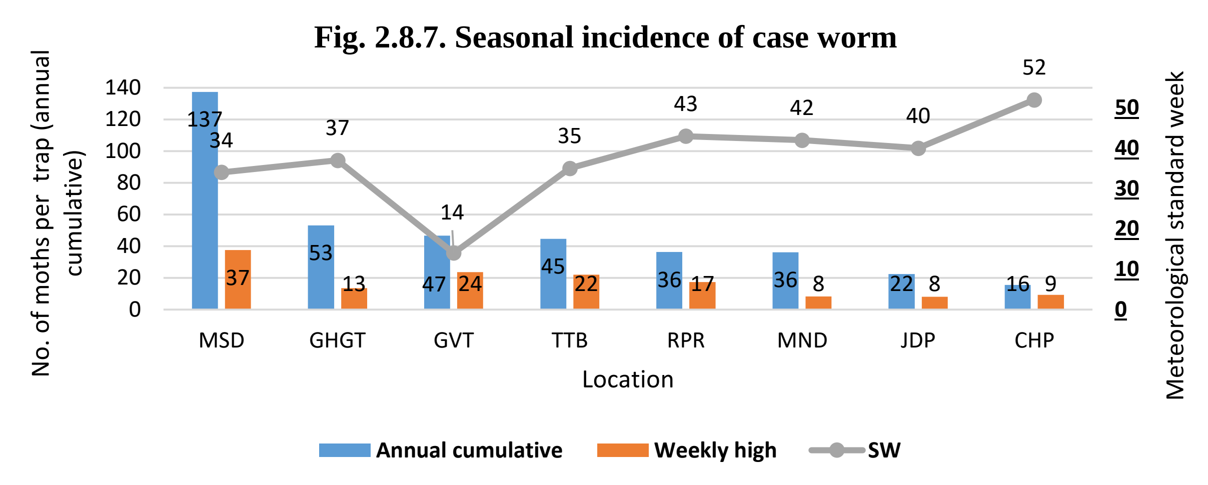
Table 2.8.6. Seasonal incidence of green leafhopper based on light trap catches

S. No.	Zone	Location	Annual Cumulative	Weekly high	SW
1	Zone-I Hills	MLN	26	3	15
2	Zone-II North	CHT	1534	481	7
3		KUL	563	408	14
4		PNT	2050	795	41
5	Zone-III East	TTB	19931	2799	37
6		CHP	15236	2287	44
7		CHN	1513	130	43
8		GHGT	7201	375	33
9	Zone-V Central	MSD	28185	1976	34
10		RPR	463	80	42
11		JDP	57495	7776	44
12	Zone-VI Western	KJT	4000	340	49
13		NVS	955	129	42
14	Zone-VII: Sothern	ADT	10972	8005	34
15		PTB	5509	981	41
16		WGL	4901	1286	40
17		GNV	3459	226	43
18		NLR	1734	364	42
19		CBT	1344	91	16
20		RNR	1087	415	42
21		MND	803	46	36
22		MNC	802	54	6
23		KRK	532	54	47
24		MTU	29191	5095	46

Case worm: Case worm was recorded in 1 location spread across four zones. It was most active in MSD, GHGT, and GNV. Except at GNV and CBT; CW was most active during the rainy season. Weekly catches were highest at GHGT followed by GNV and TTB during 37th, 14th and 35th SWs respectively. In the year 2022, it was most active in MSD (18876), followed by MLN (2566) and TTB (2324) **(Table 2.8.7 and Fig. 2.8.7).**

Table 2.8.7. Seasonal incidence of case worm based on light trap catches

S.No	Zone	Location	Annual cumulative	Weekly high	SW
1	Zone-III: East	CHP	243	87	52
2		TTB	1984	484	35
3		GHGT	2828	181	37
4	Zone-V: Central	RPR	1316	297	43
5		JDP	501	65	40
6		MSD	18876	1404	34
7	Zone-VI: Western	KJT	1	1	32
8	Zone-VII: Sothern	MND	1298	66	42
9		GNV	2171	555	14
10		CBT	37	3	1
11		MTU	14	14	50

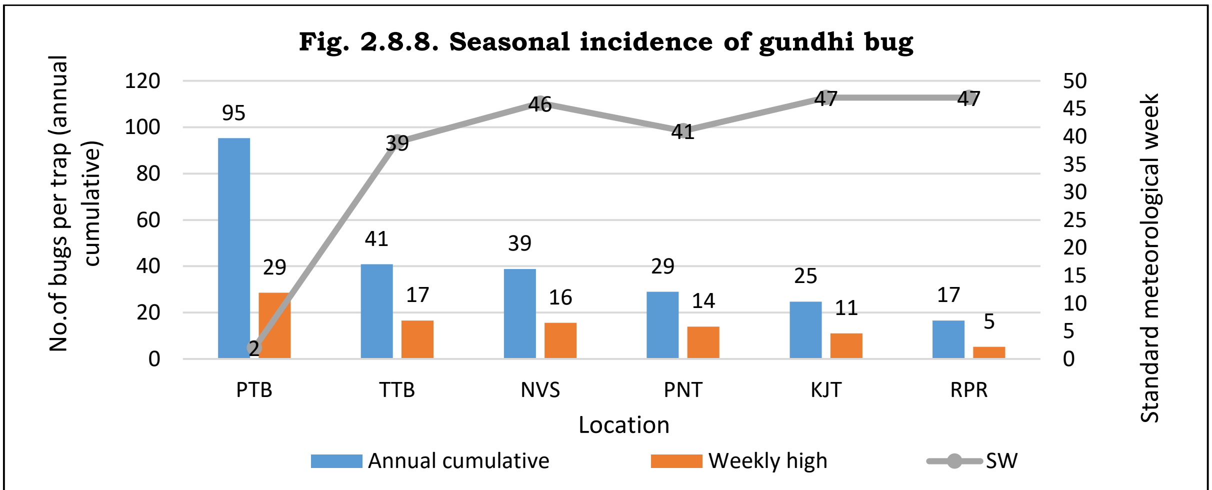


(Catches>10)

Gundhi bug: Rice gundhi bug was recorded at six locations: PTB, TTB, NVS, PNT, KJT and RPR. It was most abundant in PTB followed by TTB and NVS. Weekly peak catches were also highest at the same locations in 2nd, 39th and 46th SWs. In year 2022 its activity was high in PTB (7100), followed by MSD (1890), and TTB (1604) **(Table 2.8.8 and Fig. 2.8.8).**

Table 2.8.8. Seasonal incidence of gundhi bug based on light trap catches

S. No.	Location	Annual cumulative	Weekly high	SW
1	PTB	9075	820	2
2	TTB	1667	276	39
3	NVS	1510	245	46
4	PNT	842	196	41
5	KJT	613	123	47
6	RPR	275	27	47

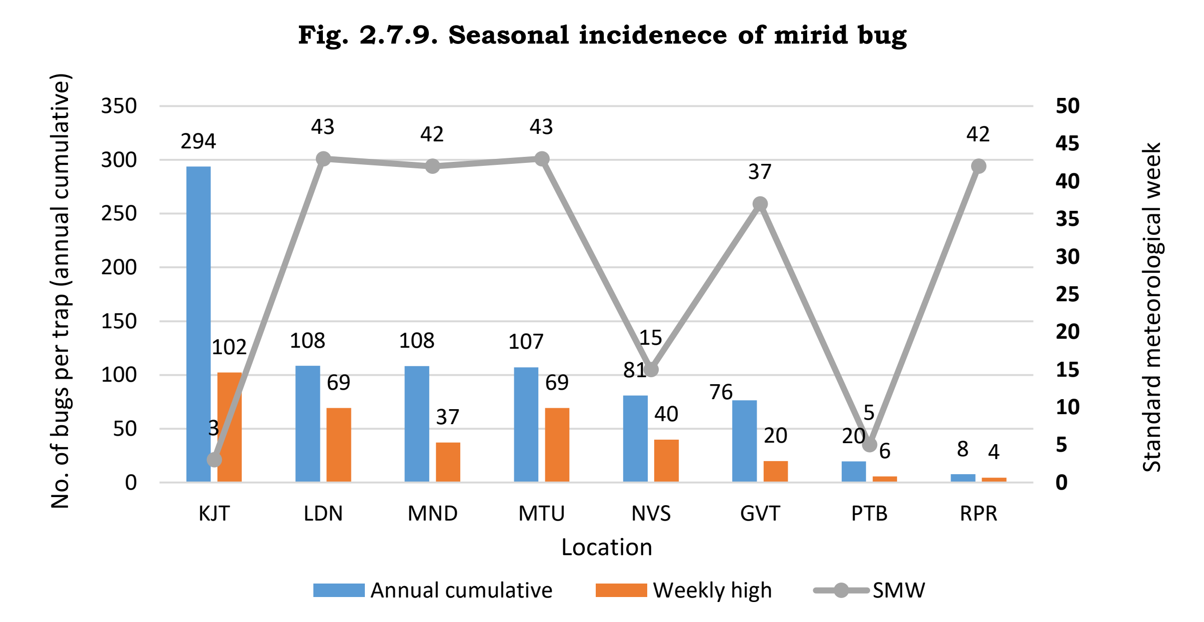


(sqrt transformed)

Mirid bug: It was reported from LDN, RPR, NVS, KJT, GNV, PTB, MND and MTU. Except in KJT, NVS and PTB it was most active during the rainy season. It was most abundant in KJT, LDN, MND followed by MTU. Highest weekly catches were recorded at LDN and MND followed by MTU in 42 and 43 SWs respectively (Table 2.8.9 and Fig. 2.8.9).

Table 2.7.9. Seasonal incidence of green leafhopper based on light trap catches

S. No.	Zone	Location	Annual cumulative	Weekly high	SW
1	Zone I: North	LDN	11767	4795	43
2	Zone-V: Central	RPR	58	20	42
3	Zone VI: Western	NVS	6532	1592	15
4		KJT	86285	10450	3
5	Zone-VII: Sothern	GNV	5838	399	37
6		PTB	383	32	5
7		MND	11718	1382	42
8		MTU	11463	4785	43



(sqrt transformed)

White stem borer was reported from TTB, PTB, and MLN. Pink stem borer was also reported from LDN, RNR, and RPR. Black bug was reported from five locations: MLN, ADT, TTB, MTU, and MNC. Zigzag leaf hopper was found in three locations: RPR, MTU, and JDP. Paddy skipper was reported from NVS. White grub was a concern at KHD and CHT. Grasshoppers were regular pests at CHT.

Overall, the light trap data revealed that yellow stem borer, leaf folder, and hoppers continued to be the most important pests in terms of numbers as well as spread across the locations. Gall midge continues to be an endemic pest. However, case worm, and gundhi bug showed an increase in the spread and intensity of incidence posing concern for future. Patterns in seasonal incidence and population build up based on light trap data indicates that the key pests are reaching their peak levels in the months of October and November in the kharif season. Therefore, strategies are to be timed accordingly for the effective management of insect pests in rice.

Rabi 2021-2022

Summary

1. Stem borer screening trial (SBST): Evaluation of 45 entries in 8 valid field tests (5 tests for dead heart damage and 2 tests for white ear damage and 1 test for grain yield) identified 3 entries *viz*., WGL1062, NND5, NSR 88 (RP BIO 4919) with ≤5 % WE as promising in 1 test for low white ear damage and one test for high grain yield (≥15 g/hill suggesting that recovery resistance and tolerance could be the mechanism in these entries as they recorded good grain yield despite damage.

2. Multiple resistance screening trial (MRST)

Evaluation of 35 entries against planthoppers at Maruteru under field conditions identified nine entries as promising *viz*., RPBio4918, Cul M9, JS 5, W 1263, CRCPT 7, CRCPT8, Suraksha, RP 2068-18-3-5 33 with DS 3.0 and PTB 33 with DS 1.

3. National Screening Nursery (Boro) Evaluation of 58 entries along with 14 disease checks and 10 insect checks in NSN boro trial at 5 locations in 11 valid tests against 5 insect pests identified 5 entries *viz.,* IET No 29599, 29632, 28852, 30463, 30472 as promising in 2-3 tests against 1-3 pests.

Insecticides and Botanical Evaluation Trial (IBET) was carried out at 6 locations to evaluate the efficacy of four combination modules/treatments against major insect pests of rice and grain yield during Rabi, 2021-22. Based on the performance of the treatments in reducing the pest incidence at various locations, all insecticide treatment-Chlorantraniliprole, Cartap hydrochloride and Triflumezopyrim–was found effective against damage by stem borer, plant hoppers, leaf folder and whorl maggot. Highest grain yield of 4776.0 kg/ha was recorded in all insecticide treatment.

Ecological engineering for planthopper management was taken up in Maruteru and Moncompu with a combination of interventions such as organic manuring, and growing of flowering plants on bunds. The results were not confirmatory.

Integrated Pest Management special (IPMs) trial was conducted at five locations in ten farmer's fields during Rabi 2021-22. Incidence of stem borer, leaf folder, gall midge, hispa, whorl maggot, BPH and WBPH was observed in both IPM and FP plots across locations. Dead heart incidence crossed ETL at Pattambi (22.7%) in FP plots alone while it crossed ETL in IPM (30.9%) and FP plots (22.0%) at Aduthurai. Incidence of gall midge was very high at Pattambi in both IPM (23.5%) and FP plots (57.8%) while at Aduthurai, it was high in IPM plots in two farmer's fields (32.2-38.2% SS) and high in FP plot in one farmer field (35% SS). The incidence of whorl maggot (31.3% WMDL), caseworm (24.5% CWDL) and blue beetle (30.4% BBDL) was high in FP plots as compared to IPM plots. Across the locations, gross returns were high in IPM plots due to the high grain yield and low cost of cultivation resulting in a high BC ratio.

Rabi 2021-2022

i. Stem borer screening trial (SBST)

During Rabi 2021-22, **Stem borer screening trial (SBST)** comprising of 45 nominations from IIRR, Jagtial, Rudrur, Warangal, Sakoli and NRRI Cuttack were evaluated at 5 locations *viz.*, IIRR, Cuttack, Pattambi, Maruteru and Rajendra Nagar. At each location, observations were recorded on dead heart damage at vegetative phase and white ear damage, grain yield in the infested plant and the larval survival in the stubbles at harvest. For effective screening, two staggered sowings were taken up in most of the locations or efforts were made to infest the plants. The results of the evaluation against yellow stem borer damage from the valid tests are discussed below and some of the best lines were identified.

Dead heart damage: The dead heart damage in the trial varied from 10.9% to 59.14% with an average damage of 25.9% DH across 3 locations in 5 valid tests. None of the entries were promising for dead heart damage.

White ear damage: The white ear damage across 2 locations in 2 valid tests varied from 0.0 to 68.4% with a mean of 38.88% WE. Evaluation of entries identified WGL1062, NND5, NSR 88 (RP BIO 4919) as promising with ≤5 % WE damage. The larval survival recorded at Rajendranagar was 1-3 larvae/ hill stubbles. Traces of pink stem borer larvae were also observed in few entries.

Grain yield: The grain yield in the lines with low white ear damage was WGL1062, NND5, NSR 88 (RP BIO 4919) 23.4,25.4 and 19.2g/hill, respectively. Another 32 entries recorded higher grain yield (≥15g grain yield /hill) despite high white ear damage.

Overall reaction: Evaluation of 45 entries in 8 valid field tests (5 tests for dead heart damage and 2 tests for white ear damage and 1 test for grain yield) identified 3 entries *viz.*, WGL1062, NND5, NSR 88 (RP BIO 4919) as promising with ≤5 % WE in one test with low white ear damage and high grain yield (1test) for high grain yield (≥15 g/hill) suggesting that recovery resistance and tolerance could be the mechanism in these entries as they recorded good grain yield despite damage **(Table 2.1.1)**.

Table2.1.1 Reaction of most promising cultures to stem borer in SBST, Rabi 2021-22

S. No.	Entries	IIRR	IIRR	PTB	PTB	CTC	SB DH	IIRR	PTB	SB WE	SBDH+ WE	IIRR	GY	SBDH+ WE+GY
		66 DAT	78 DAT	30 DAT	85 DAT	51 DT	NPT	92 DAT	85 DAT	NPT	NPT		NPT	NPT
		DH (%)	DH (%)	DH (%)	DH (%)	DH (%)	5	WE (%)	WE (%)	2	7	GY/ h	1	8
1	CR Dhan 308	10.9	36.5	25.2	24.2	5.9	0	23.8	24.2	0	0	28.3	1	1
23	WGL 1062*	24.4	22.4	19.7	39.8	16.4	0	1.4	39.8	1	1	23.3	1	2
36	NND5*	25.8	23.6	38.0	NF	14.1	0	0.0	NF	1	1	25.4	1	2
42	NSR 88 (RP BIO 4919)	54.2	56.1	22.5	32.9	14.7	0	1.8	32.9	1	1	19.2	1	2

*Entry under retesting. Data on SB from RNR not included due to low pest pressure

ii. Multiple resistance screening trial (MRST): The trial was constituted with 30 entries and five checks and conducted at Khudwani, Maruteru and Rajendranagar. At Maruteru incidence of stem borer damage, and planthoppers was observed. Stem borer incidence was observed at RRS, Rajendranagar. Rice skipper and grasshopper incidence was recorded at Khudwani. Valid data on field reaction to planthopper from Maruteru identified nine entries *viz.*, RPBio4918, Cul M9, JS 5, W 1263, CRCPT 7, CRCPT8, Suraksha, RP 2068-18-3-5 as promising with DS 3.0 and PTB 33with DS 1.

iii. NSN- Boro:

NSN Boro trial was constituted with 58 boro entries along with 14 disease checks and 10 insect checks. Entries evaluated at 5 locations *viz.*, Coimbatore, Pattambi, Maruteru, Titabar and Gerua against 7 insect pests. The results are discussed pest wise.

BPH: Evaluation of entries in greenhouse test at Coimbatore identified IET Nos 29599, 30451 and 30472 as promising with a DS ≤ 3.0 but they were highly susceptible in field reaction at Maruteru. PTB 33 had a damage score of 3.2 and MO1 recorded 2.8. However, IET Nos 30463, 30449, 30458, 30448, 30453, 30459, 30467 along with PTB 33 recorded a DS 3.) in field evaluation at Maruteru.

WBPH: IET nos 29599, 30460 and 30472 recorded a DS ≤ 3.0 in greenhouse evaluation at Coimbatore.

Gall midge: None of the entries was promising in field reaction at Titabar.

Stem borer: Rajyalakshmi (hybrid check) recorded nil damage at Gerua out of three valid tests for dead heart damage. IET Nos 29632 28852 and 30442 were promising with a reaction of ≤ 5 % WE (DS1.0) at both Pattambi and Titabar. Another five entries recoded nil white ear damage at Pattambi.

Other pests: Leaffolder damage was recorded at Titabar (6.7%DL) and Pattambi (Mean 14.5% DL). Whorl maggot at Pattambi (8.7% DL) and gundhi bug damage (6.8 % DG) from Titabar was reported.

Overall reaction: Evaluation of 58 entries along with 14 disease checks and 10 insect checks in NSN boro trial at 5 locations in 11 valid tests against 5 insect pests identified 5 entries viz., IET No. 29599, 29632, 28852, 30463, 30472 as promising in 2-3 tests against 1-3 pests **(Table 2.1.2)**.

Table 2. 1.2 Performance of cultures to insect pests in NSN (Boro) trial, Rabi 2021- 2022

				CBT	MTU		CBT		TTB		PTB	TTB	Gerua		PTB	TTB		PTB	TTB		
				BPH	BPH	**BPH**	WBPH	**WBPH**	GMB		SBDH	SBDH		**SBDH**	SBWE	SBWE	**SBWE**	LF	LF	**LF**	
				GH	80DT	**NPT**	GH	**NPT**	45DT	**GM**	30DT	45DT	56 DT	**NPT**	Pr.h	84DT	**NPT**	60DT	52DT	**NPT**	**Overall NPT**
B.ENO	**Entry No.**	**IET No.**	**Designation**	DS	DS	**2**	DS	**1**	%SS	**1**	%DH	DH%	%DH/DT	**3**	%WE	%WE	**2**	%DL	%DL	**2**	**11**
2108	2108	29599	KAUM 238-1-1-1-1-1	1.4	9.0	**1**	2.8	**1.0**	14.3	**0**	22.8	17.9	6.3	**0**	0.0	9.5	**1**	22.2	4.9	**0**	**3**
2113	2113	29632	CR 4340-2-4-GSR IR2-1-R6-N5-N3-N53-N80	NG	9.0	**0**	NG	**0.0**	19.0	**0**	21.7	9.5	3.3	**0**	0.0	4.3	**2**	17.8	5.7	**0**	**2**
2114	2114	28852	CR 4311-2-2-2-1-2-2	5.2	9.0	**0**	5.8	**0.0**	8.0	**0**	23.9	8.0	17.8	**0**	0.0	4.8	**2**	13.8	4.8	**0**	**2**
2224	2224	30463	CR 4114-2-4-2-1-2-2	5.0	3.0	**1**	NG	**0.0**	6.3	**0**	19.3	6.3	18.8	**0**	0.0	9.5	**1**	9.9	4.4	**0**	**2**
2233	2233	30472	MLD 208 IIRR GSR N03	3.0	7.0	**1**	3.0	**1.0**	10.3	**0**	27.6	13.8	20.7	**0**	3.1	10.5	**0**	13.1	7.9	**0**	**2**
Total Tested				63	80		60		82		81	82	79		77	82		81	82		
Max. damage in the trial				9	9		9		38.5		33.7	42.9	41.9		59.1	46.2		23.5	15.4		
Min. damage in the trial				1.4	1.0		2.8		3.2		2.9	3.4	0.0		0.0	3.8		7.6	2.2		
Ave. damage in the trial				5.8	8.1		6.5		10.5		19.2	10.5	13.3		11.8	17.4		14.5	6.7		
Damage in TN1				7.6	9.0		8.9		11.3		14.4	7.6	11.7		7.7	22.5		14.5	5.0		
Promising level				3	3		3		0		0	0	0		0	5		0	0		
No. promising				0	9		3		0		0	0	1		7	4		0	0		

Data on SB from MTU; WM from PTB; GB from TTB was not considered for analysis due to low pest pressure

2.2 Chemical Control studies:

1. Insecticide-Botanicals Evaluation Trial (IBET)

Insecticide-Botanicals Evaluation Trial (IBET) was carried out at 5 locations to evaluate the efficacy of four combination modules/treatments consisting of three insecticides- Chlorantraniliprole 20% SC, Cartap hydrochloride 50% SC and Triflumezopyrim 10% SC, one commercial neem formulation - Neemazal and two oils - Neem and Eucalyptus oil along with untreated control against major insect pests of rice and consequent impact on natural enemies and grain yield during Rabi, 2021-22.

Observations were recorded on pest incidence, natural enemy counts as well as grain yield as per the standard procedures. The data were subjected to Anova analysis and the performance of the treatments were evaluated based on their efficacy against the major pests specific to each location as well as the grain yields obtained in each treatment.

Pest infestation table (2.2.1)

Stem borer incidence was recorded in six locations and high dead hearts damage was recorded at Titabar (12.7-26.5%) followed by Raipur with highest of 24.4% in control plots. There were significant differences in damage among the treatments at most of the locations except Raipur. Mean dead heart damage in botanical combination treatments ranged between 7.2 and 9.4% compared to13.9% in control, while all insecticide treatment was the most effective treatment showing 5.4% DH damage.

Highest white ear damage was reported from Pattambi with 48.6-57.6% in treatments and control. All treatments significantly reduced white ear damage (12.9-17.6%) when compared to 20.0% in control. All insecticide combination was the most effective treatment against stem borer with 12.9% mean white ear damage. Among botanical treatments neemazal, eucalyptus oil and cartap hydrochloride combination was found effective with 16.1% WE.

Gall midge incidence was reported from three locations- Aduthurai, Chiplima and Ttabar. The silver shoot damage varied from 0.8-11.9% in treatments as compared to 8.3-22.6% in control. The lowest mean damage was recorded in all insecticides treatment (4.1%) while the damage recorded was 14.1% in control.

Brown planthopper incidence was recorded only from 2 locations. There were significant differences in the efficacy among the treatments at both locations, except 30DAT at Aduthurai. All insecticide treatment was the most effective treatment with lowest mean population of 11.6 BPH/10 hills compared to 44.5 per 10 hills in control. However, there was no significant difference in mean efficacy of among all treatments against hoppers.

Green leaf hopper incidence was recorded in Aduthurai and Titabar. Lowest mean number of GLH (2.8 hoppers/10 hills) was recorded in all insecticide treatment followed by neemazal, eucalyptus oil and cartap hydrochloride combination (5.1) as compared to 14.6 in control.

Leaf folder damage was reported from 3 locations and highest leaf damage was recorded in Titabar at 50DAT (23.6%). There were significant differences in leaf damage among the treatments at all locations. All insecticides combination was the most effective treatment showing mean leaf damage of 2.4% in comparison to 13.3% in control.

Whorl maggot damage was recorded in 4 locations. Highest damage was reported from Titabar centre (20.8-20.1%), while damage was 5.0-11.1% in other centres. Lowest mean damage of 3.8 % was noticed in all insecticides treatment followed by neemazal, eucalyptus oil and cartap hydrochloride combination with 4.6% when compared to control (10.9%).

Grain Yield **(Table:2.2.2)**

There were significant differences in grain yield among the treatments at all 6 locations except Pattambi. Based on mean yield of these locations, all insecticide treatment recorded the highest grain yield of 4776.0 kg/ha followed by neemazal, eucalyptus oil and cartap hydrochloride combination (4426.0). However, there was no significant difference in the mean yields recorded among treatments.

Insecticides and Botanical Evaluation Trial (IBET) was carried out at 6 locations to evaluate the efficacy of four combination modules/treatments against major insect pests of rice and grain yield during Rabi, 2021-22. Based on the performance of the treatments in reducing the pest incidence at various locations, all insecticide treatment-Chlorantraniliprole, Cartap hydrochloride and Triflumezopyrim–was found effective against damage by stem borer, plant hoppers, leaf folder and whorl maggot. Highest grain yield of 4776.0 kg/ha *was recorded in all insecticide treatment.*

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Stem borer Damage (Dead hearts)												Mean
		ADT		CTC		CHP		RPR		PTB		TTB		
		30DT	50DT	30DT	60DT	55DT	75DT	30DT	50DT	30DT	50DT	30DT	50DT	
1	Botanical-Insecticide 1	7.8b	8.2ab	5.1bc	3.3bc	2.9b	4.2bc	15.0a	7.0a	9.9b	10.5a	9.3b	8.7c	7.6bc
2	Botanical-Insecticide 2	5.2b	6.4b	5.4b	4.0b	4.9a	5.6b	22.3a	11.1a	9.0b	10.9a	12.8a	16.1b	9.4b
3	All Botanical	6.4b	9.0ab	6.4b	7.1a	2.2b	2.7dc	11.1a	3.5a	9.9b	5.9a	12.2a	10.5c	7.2bc
4	All Insecticide	1.9b	5.1b	3.2c	2.4c	0.4c	0.9d	13.6a	7.5a	9.5b	6.1a	6.6c	7.7c	5.4c
5	Control (Water Spray)	14.4a	13.7a	9.9a	8.0a	5.8a	9.3a	24.4a	8.0a	20.8a	14.4a	12.7a	26.5a	13.9a

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Stem borer Damage (%White Ears)						Mean
		ADT	CTC	CHP	RPR	PTB	TTB	
		Pr.harvest						
1	Botanical-Insecticide 1	1.5b	6.2c	5.1bc	17.0b	57.6a	9.4bc	16.1a
2	Botanical-Insecticide 2	4.5b	6.6c	7.1b	17.3b	51.7a	18.4a	17.6a
3	All Botanical	6.4b	9.8b	4.0dc	17.2b	48.6a	12.1b	16.3a
4	All Insecticide	3.1b	4.2d	1.5d	14.9b	47.9a	6.0c	12.9a
5	Control (Water Spray)	17.3a	14.3a	11.4a	22.2a	49.8a	23.3a	23.0a

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Gall midge Damage (% Silver Shoots)						Mean
		ADT		CHP		TTB		
		30DT	50DT	30DT	50DT	30DT	50DT	
1	Botanical-Insecticide 1	8.2b	6.9ab	3.9bc	2.5bc	7.6bc	8.4bc	6.2b
2	Botanical-Insecticide 2	8.2b	4.5b	5.4bc	1.4c	9.8b	11.9b	6.8b
3	All Botanical	9.2b	6.3ab	3.0c	2.4bc	5.8bc	10.7bc	6.2b
4	All Insecticide	0.8c	3.6b	6.6b	3.0b	4.8c	6.1c	4.1b
5	Control (Water Spray)	15.5a	9.7a	10.9a	8.3a	17.7a	22.6a	14.1a

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Brown Planthopper (No./10hills)			Mean
		ADT		CHP	
		30DT	50DT	75DT	
1	Botanical-Insecticide 1	6.6a	8.3ab	77.0b	30.6a
2	Botanical-Insecticide 2	7.3a	6.0ab	25.0c	12.7a
3	All Botanical	8.3a	8.6ab	77.0b	31.3a
4	All Insecticide	7.6a	5.3b	22.0c	11.6a
5	Control (Water Spray)	13.0a	9.6a	111.0a	44.5a

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT), Cartap hydrochloride 50% SC 2g/l (60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Leaf folder (% Damaged leaves)						Mean
		ADT		TTB		PTB		
		30DT	50DT	30DT	50DT	45DT	60DT	
1	Botanical-Insecticide 1	2.8b	3.5b	7.9c	6.1c	3.7b	5.4b	4.9b
2	Botanical-Insecticide 2	3.2b	3.0b	13.4b	10.9b	2.6b	4.1bc	6.2b
3	All Botanical	4.1b	3.5b	9.7c	8.4bc	2.7b	4.6bc	5.5b
4	All Insecticide	1.1b	1.6b	4.1a	4.1a	0.7c	2.9c	2.4b
5	Control (Water Spray)	9.2a	8.8a	21.2a	23.6a	8.4a	8.9a	13.3a

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Whorlmaggot (%Damaged Leaves)								Mean
		ADT		RPR		PTB		TTB		
		30DT	50DT	30DT	50DT	25DT	45DT	30DT	50DT	
1	Botanical-Insecticide 1	5.1bc	3.8b	5.1a	2.1a	4.4ab	7.0a	4.9c	5.1c	4.6b
2	Botanical-Insecticide 2	5.7bc	3.3b	6.7a	4.7a	5.9ab	6.3a	11.4b	10.5b	6.8b
3	All Botanical	6.5b	4.5b	6.4a	4.2a	6.0ab	6.6a	8.4b	8.5b	6.3b
4	All Insecticide	3.2c	2.7b	4.7a	2.8a	3.0b	5.1a	4.2c	4.7c	3.8b
5	Control (Water Spray)	11.1a	8.3a	6.1a	5.0a	7.21a	8.8a	20.8a	20.1a	10.9a

Table: 2.2.1 Insect pests incidence in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Green Leafhopper(No. 10/hills)				Mean
		ADT		TTD		
		30DT	50DT	30DT	50DT	
1	Botanical-Insecticide 1	7.6ab	8.0ab	2.5b	2.5c	5.1bc
2	Botanical-Insecticide 2	9.3ab	7.6ab	4.2b	4.7b	6.4b
3	All Botanical	9.3ab	9.6a	4.0b	4.5bc	6.8b
4	All Insecticide	2.6b	3.0b	3.2b	2.7bc	2.8c
5	Control (Water Spray)	12.6a	14.0a	17.0a	15.0a	14.6a

Table: 2.2.1 Incidence of Natural enemies in different treatments, IBET, Rabi 2019

S. No.	Common Name	Natural Enemies (No./10hills)			Mean
		PTB			
		Damsel flies 60DAT	Spiders 60DAT	Coccinellids 60DAT	
1	Botanical-Insecticide 1	8.3a	3.3ab	2.6a	4.7a
2	Botanical-Insecticide 2	9.0a	3.0b	3.3a	5.1a
3	All Botanical	10.3a	3.6ab	2.3a	5.4a
4	All Insecticide	7.6a	2.0b	3.0a	4.2a
5	Control (Water Spray)	7.0a	5.6a	6.0a	6.2a

Table: 2..2.2 Grain Yield in different treatments, IBET, Rabi 2021-22

S. No.	Common Name	Yield (Kg/ha)						Mean
		ADT	CTC	CHP	RPR	PTB	TTB	
1	Botanical-Insecticide 1	2476.1b	3650.0b	4352.9b	10650.0a	1625.0a	3800.0c	4426.0a
2	Botanical-Insecticide 2	2285.7bc	3350.0c	4411.7b	8800.0ab	1593.7a	4000.0b	4074.0a
3	All Botanical	2095.2cd	3150.0d	4176.4c	6500.0b	1531.2a	3560.0d	3502.0a
4	All Insecticide	2857.1a	4050.0a	5058.8a	10450.0a	2000.0a	4240.0a	4776.0a
5	Control (Water Spray)	1857.1d	2800.0e	3000.0d	9500.0ab	1531.2a	2680.0e	3561.0a

Botanical-Insecticide 1:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT), Cartap hydrochloride 50% SC 2g/l (60-65 DAT)
Botanical-Insecticide 2:	Neemazal 1% EC 2ml/l (25-30 DAT), Neemoil 10 ml/l (45-50 DAT), Triflumezopyrim 10% SC 0.48ml/l (60-60 DAT)
All Botanical:	Neemazal 1% EC 2ml/l (25-30 DAT), Eucalyptus oil 2ml/l (45-50 DAT) , Neem oil 10ml/l (60-65 DAT)
All Insecticide:	Chlorantraniliprole 20% SC 0.2ml/l (25-30 DAT), Cartap hydrochloride 50% SC 2g/l (50-55 DAT),Triflumezopyrim 10% SC 0.48ml/l (65-70 DAT)

2.3 BIOCONTROL AND BIODIVERSITY STUDIES

Ecological Engineering for Planthopper Management (EEPM)

This trial was carried out at Maruteru and Moncompu during Rabi 2021-2022.

Maruteru

The EE interventions tested at Maruteru were wider spacing, alleyways, organic manuring, water management and planting of bund flora. The observations on hoppers and their natural enemies were taken five times starting from 40 DAT. The overall analysis of pooled data showed BPH population was significantly higher in EE treatment (22.29/hill) when compared to 10.94/hill in farmers practices **(Table 2.3.1)**. On the other hand, Gall midge incidence was significantly lower in EE plots (6.90 %) as compared to 10.92% in non- EE plots (t=2.254; p <0.01). The population of green mirids was significantly higher in EE plots (4.00/ hills) while spiders and coccinellid numbers were on par. The white ear damage was high in both treatments though statistically they were on par and ranged from 16.55-19.82%. The projected yield in EE plots was 2193 kg/ha) was on par with that of FP plots (2467kg/ha) and the yield were probably lesser due to higher incidence of stem borer.

Table.2.3.1 Effect of ecological engineering on pests and its natural enemies at Maruteru, EEPM, *rabi 2021-22*

A.

Parameters	BPH (No./ hill)		GM %		WE %	
	EE	FP	EE	FP	EE	FP
Mean	22.29	10.94	6.90	10.53	19.82	16.55
t value	5.65**		2.65**		1.29^{NS}	
df	48		48		18	
P - value	0.01		0.01		0.20	

B.

Parameters	Green mirids (No./ hill)		Spiders (No./ hill)		Coccinellids (No./hill)		Yield* (Kg/ha)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	4.00	2.63	1.97	0.75	0.82	0.68	2193	2467
t value	2.97**		1.28^{NS}		1.36^{NS}		0.80^{NS}	
df	48		48		48		8	
P - value	0.01		0.20		0.18		0.46	

projected yield

Moncompu

At Moncompu, growing marigold on bunds and application of organic manure in EE Plots was followed. The observations on hoppers and their natural enemies were taken six times starting from 15 DAT. The overall analysis of pooled data showed BPH population (1.99/hill) was significantly lower in EE treatment compared to

3.52/hill in farmers practices **(Table 2.3.2)**. However, the population of predators and parasitoids were on par in EE and FP plots.

Table.2.3.4 Effect of ecological engineering on hoppers and its natural enemies at Moncompu, EEPM, *rabi 2021-22*

Parameters	BPH (No./ hill)		Green mirids (No./ hill)		Spiders (No./ hill)		Coccinellids (No./ hill)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	1.99	3.52	1.11	0.98	0.49	0.42	0.54	0.39
t value	3.14 **		0.65 NS		0.67 NS		1.40NS	
df	48		48		48		48	
P - value	0.01		0.51		0.51		0.16	

Ecological engineering for planthopper management was taken up in Maruteru and Moncompu with a combination of interventions such as organic manuring, and growing of flowering plants on bunds. The results were not confirmatory.

2.4 Integrated Pest Management Special Trial (IPMs)

During *Rabi* 2021-22, IPM special trial was conducted at five locations *viz.*, Chinsurah, Maruteru, Pattambi, Aduthurai and Karjat in ten farmer's fields. Location-wise details are discussed below:

Chinsurah: IPMs trial was conducted at Sri Narayan Chandra Mondal's field at Village Bele, Radhanagar post, Pandua Mandal, Hooghly district of West Bengal. Practices followed in IPM and FP plots are given below:

Practices followed in IPMs trial at Chinsurah, *Boro* 2021-22

	IPM practices	Farmers practices
Area/ Variety	0.5 acre; IET 4786 (Satabdi)	0.5 acre; IET 4786 (Satabdi)
Nursery	• Application of 1.5 kg mustard cake	• Application of 5 kg mustard cake
Main field	• Field preparation with power tiller, cutting of bunds and levelling the field • Application of 31 kg 10:26:26 + Urea @ 28 kg • Application of Butachlor + hand weeding • Application of Ferterra @ 4 kg/ acre • Application of Coragen @ 60 ml/ acre • Application of carbendazim • Installation of pheromone traps @ 3/acre for stem borer	• Field preparation with power tiller, cutting of bunds and levelling the field • Application of 30 kg SSP, 23 kg MOP, Urea 30 kg • Hand weeding two times • Application of Carbofuran 3G @ 12 kg/ acre • Spraying of Cartap hydrochloride 50 SP @ 500 g/ acre two times • Application of Carbendazim

A low incidence of stem borer, leaf folder and whorl maggot was observed in both IPM and FP plots at this location. Grain yield was high in IPM plots (55.28 q/ha) resulting in higher gross returns and higher BC ratio compared to FP plots (**Table 2.4.1**)

Table 2.4.1 Insect pest incidence in IPMs trial at Chinsurah, Boro 2021-22

Treatments	% DH	% WE	% LFDL	% WMDL	Yield	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC ratio
	50 DAT	Pre har	50 DAT	22 DAT	kg/ ha				
IPM	7.7 ± 0.9	4.5 ± 0.9	0.9 ± 0.2	3.8 ± 0.7	5528 ± 39	107243	64205	43038	1.67
FP	6.0 ± 1.0	7.7 ± 0.7	0.4 ± 0.1	3.7 ± 0.6	4872 ± 41	94517	65820	28697	1.44

Price of paddy = Rs. 1940/q

Maruteru: IPMs trial was conducted at two farmer's fields in two villages in Achanta Mandal, i.e., in Sri Ila Babji's field at Penumanchili village and Sri D Prasad's field in Achanta village, Achanta Mandal, Andhra Pradesh. Practices followed in both the treatments are given below:

Practices followed in IPMs trial at Maruteru, *Rabi 2021-22*		
Area	2000 sq	2000 sq
Variety	MTU 1121	MTU 1121
Nursery	• Seed treatment with Carbendazim @ 10 g/ 10 kg seeds • Application of carbofuran @800g/ 5 cents nursey, 5 days before pulling seedlings from nursery for transplantation	
Main field	• Formation of alleyways of 30 cm after every 2 m • Transplanting at 20 x 15 cm • Clipping of leaf tips • NPK @ 180-90-90 kg/ha	• Formation of alleyways of 30 cm after every 2 m • NPK @ 225-80-90 kg/ha • Applied Londax power @10kg/ha within one week after transplantation+one manual weeding

	• Application of Londax power@10kg/ha within one week after transplantation + one manual weeding • Installed pheromone traps @ 8 traps/ ha for stem borer management • One spray of chlorantraniliprole @ 0.3 ml/l at 60 DAT • Spraying of triflumezopyrim 10 SC @ 94 ml/acre at 60 DAT • Mid-season drainage • Blanket application of propiconazole @ 1ml/liter • Spraying of tricyclazole @ 0.6 g/l against leaf blast	• Application of dinotefuran, pymetrozine and triflumezopyrim against brown planthoppers • Spraying of tricyclazole and isoprothiolane against leaf blast • Application of ferterra granules, cartap hydrochloride granules and spraying of acephate @ 3 g/l against stem borer • Spraying of tricyclazole and isoprothiolane against leaf blast • Spraying of hexaconazole and azoxystrobin +difenconazole (amistar top) against sheath blight

Incidence of stem borer, gall midge, leaf folder, hispa, BPH and WBPH was observed in both IPM and FP plots in both the farmer's fields (**Table 2.4.2**). The BPH population crossed ETL in both treatments from 67 DAT onwards, which was reduced with the intervention of IPM practices. However, the incidence of other pests was low in both the locations and treatments. Grain yield was high in IPM plots compared to FP plots resulting in higher returns and high BC ratio (**Table 2.4.3**).

Table 2.4.2 Insect pest incidence in IPMs trial at Maruteru, *Rabi* 2021-22

Farmer Name	Treatments	% DH	% WE	% SS	% LFDL	% HDL	BPH/hill	WBPH
		37 DAT	Pre-har	37 DAT	52 DAT	22 DAT	67 DAT	67 DAT
Sri Ila Babji	IPM	4.2 ± 0.7	4.1 ± 0.3	1.1 ± 0.5	0.8 ± 0.2	1.1 ± 0.3	245 ± 8	74 ± 5
	FP	7.2 ± 0.6	6.2 ± 0.7	1.5 ± 0.3	1.4 ± 0.2	0.3 ± 0.1	356 ± 16	76 ± 15
Sri D Prasad	IPM	6.7 ± 0.8	4.6 ± 0.3	2.4 ± 0.9	1.1 ± 0.2	1.0 ± 0.2	253 ± 5	47 ± 6
	FP	6.4 ± 0.7	7.7 ± 0.4	3.3 ± 0.5	1.5 ± 0.1	1.6 ± 0.2	501 ± 21	44 ± 6

Table 2.4.3 Returns and BC ratio in IPMs trial at Maruteru, *Rabi* 2021-22

Treatments	Yield (Q/ ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC Ratio
IPM	81.14	139967	52150	87817	2.68
FP	84.5	145763	58750	87013	2.48

Price of Paddy = Rs. 1725/q

Pattambi: IPMs trial was conducted at Sri Ummer's field in Parambil house, Kondurkara village, Palakkad district, Kerala State. Supriya variety was grown in both IPM and FP plots during *Rabi* 2019-20. Practices followed in IPM and FP plots are given below:

Practices followed in IPMs trial at Pattambi, *Rabi* 2021-22

	IPM practices	Farmers Practices
Area	4000 sq.m	4000 sq m
Variety	Supriya	Supriya
Fertilizers	Application of NPK @ 90:45:55	Application of 100 kg Factomphos, 75 kg urea and 40 kg Potash
Nurse	• Seed treatment with *Pseudomonas fluorescence* @ 10g/kg seed • Seedling dip with Pseudomonas @ 20 g / litre of water	
Main field	• Five Sprays with Eco-neem 1 % at 15, 25, 45, 65 and cartaphydrochlorie 4%G @ 1000g a.i/ha at 80 DAT • Installation of pheromone traps • Six releases of *Trichogramma japonicum* for stem borer and *T chilonis* for leaf folder at weekly interval	• Sprayed with Chlorantanilipole, flubendiamide, lambda-cyhalothrin and streptomycin at 30, 60, 75 and at 95 DAT

Incidence of dead hearts caused by stem borer was low in IPM plot throughout the crop growth period while it crossed ETL in FP plot starting from 25 DAT and maximum damage was found at 25 DAT (22.7% DH) while white ears were high in FP plot at pre-harvest (31.5% WE). High whorl maggot incidence was reported at 25 DAT in both IPM (17% WMDL) and FP plots (31.3% WMDL) but later it got reduced due to appropriate IPM interventions. Leaf folder incidence was found low in both the treatments while case worm damage was high at 25 DAT in both the plots (**Table 2.4.4**). Blue beetle damage was low in IPM plot (8.1% BBDL) while it was very high in FP plot (30.4% BBDL). Grain yield was high in IPM plot resulting in higher gross returns and better BC ratio (3.45) compared to FP plot (**Table 2.4.4**).

Table 2.4.4 Pest incidence, grain yield and BC ratio in IPMs at Pattambi, *Rabi* 2021-22

Treatments	% DH	% WE	% SS	% LFDL	% WMDL	% CWDL	% BBDL
	25 DAT	Pre har	25 DAT	70 DAT	25 DAT	25 DAT	25 DAT
IPM	0.0 ± 0.0	11.5 ± 1.0	23.5 ± 6.3	5.4 ± 0.6	17.0 ± 4.3	25.7 ± 3.5	8.1 ± 1.6
FP	22.7 ± 4.3	31.5 ± 2.0	57.8 ± 1.3	7.6 ± 0.4	31.3 ± 1.6	24.5 ± 1.7	30.4 ± 3.7

Treatments	Yield (Q/ ha)	Gross Returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC Ratio
IPM	8100 ± 287	226800	65675	161125	3.45
FP	7305 ± 304	204540	97000	107540	2.11

Price of Paddy = Rs.2800/q

Aduthurai: IPMs trial was conducted at three farmer's fields in three villages, viz., Sri S Shanmugam of Komal East village, Sri N Mathiyazhagan of Nallavur village, Nagapattinam district and Sri Vilwanathan of Nankudi village, Thanjavur district, Tamilnadu state. The details of package of practices followed are given below:

Practices followed in IPMs trial at Aduthurai, *Rabi* 2021-22

	IPM practices	Farmers practices
Area/ variety	1 ha; ADT 46	1 ha; ADT 46
Nursery	• Seed treatment with carbandezim @ 2g / kg seed	
Main field	• Transplanting the seedlings at a spacing of 20 x 15 cm. • Leaving alleyways of 30 cm after every 2 m or 10 rows. • Fertilizers applied as per local recommended fertilizer dose. • Application of Butachlor 1.5 kg a.i./ ha within one week after transplanting the crop. • At 15 DAT, installed pheromone traps with 5 mg lure @ 8 traps/ha for stem borer monitoring • One spray of Cartap hydrochloride 50 WP @ 600 g /ha at 60 DAT • Application of Propiconazole	• Five rounds of insecticides followed due to gall midge, stem borer, leaf folder and BPH incidence. • Applied Thiamethoxam25 WG 100g/ha, Profenophos 20EC 1000ml/ha, Chlorantraniliprole 18.5 EC 100ml/ ha, Cartap hydro chloride 10kg/ha • Applied Copper oxy chloride, Mancozeb+ carbendazim (saaf), Propiconozole

Incidence of stem borer, gall midge, leaf folder, whorl maggot, hispa, thrips, BPH, WBPH and GLH was observed in both IPM and FP plots in all the farmers' fields. Incidence of dead hearts and white ears crossed ETL and was significantly high in IPM plots as compared to FP plots in two farmer's fields while it was high in FP plots in Sri Vilwanathan farmer's field. **(Table 2.45).** Across farmers/villages, dead heart incidence was significantly high in IPM plots (30.9%) than in FP plots (22%). A similar trend was observed with respect to gall midge incidence also wherein the incidence was high in FP plots in two farmers' fields and low in the third farmer's field. Across the farmers, the incidence of gall midge and leaf folder was at par in both IPM and FP plots. There is no significant difference in the pest incidence among the DATs. However, the incidence of whorl maggot, hispa, thrips, BPH, WBPH and GLH was low in both the treatments in all the farmers' fields. Grain yields were high in IPM plots resulting in higher gross returns and a better BC ratio (1.45) compared to the FP plot (**Table 2.4.6**).

Table 2.4.5 Pest incidence in IPMs trial at Aduthurai, *Rabi* 2021 -22

Name of the Farmer	Treatments	%DH/WE	% SS	% LFDL
F1 - Sri S Shanmugam	IPM	44.2(6.2)a	32.2(4.9)a	16.4(3.9)a
	FP	24.8(4.6)b	11.7(3.2)a	2.6(1.6)b
LSD (0.05, 36df)		**1.20**	**1.91**	**0.95**
F2 - Sri N Mathiyazhagan	IPM	29.2(5.1)a	38.2(5.8)a	11.8(3.3)a
	FP	15.6(3.7)b	22.7(4.6)a	12.6(3.3)a
LSD (0.05, 36df)		**0.75**	**1.62**	**1.45**
F3 - Sri Vilwanathan	IPM	19.2(4.0)b	9.0(2.7)b	5.0(2.1)b
	FP	25.7(5.0)a	35.0(5.8)a	12.1(3.3)a
LSD (0.05, 36df)		**0.79**	**1.22**	**1.14**
Treatments				
T1 = IPM		30.9(5.1)a	26.5(4.5)a	11.0(3.1)a
T2 = FP		22.0(4.4)b	23.1(4.5)a	9.1(2.7)a
LSD (0.05,108df)		**0.53**	**0.89**	**0.64**
DAT				
D1 = 29 DAT		23.6(4.5)a	23.0(4.4)a	
D2 = 43 DAT		29.4(5.0)a	27.0(4.6)a	8.4(2.8)a
D3 = 57 DAT		29.3(5.1)a	24.4(4.5)a	11.8(3.1)a
D4 = 64 DAT		26.9(4.9)a		
D5 = Pre har		23.1(4.3)a		
LSD (0.05,108)		**0.83**	**1.09**	**0.64**

Table 2.4.6 Returns and BC ratio in IPMs trial at Aduthurai, *Rabi* 2021 -22

Treatments	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
IPM	56.56	105202	72388	32814	1.45
FP	51.4	95604	90450	5154	1.06

Price of Paddy = Rs. 1860/q

Karjat: IPMs trial was conducted in three farmer's fields, *viz.,* Sri Gajanan Masane, Sri Jagdish Masne and Sri Dhaneshwar Masne's fields of Aambot village, Karjat. The package of practices followed in both IPM and FP plots is given below:

Practices followed by three farmers in IPMs trial at Karjat, *Rabi* 2021-22

	IPM practices	Farmers practices
Area	1 acre	1 acre
Varieties	F1- Sri Gajanan Masane – Karjat 184 F2 - Sri Jagdish Masne - Karjat 3 F3- Sri Dhaneshwar Masne - Karjat 3	
Main field	• Seed treatment with carbendazim @ 10 g/ 10 kg seed • Raised bed 3x1m treated with rice husk (hull) ash @3kg/bed	Land burned with waste materials
	• Line sowing at a spacing of 20 cm • Application of FYM 4 T, Suphala 215 Kg, Urea 87 Kg • 2-3 seedlings transplanted at a spacing 20 x15 cm. • Alleyways of 40cm left after every 10 rows	• Seed broadcasted • Application of FYM 2 T, Urea 180 kg, Suphala 75 kg • 4-5 seedlings transplanted randomly

	• Bispyribasodium 250ml/ha (Nomini gold). • Pheromone traps @ 8 / acre • Use of bird perches in the field • Use Vaibhav sickle for harvesting • Application of Cartap hydrochloride @ 18 kg/ha (one application)	• Hand weeding once • Phorate 10 kg/ha (two applications)

A low incidence of stem borer and leaf folder was reported in all three farmer's fields in both IPM and FP plots. Grain yield was significantly high in IPM plots than in FP plots in all three farmer's fields resulting in higher gross returns and higher BC ratio (**Table 2.4.7**).

Table 2.4.7 Insect pest incidence in IPMs trial at Karjat, *Rabi* 2021-22

Farmer Name	Treatments	% DH	% LFDL	Yield	Gross Returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC ratio
		43 DAT	43 DAT	Kg/ha				
F1 = Sri Gajanan Masane	IPM	6.7 ± 0.6	2.2 ± 0.6	3400 ± 13	68000	49787	18213	1.37
	FP	8.1 ± 0.4	3.6 ± 0.8	2901 ± 19	58020	51450	6570	1.13
F2 = Sri Jagdish Masne	IPM	8.2 ± 0.7	2.4 ± 0.3	3348 ± 27	66960	49787	17173	1.34
	FP	9.0 ± 0.7	2.4 ± 0.2	2800 ± 64	56000	49800	6200	1.12
F3 = Sri Dhaneshwar Masne	IPM	9.1 ± 0.9	1.8 ± 0.4	3499 ± 19	69980	49787	20193	1.41
	FP	10.1 ± 0.8	2.5 ± 0.4	2900 ± 24	58000	51800	6200	1.12

Price of Paddy = Rs. 2000/q

Integrated Pest Management special (IPMs) trial was conducted at five locations in ten farmer's fields during Rabi 2021-22. Incidence of stem borer, leaf folder, gall midge, hispa, whorl maggot, BPH and WBPH was observed in both IPM and FP plots across locations. Dead heart incidence crossed ETL at Pattambi (22.7%) in FP plots alone while it crossed ETL in IPM (30.9%) and FP plots (22.0%) at Aduthurai. Incidence of gall midge was very high at Pattambi in both IPM (23.5%) and FP plots (57.8%) while at Aduthurai, it was high in IPM plots in two farmer's fields (32.2-38.2% SS) and high in FP plot in one farmer field (35% SS). The incidence of whorl maggot (31.3% WMDL), caseworm (24.5% CWDL) and blue beetle (30.4% BBDL) was high in FP plots as compared to IPM plots. Across the locations, gross returns were high in IPM plots due to the high grain yield and low cost of cultivation resulting in a high BC ratio.

Appendix-I

IIRR headquarters, Hyderabad: Drs. V. Jhansi Lakshmi, A. P. Padmakumari, Chitra Shanker, Ch. Padmavathi and Y. Sridhar

Cooperating centres

Sl. No.	State	Location	Code	Name of the cooperator, Designation
1	Andhra Pradesh	Bapatla*	BPT	Dr. N. Sambasiva Rao, .Sr. Scientist (Entomology)
2		Maruteru	MTU	Dr. A.D.V.S.L.P. Anand Kumar, Scientist (Entomology)
3		Nellore*	NLR	Dr. I. Paramasiva Reddy, Scientist (Entomology)
4		Ragolu*	RGL	Dr. UdayaBabu, Scientist, Entomology
5	Assam	Titabar	TTB	Dr. Mayuri Baruah, Junior Scientist
6	Bihar	Pusa	PSA	Dr. Abbas Ahmed, Scientist (Entomology)
7		Ambikapur *	ABP	Dr. Kanhaiyalal Painkra, Scientist (Entomology)
8	Chattisgarh	Jagdalpur	JDP	Dr. N. C. Mandawi, Scientist
9		Raipur	RPR	Dr. Sanjay Sharma, Pr. Scientist (Entomology)
10	New Delhi	New Delhi*	NDL	Dr. S. Rajna, Scientist (Entomology)
11	Jharkhand	Ranchi	RCI	Dr. Binay Kumar, Jr. Scientist
12	Gujarat	Nawagam	NWG	Dr. Sanju Thorat, Asst. Res. Scientist
13		Navsari	NVS	Dr. P. D. Ghoghari, Assoc. Res. Scientist (Entomology)
14	Haryana	Kaul	KUL	Dr. Sumit Saini, Asst. Scientist (Entomology)
15	H.P	Malan	MLN	Dr. Chavi, SMS, Entomology
16	J & K	Chatha	CHT	Dr. Rajan Salalia, Jr. Scientist (Entomology)
17		Khudwani	KHD	Dr. Basheer Ahmed , Professor, (Entomology)
18	Karnataka	Brahmavar	BRM	Dr. Revanna Revannavar, Entomologist
19		Gangavathi	GNV	Dr. Sujay Hurali, Scientist (Entomology)
20		Mandya	MND	Dr. Kitturmath, Entomologist
21	Kerala	Moncompu	MNC	Dr. Jyoti Sara Jacob, Asst. Prof. (Entomology)
22		Pattambi	PTB	Dr. K. Karthikeyan, Prof. of Entomology
23	M.P	Rewa	REW	**No Entomologist-No trials allotted**
24	Maharashtra	Karjat	KJT	Dr. Vinayak Jalgaonkar, Entomologist
25		Sakoli	SKL	**No Entomologist, Trials were conducted**
26	Manipur	Wangbal	WBL	**No Entomologist-No trials allotted**
27	Odisha	Cuttack*	CTC	Dr. P.C Rath, Principal Scientist (Entomology)
28		Chiplima	CHP	Dr. Atanu Seni, Jr Entomologist
29	Punjab	Ludhiana	LDN	Dr. P. S. Sarao, Principal Scientist
30	Tamil Nadu	Aduthurai	ADT	Dr. P. Anandhi, Asst. Professor
31		Coimbatore	CBT	Dr. Sheela Venugopal, Asst. Professor (Entomology.)
32	Tripura	Arundhutinagar*	AND	Dr. Srikantanath, Asst. Dir. of Agril.
33	Telangana	Jagtial*	JGT	Dr. S. Omprakash, Scientist (Entomology)
34		Rajendranagar	RNR	Dr. N. Ramagopala Varma, Pr. Scientist (Ento.)
35		Warangal	WGL	Dr. R. Shravan Kumar, Scientist (Ento)
36	Union Territory	Karaikal*	KRK	Dr. K. Kumar, Prof. & Head (Agril. Entomology)
37		Kurumbapet	KBP	**No Entomologist-No Trials allotted**
38	Uttaranchal	Pantnagar	PNT	Dr. Ajay K. Pandey, Prof. (Dept. of Entomology)
39	Uttar Pradesh	Masodha	MSD	Dr. Sanjai Rajpoot, Entomologist
40		Ghaghraghat	GGT	- do -
41	West Bengal	Chinsurah	CHN	Dr. Sitesh Chatterjee, Entomologist

* - Voluntary Centre

Appendix II

State	Location	*Rabi* 2021-22		*Kharif* 2022	
		Allotted	Recd.	Allotted	Recd.
Andhra Pradesh	Bapatla *	0	0	3	3
	Maruteru	6	5	13	13
	Nellore *	0	0	8	7
	Ragolu *	1	0	8	4
Assam	Titabar	2	0	11	11
Bihar	Pusa	0	0	7	6
Chattisgarh	Ambikapur *	0	0	8	8
	Jagdalpur	0	0	12	12
	Raipur	1	1	13	13
Gujarat	Navsari	0	0	9	9
	Nawagam	0	0	9	9
Haryana	Kaul	0	0	5	5
Himachal Pradesh	Malan	0	0	8	7
Jammu & Kashmir	Chatha	0	0	6	6
	Khudwani	0	0	5	5
Jharkhand	Ranchi	0	0	5	4
Karnataka	Brahmavar	0	0	5	5
	Gangavathi	3	0	14	14
	Mandya	0	0	10	10
Kerala	Moncompu	1	1	11	11
	Pattambi	4	4	11	11
Madhya Pradesh	Rewa	0	0	0	0
Maharashtra	Karjat	2	2	7	7
	Sakoli	0	0	9	4
Manipur	Wangbal	0	0	0	0
New Delhi	New Delhi *	0	0	4	4
Odisha	Cuttack *	3	2	7	5
	Chiplima	1	1	10	9
Puducherry	Karaikal *	0	0	3	3
	Kurumbapet	0	0	0	0
Punjab	Ludhiana	0	0	14	14
Tamil Nadu	Aduthurai	3	3	12	12
	Coimbatore	2	1	12	12
Telangana State	Jagtial *	0	0	6	5
	Rajendranagar	2	2	11	11
	Warangal	0	0	11	11
Tripura	Arundhutinagar *	0	0	4	3
Uttar Pradesh	Ghaghraghat	0	0	6	6
	Masodha	0	0	5	5
Uttaranchal	Pantnagar	0	0	12	12
West Bengal	Chinsurah	4	1	12	8
Total trials in funded and voluntary centres		29	22	320	314
% Receipt of data for *kharif 2022*& *rabi 2021-22*		**79.3**		**93.8**	
Overall % Receipt of data		**86.6**			

Appendix-III

List of Abbreviations						
a.i.	:	Active ingredient		LF	:	Leaf folder
ADL	:	Average damaged leaves		MB	:	Mirid bug
AT		After treatment		MLB	:	Mealy bug
Av.No./AN	:	Average number		N.n	:	*Nephotettix nigropictus*
AW	:	Army worm		N.v	:	*Nephotettix virescens*
BB	:	Blue beetle		N.vi	:	*Nezara viridula*
BCR	:	Benefit cost ratio		No./10h	:	Number per 10 hills
BPH	:	Brown planthopper		NP	:	Net profit
BT		Before treatment		NPT	:	Number of promising tests
Cocc.	:	Coccinellids		NT	:	Not tested
CPP	:	Cost of plant protection		PH	:	Planthoppers
CW	:	Case worm		PLD	:	Promising level of damage
DAT/DT	:	Days after transplanting		PM	:	Panicle Mite
DG	:	Damaged grain		PSB	:	Pink stem borer
DH	:	Dead hearts		RF	:	Rainfall
DHB	:	Dark Headed borer		RH	:	Relative humidity
DL	:	Damaged leaves		RT	:	Rice thrips
DP	:	Damaged plants		SBDH	:	Stem borer dead heart
DS	:	Damage score		SBWE	:	Stem borer white ear
FR	:	Field reaction		SW		Standard week
RGB	:	Rice Gundhi bug		SS	:	Silver shoots
GH	:	Greenhouse reaction		SSB	:	Striped Stem borer
GHC	:	Green horned caterpillar		SSH	:	Sunshine hours
GLH	:	Green leafhopper		WB	:	Water bug
GMB	:	Gall midge biotype		WBPH	:	White-backed planthopper
Gr. H	:	Grasshopper		WE	:	White ears
GSB	:	Green stink bug		WLH	:	White leafhopper
HB	:	Hopper burn		WM	:	Whorl maggot
HBP	:	Hopper burned plants		WSB	:	White Stem borer
IOC	:	Increase over control		YSB	:	Yellow stem borer
IPD	:	Infested Plants Dead		ZZLH	:	Zigzag leafhopper

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