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PREFACE

Rice is the most important food crop of our country and identifying solutions for issues faced in cultivation and production of the crop is the key for national food security. Under the All India Coordinated Rice Improvement Project (AICRIP), evaluation of crop improvement, crop production and crop protection technologies across locations has been undertaken to contribute towards strategies adapted by rice farmers for sustainable rice production. About 400 scientists, belonging to ICAR - Indian Institute of Rice Research, 45 funded and more than hundred voluntary centres of State Agricultural Universities, Departments of Agriculture, ICAR Institutes and Private Undertakings work towards progress of rice research under the umbrella of AICRIP.

This volume reports the salient findings of experimental trials in Entomology and Plant Pathology during 2021. Despite unusual situation faced by nation due to Covid-19 pandemic, the scientists involved in AICRIP system conducted majority of the trials allotted showing their commitment to the programme. The major goal of Crop Protection programme of AICRIP is to develop broad based, environmental-friendly, cost effective and adaptable IPM technologies which can help in alleviating socio-economic constraints by providing gainful benefits for rice farmers. Emphasis is on safe and cost-effective IPM components such as host plant resistance, ecological studies, biological control utilization as well as need based application of safe chemicals. Regular monitoring of pest occurrence at various locations across nation is undertaken to know changing pest scenario and to have timely management interventions. Efforts are also underway to build decision support systems for assisting farmers in decision making.

I compliment the efforts of the entire staff of Entomology and Plant Pathology including Principal Investigators, Cooperating scientists, technical and supporting personnel for their contribution in bringing out this document containing useful and pertinent information related to rice IPM.

(R. M.Sundaram)

Director

April 2022

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2 Entomology *Kharif* 2021

SUMMARY

All India Coordinated Entomology Programme was organized and conducted during *kharif* 2021 with seven major trials encompassing various aspects of rice Entomology were conducted at 38 locations (IIRR, 28 funded & 9 voluntary centres) in 21 states and 2 Union territories. During *kharif* 2021, 268 experiments (98.13%) were conducted in funded centres and 52 experiments (88.46%) in voluntary centres. Details of scientists involved in the program at headquarters, cooperating centres and the performance of centres is provided in Appendices I and II.

2.1 Host plant resistance studies comprised of six screening experiments involving 1562 entries which included 1324 pre-breeding lines, 100 hybrids, two varieties, 13 germplasm accessions and 121 check varieties. These entries were evaluated against 13 insect pests in 182 valid tests (48 greenhouse reactions +134 field reactions). The results of these reactions identified 80 entries (5.12 % of the tested entries) as promising against various insect pests. Of these promising entries, 18 entries (22.5%) were under retesting. The trial wise summary of the results of the evaluations are given below:

Planthopper screening trial (PHS): Evaluation of the 145 entries against the two planthoppers, BPH and WBPH in 10 greenhouse and 7 field tests indicated 16 entries (11 breeding lines, 1 land race, 1 local collection and 3 three checks) as promising in 4 to 15 valid tests. Three breeding lines viz., HWR-1-IR83784-5-28-B, HWR-15-IR 75870-5-8-5-B-5-B, KNM 7660 performed better in the second year of retesting.

Gall midge screening trial (GMS): Evaluation of 115 entries in 8 field tests and one greenhouse reaction against 9 populations of gall midge helped in identification of six entries in 5-6 tests of the 9 valid tests. ENTGP 2018-178 which is in third year of testing and Aganni were promising in 6 tests. RP 6614-102-11-3-3-1-1-1(FBL 19102), RP 6614-112-11-4-2-1-1-1(FBL 19112), WGL 21 (IBT), RP6504-75 (APKS 82-75), were promising in 5 of the 9 valid tests.

Leaf Folder Screening Trial (LFST) Field evaluation of 24 entries replicated thrice at 20 locations in during *Kharif* 2021, revealed that 14 entries were promising in 4-8 tests out of 12 valid field tests. In the second year of testing, BPT 2699 was found promising in 8 of the 12 valid tests while three entries, NWGR 15028, BPT 3059 and BPT 3034 were found promising in 6 of the 12 valid tests. Other entries were also found promising in 3-5 tests out of 12 valid tests. Entries from Bapatla were found promising last year also in 2-4 tests out of 13 valid field tests.

Stem borer screening trial (SBST) Forty five entries were evaluated in 18 valid field tests which helped in identification of 11 entries as promising in 6 to 8 of the 18 tests in terms of low dead hearts (≤10% DH, DS=3.0), white ear damage ≤5% WE (DS=1.0). They were also promising in 2 to 7 tests with high grain yield (≥15.0 g/hill) in 10 valid tests suggesting that recovery resistance and tolerance could be the mechanisms in these entries as they have good grain yield despite damage. The mean no. of larvae in the stubbles in these entries varied from 0.39-1.03/hill.WGL 1062, RP 5587-B-B-B-273-1, NND5, NND2, RP 5588, HWR 17, RP 5588-B-B-B-B-223, BK 64-116 and RP 2068-18-3-5 were under retesting.

Multiple resistance screening trial (MRST) was constituted with 35 entries which included breeding lines, germplasm accession and check varieties and evaluated at 26 locations against 12 insect pests. Valid data from 7 greenhouse and 42 field tests against 8 insect pests identified Two germplasm accessions, CRCPT 7 and CRCPT 8 as promising in 6 and 5 tests respectively against 4 pests with a per cent promising reaction (PPR) of 6.12 and 5.10. RP Bio 4918-230 was promising in 5 tests against 3 pests with a PPR of 3.83. The check lines W1263, RP 2068-18-3-5, Suraksha and PTB 33 were promising in 7-12 valid tests against 3-5 pests with a PPR of 5.36 -15.31.

National Screening Nurseries (NSN): IRRI-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: Evaluation of 313 entries (289 AVT entries with checks 24 checks) at 18 locations in 8 greenhouse and 17 field tests against 8 insect pests identified seven entries viz., IET nos 28981, 29343, 28524, 29410, 28818, MTU 1121 (RP), and 30253, as promising in 5 tests of the 25 valid tests against four to five pests. RP2068-18-3-5 and PTB 33 were promising in 6 and 5 tests, respectively).

IIRR-NSN2*:* Evaluation of 635 NSN 2 entries (611 entries with 24 checks) in 24 valid tests (9 greenhouse and 15 field tests) against 9 insect pests identified IET nos 29916 30068 and RP 2068-18-3-5 as promising in 5 tests, IET nos. 30144, 30163, 29808, 30232, 30248, 29830, 29834, 30258, 30261, 30102, and PTB-33 as promising in 4 tests of the 24 valid tests.

IIRR- NSN hills*:* Hill entries (104 hill entries + 24 checks) were evaluated at 7 locations in 11 valid tests (6 greenhouse and 5 valid field tests) against 6 insect pests. Four test entries viz., Vivekdhan 86 (NC), IET Nos 28882, 29640, 28908 (R) along with PTB 33 and RP 2068-18-3-5 were promising in 3-4 test of the 11 valid tests.

***IIRR-NHSN**:* In this trial, 100 hybrids along with 22 checks were evaluated in 7 greenhouse and 10 field tests against 7 insect pests at 12 locations in 17 valid tests and identified IET 29743 and PTB33 as promising in 6 tests. IET 29749 and RP 2068-18-3-5 were promising in 4 tests of the 17 valid tests.

2.2 Insect biotype studies included four trials 1. Gall midge biotype trial (GMBT). 2. Gall midge population monitoring trial (GMPM) and 3. Planthopper Special Screening Trial (PHSS) 4) Planthopper population monitoring (PHPM).

Under **Gall midge biotype trial (GMBT)** reaction of 20 differentials in five different groups and TN1 was noted against different biotypes and populations of gall midge at 12 locations. Evaluation of the gene differentials in one greenhouse and 12 field tests in 12 locations identified Aganni (*Gm8*), INRC 3021(*Gm8*) and as promising in 10 of the 13 valid tests. W1263 (*Gm1*) and Kavya (*Gm1*) were promising in 7 and 6 tests, respectively of the valid 13 tests. The results suggest that donors with *Gm8* and *Gm1* gene and INRC 17470 (new donor) confer resistance to gall midge in infested areas.

Virulence composition of gall midge populations was monitored in **Gall midge population monitoring trial (GMPM)** at six locations *viz.*, Jagtial, Gangavathi, Moncompu, Pattambi, Ragolu and Warangal through single female progeny tests. Results suggest that Aganni *(Gm8)* holds promise at Jagtial, Ragolu and Warangal. Low virulence against W1263 *(Gm1)* was observed at Gangavathi, Pattambi and Warangal. However, a close monitoring of the virulence pattern in endemic areas is important.

Among the 17 gene differentials evaluated in **Planthopper special screening trial (PHSS**), two differentials *viz.,* PTB 33 (with *bph2*+*Bph3*+ *Bph32*+unknown factors) and RP 2068- 18-3-5 (with *Bph33(t)* gene) were promising in 10 and 9 tests respectively out of 11 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 only.

Planthopper population monitoring trial (PHPM) the virulence of brown planthopper populations was monitored using the three gene differentials *viz.*, PTB 33 (*bph 2, 3 and 32* genes), RP 2068-18-3-5 (*Bph 33t gene*) and RP Bio4918-230S (*Bph39 and 40* genes) at four locations. Results revealed that brown planthopper population at Gangavathi was more virulent than the other three BPH populations *viz.*, IIRR-Rajendranagar, Coimbatore and Ludhiana in terms of highest fecundity, nymphal hatching, lowest male population and highest

percentage of brachypterous adults. At all the locations, all the females were virulent.

Evaluation of granular insecticides against gall midge (EIGM) For gall midge management, seed treatment with thiamethoxam @ 4 g /kg seed followed by application of fipronil 3% GR @ 25 kg /ha at 20-25 days after transplanting was most effective across the locations with significantly lower per cent silver shoots (6.34%) as compared to the remaining treatments including the untreated control (15.60%) and check insecticide, carbofuran 3% CG (7.03%). Whereas, application of fipronil 3% GR in nursery @ 25 kg /ha + chlorantraniliprole 0.4 GR @ 10 Kg /ha at 20-25 days after transplanting resulted in significantly higher yield (3968.9 kg/ha).

For whorl maggot and leaf folder, in all the treatments significantly lower damage was recorded as compared to the untreated control and in general, combination treatments performed better than single application. For WM, T12 and T10 (2.09% and 2.10% DL respectively) were most effective though were at par with T7 (2.17%), T13 (2.39%), and T11 (2.69%). Similarly, For LF, T9 (2.69% DL), T13 (2.83%), T12 (2.85%), and T10 (2.91%) were significantly superior with lower damage as compared to the remaining treatments.

For BPH and WBPH, T9 (seed treatment with thiamethoxam + fipronil 0.4 GR in the main field) was the most effective as compared to rest of the treatments

Yield was significantly higher in all the treatments as compared to the untreated control (T14) (2707.6 kg/ha). T12 (fipronil granules in nursery + chlorantraniliprole granules in main field) was the best treatment with significantly higher yield (3968.9 kg/ha).

Insecticide Botanicals Evaluation Trial (IBET) was carried out at 30 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, 2021. 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.

Insecticide and botanical combination treatments were found moderately effective in reducing damage by hispa and whorl maggot. 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 yield of 4581.7 kg/ha with 44.2% increase over control followed by treatment with applications of neemazal, neem oil and triflumezopyrim showing yield of 4071 kg/ha (25.3% IOC).

Influence of crop establishment methods on pest incidence (IEMP) trial, a collaborative trial with Agronomy, was conducted at nine locations during Kharif 2021. Across the locations, incidence of dead hearts caused by stem borer was significantly high in wet DSR while white ears were high and at par in semi dry rice, normal transplanting, SRI and aerobic rice methods. Gall midge incidence was high in direct seeding while leaf folder damage was high in normal transplanting method. Hispa, whorl maggot, caseworm and blue beetle incidence was high in machine transplanting method. BPH incidence was high in direct seeding while WBPH in normal transplanting method across locations. In general, the incidence of pests was relatively high in machine transplanting, normal transplanting and direct seeding methods as compared to SRI, aerobic rice and semi dry rice methods.

Cropping system influence on insect pest incidence (CSIP), a collaborative trial with Agronomy was conducted at two locations during Kharif 2021. 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 11 locations during Kharif 2021.The field trial was constituted with normal and slow release blends of yellow stem borer, rice leaf folder and multispecies blend of both RLF and YSB pheromone compounds, as well as pink stem borer (PSB) and ear cutting caterpillar. The slow release blends recorded maximum catches compared to normal blends in case of all pests across locations. The peak mean catches of leaf folder per week were maximum at Aduthurai (33) followed by IIRR (18), while yellow stem borer, catches were maximum at Pattambi (23) followed by multispecies blend at IIRR (12), Pusa and Raipur (11). The slow release blend of ear cutting caterpillar, Mythimna separata recorded higher cumulative total catches (32) than the normal blend (15), at Ludhiana.

Ecological engineering for pest management (EEPM) was taken up in eight locations with a combination of interventions such as organic manuring, alleyways, spacing management, water management and growing of flowering

plants on bunds. The results indicated that water management along with ecological engineering significantly reduced hopper population at Warangal (4.26/hill) when compared to farmers practice (8.03/hill) while increasing yields. Habitat interventions increased the natural enemy populations like mirids, spiders and coccinellids at many locations – Coimbatore, Gangavati, Malan, Mandya, Moncompu and Warangal. While pest incidence was at par in Mandya, Moncompu, New Delhi and Bapatla, hoppers were increased in EE plots at Gangavati. At Warangal, the benefit cost was also significantly higher with ecological engineering and water management (1.67) when compared to Farmers' practice (1.28).

Bio intensive pest management trial (BIPM) was initiated to explore the feasibility of bio-intensive approaches for managing pests for organic rice cultivation. The trial was conducted in 13 locations this year. Low pest incidence was observed in Bapatla, Karjat, Karaikal, Ludhiana and Ranchi. Pests such as stem borer incidence was reduced in BIPM plots as in Chinsurah (14.17 %), Masodha (19.61 and Titabar (1.55 %) as compared to farmers practice where it was 25.25, 25.10, 30.22 and 8.08 % respectively. Pests such as leaffolder, whorl maggot and caseworm were also reduced in BIPM plots at Masodha and Titabar. The natural enemies such as spiders and coccinellids were higher in BIPM plots at Chinsurah, Gangavati, Ludhiana, Moncompu, Masodha and Titabar. In Jagdalpur, Moncompu and Raipur, the pest incidence was on par with that of Farmers' practice. Yields were higher in BIPM practices at Gangavati, Karjat, Moncompu, Masodha and Titabar indicating the economic sustainability of BIPM interventions.

Integrated Pest Management Special (IPMs) trial was conducted with Zone-wise practices at 19 locations in 40 farmers' fields during Kharif 2021. In Zone I (Hilly areas), hispa was the predominant pest causing increasing damage up to 29.17% damage at 71 DAT in FP plot as against 15.45% in IPM plot. In Zone II (Northern areas), incidence of stem borer, leaf folder, BPH and WBPH was observed. Leaf folder incidence (> 20% LFDL) was higher in FP plots at Kaul in all the three farmer's fields. In Zone III (Eastern areas) and Zone IV (North Eastern areas), stem borer, gall midge, leaf folder, BPH and other pests were observed but the incidence was low. In Zone V (Central areas), high incidence of thrips was reported in FP plots (> 10% THDL) compared to IPM plots. However, the incidence of stem borer, leaf folder and BPH was low. In Zone VI (Western areas), incidence of steam borer, leaf folder, BPH and WBPH was low in both IPM and FP plots across locations. In Zone VII (Southern areas), stem borer and BPH incidence was high in both IPM and FP plots at Aduthurai and Maruteru, respectively, whereas WBPH populations were higher in FP plots, at Gangavathi.

Adoption of IPM practices effectively reduced the disease progression of leaf blast, BLB, sheath blight, brown spot in Zone II (Northern areas), neck blast and sheath blight in Zone III (Eastern areas), bacterial blight and sheath blight in Zone IV (North Eastern areas), leaf blast in Zone V (central areas), neck blast,

sheath blight, sheath rot and grain discolouration in Zone VI (Western areas), leaf blast and grain discolouration in Zone VII (Southern areas).

In IPM adopted fields, the mean weed population reduction over the zones ranged from 41.02% in Zone III (Eastern areas) to 100 % in Zone II (Northern areas) at active vegetative stage. At panicle initiation stage, weed population reduction varied from 33.55% in Zone III (Eastern areas) to 69.79% in Zone I (Hilly areas). The dry weed biomass reported at 12 locations showed significant reduction by 5.67% in Zone I (Hilly areas), 64.84% in Zone VI (Western areas), 25.29% in Zone III (Eastern areas) to 51.76 in Zone VII (Southern areas).

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.

Population Dynamics of Rice Insect Pests Assessed Through Light Trap Catches 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, white stem borer, pink stem borer, black bug, gundhi bug, and zigzag leaf hopper showed an increase in the spread and intensity of incidence posing concern for future. Patterns in seasonal incidence and population build up on the basis of 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.

ENTOMOLOGY

INTRODUCTION

Insect pests are the prime constituents of biotic stresses creating hurdles for sustainable rice production across the world. Global climatic change, in recent times, has had a continued impact on crop cultivation practices resulting in altered pest profiles in rice. Socio-economic changes and associated ecological constraints make it particularly challenging for the farmers to battle the variety of pests infesting rice in our country. The national pests *viz.*, stem borer, gall midge, planthoppers and leaf folder consistently occur and affect rice crop across the diverse ecosystems. There are other pests of regional significance like hispa, caseworm, swarming caterpillar, cut worms etc. which also have the potential to cause economic losses to rice farmers under unpredictable situations.

Under All India Coordinated Rice Improvement Project (AICRIP) Entomology programme, our research focus is to develop and strengthen the theme of integrated rice pest management to achieve the sustainable goal of ensuring social, economic and ecological benefits for the rice farmers. Pest surveillance is the key initial step in any pest management programme. Under AICRIP, Pest Survey Reports (PSR) are generated at fortnightly interval by each cooperating centre that includes real time information on insect pest incidence in farmers' fields.

In 2021, Navsari area (Gujarat) leaf folder occurred in low to moderate levels during active tillering to booting stage. Whereas, in Kheda and Ahmedabad districts early in the season, leaf mite was a problem in some areas and caused damage up to 20-30%. Among the planthoppers, WBPH was predominant. At grain development stage, gundhi bug caused considerable damage. In Raigarh region (Maharashtra) moderate to high level of leaf folder and stem borer damage were noticed. Kuravai crop was heavily infested by black bug in Thanjavur area (Tamil Nadu). Whereas, in Nagapattinam severe damage was inflicted by leaf folder and leaf mite. In Pattambi (Kerala) severe incidence of BPH was on observed at Pattanchery, Kollengode, and Perumatti areas. In Hasanparti and Hanamkonda mandals of Warangal district (Telangana) low incidence of stem borer, moderate incidence of gall midge, very low incidence of leaf folder and whorl maggot were observed. In Jharkhand, termite, yellow stem borer, leaf folder and gundhi bug are major pests in upland rice. In Gopalganj and Sitamarhi (Bihar) during the booting stage yellow stem borer incidence was observed. In Burla, Dhankauda blocks of Sambalpur (Orissa) low incidence of gall midge was reported. In Karnal (Haryana) low incidence of leaf folder, stem borer, and planthoppers were reported, while late transplanted crop was affected by whorl maggot.

Development of multiple pest resistant varieties and strengthening all our efforts to consistently maintain a strong Host plant resistance programme is the important activity at different centres and target pests include mainly - planthoppers, gall midge, stem borer and leaf folder. Germplasm accessions of both indigenous and exotic origin, landraces, wild rice resources and advanced breeding lines at different stages are screened against insect pests and diseases at different centres, particularly hot spots for specific pests. Promising lines with desirable resistance traits are identified for use in advanced breeding programme. Apart from screening for major insect pest studies on the reaction of Gall midge and Planthoppers to various gene differentials is being undertaken to understand the virulence pattern. This year, a new trial has been constituted to study the virulence of Brown planthopper on selected differentials.

In view of the importance of all-round plant health, insecticides with their curative action and botanicals with their environment friendliness need to be integrated into pest management programmes to protect the interests of rice farmers. Of late, there is an uptrend in the incidence of gall midge in many areas leading to severe damage. Hence, the need is felt to identify the effective alternative granular insecticides for the management of gall midge. With this background this trial has been constituted and conducted to identify effective granular insecticides among the available options for the management. Efforts are also made not only to screen newer insecticide molecules for bio efficacy and safety but also investigate the possibility of alternating their use with botanicals possessing green chemistry and supplementary benefits as components of organic means of managing insect pests.

Investigations are also being made to study the underlying impact of climate change scenario on shift in cropping patterns and resultant alterations in pest profile dynamics. Few collaborative trials require involvement from agronomists at different cooperating centres.

Ecological engineering and bio-intensive pest management efforts aim to understand the ways of intelligently exploiting the rice ecosystem rich with natural enemy diversity for eco-frieIARy and economically gainful rice IPM.

Adaption of integrated pest management by farmers depends on the effectiveness of holistic solution provided to alleviate their multiple pest problems. In addition to enhanced yields farmers need to be convinced about economic gains from IPM implementation. Under AICRIP, farmer participatory multidisciplinary approach through involvement of Entomology, Plant Pathology and Agronomy researchers is being advocated to validate location specific IPM practices across the country.

Monitoring of insect pest populations through light traps at different locations helps in short- and long-term assessment of pest populations for use in pest forecasting.

The following report highlights the significant findings from the greenhouse evaluations and field trials carried out at IIRR and its cooperating centres under AICRIP during 2021.

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 along with the 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 1562 entries were evaluated at 37 locations against 13 pests and 80 (5.12%) entries were identified as promising. The pest reaction of the entries to pests in each trial are tabulated in a separate volume **"Screening Nurseries: Vol. II – Insect Pests & Diseases".** The results of the evaluation are discussed trial wise:

i) Planthopper screening trial (PHS)

The planthopper screening trial was constituted with 145 entries comprising of 1 breeding line developed at RRU, ANGRAU, Bapatla; 10 breeding lines developed at TNAU, Coimbatore; 26 breeding lines developed at RARS, PJTSAU, Jagtial; 16 breeding lines developed at Kunaram, PJTSAU; 4 breeding lines developed at ARI, PJTSAU; Rajendranagar, 21 breeding lines developed at RARS, PJTSAU, Warangal; 1 land race from RARS, KAU, Pattambi; 1 local collection and 13 breeding lines from IBT, PJTSAU, Rajendranagar; 5 breeding lines developed at RARS, Rudrur; 2 breeding lines developed at ARS, Sakoli; 8 STRASA lines, 17 breeding lines, and 1 introgression line of Improved Samba Mahsuri possessing *Bph33t (BC2F6),* 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, twelve entries were under retesting. The entries were evaluated at 13 locations in 17 tests against brown planthopper (BPH), whitebacked planthopper (WBPH) and mixed populations of planthoppers under both field and greenhouse conditions. Evaluation of entries in 8 greenhouse and 2 field tests against brown planthopper, 2 greenhouse and 1 field test against whitebacked planthopper and 4 field tests against mixed populations of planthoppers revealed 11 breeding lines *viz.*, HWR-1-IR83784-5-28-B*, HWR-15-IR 75870-5-8-5-B-5-B*, JGL 38168, JGL 38237, JGL 38180, JGL 36147, KNM 7660*, KNM 12505, RP-GP-3000-179-3-9-1, WGL 1533, RPGP-1311-20-5-4-2-3, one land race PTB21 from RARS, KAU, Pattambi and one local collection IBT-BPHM23 from IBT, PJTSAU performed better in 4 to 7 tests **(Table 2.1)**. Three breeding lines viz., HWR-1-IR83784-5-28-B, HWR-15-IR 75870-5-8-5-B-5-B, KNM 7660 and one land race PTB21 performed better in the second year of retesting. The susceptible check, TN1 recorded damage score in the range of 8.1 to 9.0 in these valid tests. The universal checks - PTB 33 and MO1 performed well in 15 and 6 tests respectively.

The breeding line, RP 2068-18-3-5 carrying BPH resistant Bph33t gene and identified as a donor check line for BPH performed better in 11 tests. Mixed populations of brown planthopper and whitebacked planthopper were present at Gangavathi, Pantnagar, Sakoli and Jagitial. Data on BPH and WBPH populations during the field evaluation at Gangavathi (WBPH: BPH in 1.3:1.0 ratio) revealed predominance of WBPH over BPH. At Nawagam, only WBPH was present. BPH was predominant throughout the crop season at Pantnagar (BPH is 6-200 times more than WBPH). At Rajendranagar and Aduthurai, only BPH population was present.

Overall reaction: *Evaluation of the entries against the two planthoppers BPH and WBPH in 10 greenhouse and 7 field tests indicated 16 entries (including 11 breeding lines, 1 land race, 1 local collection and 3 three checks) as promising in 4 to 15 tests. Three breeding lines viz., HWR-1-IR83784-5-28-B, HWR-15-IR 75870-5-8-5-B-5-B, KNM 7660 and one land race PTB 21 performed better in the second year of retesting.*

Table 2.1: Performance of the most promissing entries against planthoppers, PHS kharif 2021

Entry No.	Designation	Cross	Brown Planthopper										Whitebacked Planthopper			Planthoppers				No of promissing tests						
			IIRR	ADT	CBT	CTC	LDN	MND	PNT	WGL	ADT	RNR	IIRR	CBT	NWG	GNV	JGT	PNT	SKL							
			Greenhouse reaction								Field reaction		Greenhouse reaction		Field reaction	Field reaction				BPH		WBPH		PH		Total NPT
			DS								No/10hills		DS		No/10hills	No/10hills			%TD	GH (8)	Field (2)	GH (2)	Field (1)	Field (4)		
13	HWR-1-IR83784-5-28-B*	IR31917-45-3-2/O. *latifolia*100914(BC1F11)	3.1	9.0	3.0	9.0	3.3	3.0	8.8	9.0	89	36	2.5	2.8	73	7.0	42	98	79.4	4		2			6
15	HWR-15-IR 75870-5-8-5-B-5-B*	*IR 64 x O. glaberrima(BC1F11)*	3.2	7.0	3.0	9.0	3.0	5.0	9.0	9.0	84	53	6.8	1.8	105	5.0	28	68	40.8	4		1			5
32	IBT-BPHM23		3.0	9.0	2.8	NG	8.4	3.0	NG	8.2	101	35	5.6	3.0	77	5.0	48	84	67.7	3		1			4
53	JGL 38168	JGL 30865 X MTU 1156	3.2	5.0	8.6	NG	6.4	7.0	6.9	7.9	74	39	6.9	8.6	52	3.0	35	88	34.6	2	1		1	2	6
55	JGL 38237	GP 301 -3 X JGL 24423	3.3	3.0	8.8	NG	3.0	7.0	6.0	8.6	57	37	6.3	4.4	108	5.0	35	86	43.3	3	1				4
57	JGL 38180	JGL 30876 X JGL 18047	4.5	9.0	9.0	NG	NG	5.0	9.0	8.0	65	43	7.9	9.0	77	3.0	39	128	44.1	2	1			1	4
61	JGL 36147	JGL 19621 X NLR 34449	9.0	9.0	NG	NG	5.0	NG	7.6	NG	89	17	NG	NG	63	3.0		NG	35.0	1	1			2	4
62	KNM 7660*	TME 80518 x KNM 118	8.2	7.0	2.2	NG	8.4	5.0	7.5	7.1	NG	39	2.4	8.6	57	5.0	43	49	58.0	2		2		1	5
77	KNM 12505	KNM 118 X IR 72 // MTU 1156	6.6	9.0	3.0	9.0	3.0	7.0	6.5	4.9	93	40	5.7	6.4	55	7.0	39	137	43.8	3		1			4
79	PTB 21*	Land race	5.0	9.0	3.0	9.0	3.1	9.0	9.0	9.0	127	25	7.7	5.0	43	3.0	20	71	30.5	3			1	3	7
93	RP-GP-3000-179-3-9-1	MTU 1121/Vijetha	2.9	9.0	4.6	9.0	3.0	7.0	9.0	6.5	79	44	3.3	3.0	78	5.0	46	72	51.5	2		2			4
99	WGL 1533	WGL 32100/MTU 1936-12-1-2-1//MTU1081/HRR 2143	7.7	9.0	2.4	9.0	8.5	9.0	9.0	8.2	99	36	3.7	2.6	101	9.0	39	71	30.9	1		2		1	4
129	RPGP-1311-20-5-4-2-3	Gontrabidhan 3/IET 25358	1.5	9.0	3.0	NG	N.G	NG	9.0		102	44	4.5	6.0	101	5.0	9	120	55.3	2		1		1	4
80	PTB 33	Resistant check	1.5	3.0	2.4	2.7	3.0	3.0	2.5	7.7	72	36	3.3	2.8	36	1.0	9	60	28.2	7	1	2	1	4	15
60	MO1	Resistant check	7.4	9.0	6.0	NG	N.G	5.0	3.3		128	33	1.7	9.0	53	3.0	7	69	27.0	2		1	1	2	6
40	RP2068-18-3-5	Resistant check	0.8	5.0	2.8	5.0	2.8	3.0	3.4	0.4	85	43	6.8	3.0	98	3.0	20	63	54.3	8		1		2	11
Promising level			5.0	5.0	3.0	5.0	5.0	5.0	5.0	5.0	75	20	5.0	3.0	60	3.0	25	60	35.0						
No. of promising entries			30.0	20.0	26.0	9.0	25.0	23.0	9.0	15.0	18	4	21.0	16.0	12.0	32.0	14	12	19.0						

i)

ii) Gall midge screening trial (GMS)

The objective of this trial was to evaluate the performance of the breeding lines developed from known sources of gall midge resistance against various populations of gall midge. The trial was constituted with 115 entries (94 breeding lines along with six parents, 3 retesting entries, 2 varieties and 10 insect checks). The nominations included breeding lines that were developed from 49 crosses bred at 6 centres *viz* IIRR, IBT, PJTSAU, Jagtial, Kunaram, Warangal and Sakoli. Of these breeding lines, 28 lines were already identified as marker positive for various gall midge resistance genes like *gm3, Gm4, Gm8*. They 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 the 9 valid tests is discussed as under:

Seventy-three lines at IIRR and 43 lines at Jagdalpur recorded nil damage. Thirty two lines recorded nil damage against both populations IIRR and JDP.

At Cuttack, only JGL 38125 recorded nil damage apart from the resistant checks W1263, Aganni and Abhaya. WGL 1614, RP 6614-101-7-2-2-1-1-1(FBL 19101, *Gm8*), FBL 19102 (RP 6614-102-11-3-3-1-1-1 *Gm8*), FBL 19112 (RP 6614-112-11-4-2-1-1-1 with *Gm8*), Karma Mahsuri, Akshayadhan (*Gm4+Gm8*), RP6504-75 (APKS 82-75), RP6505-20 (APKS 83-20), ENTGP 2018-178, GM 4 (IBT), GM 5 (IBT), WGL 2 (IBT), WGL 3 (IBT), WGL 21 (IBT), WGL 31 (IBT) and Aganni recorded nil damage at Jagtial.

Eleven entries viz., RP 6614-101-7-2-2-1-1-1(FBL 19101, *Gm8*), FBL 19102 (RP 6614-102-11-3-3-1-1-1 *Gm8*), GM 4 (IBT), GM 5 (IBT), WGL 31 (IBT), RP 5923*, RP6504-58 (APKS 82-58), ENTGP 2018-178*, RP 6290-20-6, Karma Mahsuri and Aganni recorded nil damage against gall midge populations at Sakoli.

Eight entries *viz.*, KNM 12392, WGL 1508, FBL 19112, GM 5 (IBT), WGL 21 (IBT), RP6504-75(APKS 82-75), RP6505-20(APKS 83-20) and RP 6290-20-6 recorded nil damage against gall midge populations at Warangal.

JGL 34985, JGL 35161, JGL 38071, JGL 38206, KNM 12368, KNM 12424, WGL 1590, WGL 1620, WGL 1624 GM 40 (IBT) Kavya, Mahamaya, and RP 2068-18-3-5 recorded nil damage against gall midge populations at Pattambi. Twenty one entries recoded nil damage at Nellore.

Overall reaction: *Evaluation of 115 entries in 8 field tests and one greenhouse reaction against 9 populations of gall midge helped in identification of six entries in 5-6 tests* of the 9 valid tests. *ENTGP 2018-178 which is in third year of testing and Aganni were promising in 6 tests. RP 6614-102-11-3-3-1-1-1(FBL*

19102), RP 6614-112-11-4-2-1-1-1(FBL 19112), WGL 21 (IBT), RP6504-75 (APKS 82-75), were promising in 5 of the 9 valid tests ***(Table 2.2)****.*

Table 2.2: Reaction of the most promising rice cultures to gall midge populations in GMS, *kharif* 2021

Entry No.	Designation	Cross combination	IIRR	JDP	CHP	CTC	JGT	SKL	WGL	PTB	NLR	Overall NPT
			GH	50DT	50DT	16DAR	50DT	50DT	50DT	50DT	50DT	
			%DP	%DP	%DP	%SS	%DP	%DP	%DP	%DP	%DP	9
71	RP 6614-102-11-3-3-1-1-1(FBL19102)	WGL 14 (*Gm8*)	0	0	0	NT	0	0	5	4.8	20	**5**
75	RP 6614-112-11-4-2-1-1-1(FBL 19112)	WGL 14 (*Gm4 &Gm8*)	0	0	0	NT	0	20	0	42.9	15	**5**
87	WGL 21 (IBT)*	MTU1010 (Gm4& Gm8)	0	0	0	NT	0	10	0	19.1	25	**5**
96	RP6504-75 (APKS 82-75)	INRC 17470 X TN1	0	0	0	NT	0	10	0	14.3	31.6	**5**
109	ENTGP 2018-178*		0	0	0	NT	0	0	5	9.5	0	**6**
30	**Aganni**		0	0	0	0	0	10.5	10	9.5	0	**6**
Total Tested			91	114	114	55	112	113	112	115	114	
Max. in the trial			62.5	100.0	100.0	100.0	100.0	10.0	75.0	76.2	90.0	
Min. in the trial			0	0	0	0	0	0	0	0	0	
Average damage in the trial			5.1	35.1	14.8	51	75.2	78.2	26.7	18.9	24.2	
Average damage in TN1			61.3	85	55	95.2	100	100	52.5	35.7	35.9	
Promising level			0	0	0	0	0	0	0	0	0	
No. promising			75	43	44	4	17	11	8	13	21	
* Entry under retesting												

Pest pressure was low at MTU, MNC & RCI was low hence not considered for analysis; * Entry under retesting

iii) Leaf folder screening trial (LFST)

Leaf Folder Screening Trial (LFST) was constituted in the field to identify new sources of resistance to rice leaf folder, *Cnaphalocrocis medinalis.* The nominations included 16 entries from Bapatla, Rice section, Acharya NG Ranga Agricultural University; two entries from Nawagam Main Rice Research Station, Anand Agricultural University; two back-cross inbred lines (BILs) of Swarna/*Oryza nivara* from IIRR along with susceptible check (TN1) and resistant check (W 1263). During *Kharif* 2021, the trial was conducted at 20 locations with 24 entries replicated thrice in a randomised block design.

This is the second year of testing of these entries across locations except the two entries from Nawagam. The maximum damage in the entries varied between 12.8 and 75.8% while the average damage in the trial ranged from 7.7 to 58.2%. Data analysis revealed 14 entries as promising in 4-8 tests of 12 valid field tests (**Table 2.3**). In the second year of testing, BPT 2699 was found promising in 8 out of 12 valid tests. One entry from Nawagam (NWGR 15028) and two entries from Bapatla (BPT 3059, BPT 3034) were found promising in 6 of 12 valid field tests. Four entries from Bapatla (BPT 2954, BPT 3081, BPT 2935 & BPT 2667) were promising in 5 of 12 valid tests. Six entries were found

promising in 4 out of 12 valid field tests which included one entry from Nawagam (NWGR 16032) and five entries from Bapala (BPT 3032, BPT 3049, BPT 3157, BPT 3115, BPT 2953). Except BPT 2824, other entries were found promising in 3 of 12 valid tests.

Field evaluation of 24 entries replicated thrice at 20 locations in ***Leaf Folder Screening Trial (LFST)*** *during Kharif 2021 revealed that 14 entries were promising in 4-8 tests out of 12 valid field tests. In the second year of testing, BPT 2699 was found promising in 8 of the 12 valid tests while three entries, NWGR 15028, BPT 3059 and BPT 3034 were found promising in 6 of the 12 valid tests. Other entries were also found promising in 3-5 tests out of 12 valid tests. Entries from Bapatla were found promising last year also in 2-4 tests out of 13 valid field tests.*

Table 2.3 Performance of promising entries against leaf folder in LFST, Kharif 2021

Designation	Parentage	ADT	KRK	CHT	CTC	KUL	LDN	MLN	MSD	NLR	NVS	NWG	PTB	NPT
		80 DT	60 DT	90 DT	80 DT	80 DT	80 DT	45 DT	80 DT	50 DT	80 DT	60 DT	60 DT	12
BPT 2699	BPT 5204/RP 4677-16-6-1-12-1	3.0	15.4	19.4	5.4	23.6	44.6	20.8	8.2	12.6	7.0	8.9	41.0	8
NWGR 15028	GR-11/MTU1010	6.4	8.5	21.0	3.9	25.0	31.5	21.1	7.9	15.3	7.9	10.2	37.6	6
BPT 3034	BPT 5204/MTU 1075	3.5	13.3	19.8	6.5	26.3	43.8	21.6	7.5	20.0	6.8	9.4	63.6	6
BPT 3059	MTU 1061/IR 78585-64-24-2-4-3-1	47.1	19.9	18.6	9.4	23.9	44.3	20.9	6.4	21.1	2.6	9.1	73.5	6
BPT 3081	BPT 5204/MTU 1075	28.5	14.8	19.7	9.5	23.8	42.4	21.6	6.5	25.8	3.9	11.9	54.0	5
BPT 2935	MTU 1010/IR 50	14.9	17.8	19.4	5.9	23.6	42.2	21.3	11.4	17.6	6.0	9.7	49.7	5
BPT 2677	MTU 2077/Ajay/MTU 2077	14.3	16.7	18.6	9.2	27.3	47.4	20.3	6.3	14.7	10.1	9.6	36.5	5
BPT 2954	NLR 34449/Annada/NLR 34449	27.4	10.3	21.1	2.7	31.5	40.3	21.1	9.5	13.4	2.5	9.9	61.4	5
BPT 3032	BPT 5204/IR 50	29.9	17.6	20.1	10.0	27.3	39.4	19.6	7.3	20.5	5.5	8.9	75.4	4
BPT 2953	BPT 5204/IR 50	30.9	16.5	20.4	10.4	23.2	53.1	21.3	5.9	22.8	9.4	8.8	68.1	4
BPT 3049	MTU 1010/IR 50	19.2	15.5	20.3	7.2	32.1	51.1	21.3	8.0	20.2	7.3	8.8	58.7	4
BPT 3157	MTU 7029/IRGC 18195/MTU 1081	51.0	12.3	21.5	8.0	31.7	48.7	19.8	7.9	22.0	4.3	10.2	68.4	4
BPT 3115	BPT 2270/NLR 145	35.5	17.0	21.0	4.6	27.4	38.3	20.3	9.8	22.9	6.7	9.3	64.9	4
NWGR 16032	Gurjari/NWGR-3015	39.9	16.1	20.8	3.7	31.7	40.5	20.5	6.4	20.4	8.0	9.2	44.8	4
W1263	Resistant check	5.8	1.6	20.4	1.2	20.4	24.8	21.5	6.4	14.9	2.3	8.6	21.5	10
TN1	Susceptible check	72.0	24.1	20.6	28.7	34.3	55.1	21.9	14.7	50.3	18.0	12.8	75.7	
Minimum damage		3	1.6	18.6	1.2	20.4	24.8	19.6	5.4	12.6	2.3	8.6	21.5	
Maximum damage		72	24.1	21.5	28.7	34.3	58.8	21.9	14.7	50.3	18	12.8	75.8	
Average damage in trial		28.8	15.2	20.2	8	26.6	44.7	21	7.9	22	7.7	10	58.2	
Promising level		10	10	20	10	25	30	20	10	15	10	10	25	
Number Promising		3	1	7	16	9	0	2	19	3	15	12	0	

Data from Arundhutinagar, Bapatla, Chinsurah, Gangavathi, Jagdalpur, Khudwani, Karjat and Rajendranagar was not considered for the 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 conducted during kharif 2021 with 45 entries which included 6 new nominations from IIRR (3 BPT mutants and 3 ILs from Swarna X *O.nivara*); one from Cuttack, eight from Jagtial, six from Rudrur, one from Sakoli and 17 entries found promising in the earlier years under retesting along with the checks, PB1, TN1 , W 1263, Sasyasree and TKM6. The entries were evaluated at 17 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 and white stem borer, *S. fusciflua* at Malan. The results of the evaluation from the valid tests are discussed below **(Table 2.4)**.

Dead heart damage: The dead heart damage in the trial varied from 0.0 to 56.9% with an average damage of 18.0% DH across 6 locations in 7 valid tests. Evaluation of entries for dead heart damage at 30 and 50 DAT in two staggered sowings helped in identification of four entries-CR Dhan 308, JGL 38190 and Chandrahasini (only 3 entries) as promising in 3 tests out of 7 valid tests with ≤10% DH (DS3.0). Another 15 entries were promising in 2 of the 7 valid tests which included 7 retesting entries.

White ear damage: The white ear damage across 9 locations in 11 valid tests varied from 0.0 to 75.6% with a mean of 12.92% WE. Evaluation of entries identified WGL 1062, RP 5587-B-B-B-273-1 and NND5 as promising in 6 of the 11 tests with ≤5% WE (DS1.0). HWR 17, RP5588, RP 2068-18-3-5**,** RP 5587-B-B-B- -267, NND2, BK64-116 were promising in 5 tests of the 11 valid tests with ≤5% WE (DS1.0). All the entries were under retesting. The larval survival per entry across 8 locations in 12 tests varied from 0 to 1.9 larvae/hill in the stubbles with a mean of 1.14 larvae/hill.

Grain yield: HWR 17, NND-2, NND4 (all the three under retesting) and Chandrahasini were promising in 6-7 tests of the 10 tests with ≥15g/hill despite stem borer damage in the valid tests.

Overall reaction: *Evaluation of entries in 18 valid field tests identified 11 entries as promising in 6 to 8 of the 18 tests in terms of low dead hearts (≤10% DH), white ear damage ≤5% WE. They were also promising in 2 to 7 tests with high grain yield (≥15.0 g/hill) in 10 valid tests suggesting that recovery*

resistance and tolerance could be the mechanisms in these entries as they have good grain yield despite damage. The mean no. of larvae in the stubbles in these entries varied from 0.39-1.03/hill (Table 2.4). WGL 1062, RP 5587-B-B-B-273-1, NND5, NND2, RP 5588, HWR 17, RP 5588-B-B-B-B-223, BK 64-116 and RP 2068-18-3-5 were under retesting.

Table 2.4 Reaction of most promising cultures to stem borer in SBST, kharif 2021.

SBST No.	Entries	No. of Promising tests(NPT)					
		SBDH	SBWE	SBDH + SBWE	GY/hill	SBDH+SBWE + GY/Hill	Mean larvae/hill
		7	11	18	10	28	
23	WGL 1062*	2	6	8	5	13	0.39
26	RP 5587-B-B-B-273-1*	2	6	8	4	12	0.87
36	NND5*	2	6	8	3	11	1.03
34	NND-2*	2	5	7	6	13	0.87
39	RP5588*	2	5	7	4	11	1.36
27	HWR 17*	1	5	6	6	12	0.82
31	BK 64-116*	1	5	6	3	9	0.87
33	RP 2068-18-3-5*	1	5	6	2	8	0.97
41	NSR 10 (RP BIO 4919)	2	4	6	3	9	0.63
1	CR Dhan 308	3	3	6	4	10	0.95
24	Chandrahasini	3	3	6	7	13	0.83

*Entry under retesting

Data on dead heart damage from ANR, GGT, ADT, PTB, MNC, MLN, RNR, RPR,TTB; white ear damage from CBT,GGT, NLR, RNR, PTB & MNC not considered for analysis due to low pest pressure. No infestation observed at CTC.

Valid data considered for analysis

	Locations											NPT
Dead heart damage	ADT	CHN set II	IIRR	NVS	PNT-I	PNT-I	PSA					7
White head damage	ADT	CHN set I	CHN set II	IIRR	MLN	NVS	NVS	PNT-I	PSA	RPR	TTB	11
Grain yield	ADT	CHN set I	CHN set II	IIRR	NVS	NVS	PNT-I	PSA	RPR	TTB		10

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 35 entries consisting of one nomination from SBST trial, 6 entries from PHS trial, one nomination from ARS, Rajendranagar; one from Nawagam; 7 introgressed lines from IIRR *(*derived from *O. nivara* in the background of Swarna); 6 entries under retesting along with four resistant and one susceptible check were evaluated against 12 insect pests at 26 locations. Some of the introgressed lines were promising for disease resistance and hence 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: RMS-ISM-BPh33-1 (ISM X RP2068-18-3-5) is the only entry promising in 3 of the 4 greenhouse tests against BPH with a DS ≤3.0 and at par with both the resistant checks, PTB33 and RP2068-18-3-5. At Coimbatore it had recorded a DS ≤3.2.

WBPH: None of the entries were found promising at IIRR but 14 lines recorded a DS≤3.0 at Coimbatore in greenhouse reactions.

Gall midge: Evaluation was carried out in one greenhouse and 7 field tests and identified five entries as promising in 3-5 tests. RNR 35105 (JGL 24423 / MTU 1156) was promising with nil damage in 4 of the 8 tests against gall midge. SKL 07-8-720-63-147-182-276, in the second year of retesting and NWGR 16031, a new entry (Gurjari/Varalu) were promising in 3 tests. The resistant checks, Suraksha and W1263 were promising with nil damage in 5 tests.

Stem borer: Entries were evaluated against stem borer at vegetative phase for dead heart damage in 8 valid tests. NWGR 16031 (Gurjari/Varalu) and RP 6461-248-1 (*Swarna/O. nivara*) recorded nil dead heart damage in 2 of the 7 valid tests. RP Bio 4918-230, CRCPT 7, HWR 20, JS 5, RP 179-3-9-1, RP Bio 4918-228-1, PTB 33, RP 2068-18-3-5 were promising with nil damage in 2 to 3 tests out of 14 valid tests for white ear damage at reproductive phase. JS 5 is in the second year of testing. All these lines recorded <17.5% WE damage (DS 1-7) under infested conditions at IIRR also, except PTB33 and RP Bio 4918-228-1.

Foliage feeders: Incidence of leaf folder, whorl maggot, case worm and rice hispa were observed at various locations. W 1263 and RP 2068-18-3-5 recorded nil damage for leaf folder at 45 DAT in Navsari out of the 8 valid tests. Entries were evaluated at 30 DAT for whorl maggot damage at both Pattambi and Jagdalpur. The average damage in the trial was 12.52% DL but none of the entries were promising. None of the entries were found promising for rice hispa at Malan and case worm at Titabar.

***Overall reaction**: Evaluation of 35 entries in 7 greenhouse and 42 field tests against 8 insect pests helped in identification of 3 new cultures and 4 check lines as promising in 5-12 tests against 3-5 pests. CRCPT 7 and CRCPT 8 were promising in 6 and 5 tests respectively against 4 pests with a PPR of 6.12 and 5.10. RP Bio 4918-230 was promising in 5 tests against 3 pests with a PPR of 3.83. The check lines W1263, RP 2068-18-3-5, Suraksha and PTB 33 were promising in 7-12 tests against 3-5 pests with a PPR of 5.36 -15.31 **(Table 2.5)**.*

Table 2.5 Reaction of most promising cultures to insect pests in MRST, kharif 2021.

S.No.	Designation	Cross / Designation	No. of promising tests(NPT)										No. of promising		MRI	
			BPH	WBPH	BPH + WBPH	GM	SBDH	SBWE	LF	WM	RH	CW	Tests	Pests	P X T	PPR
			4	2	1	8	8	14	8	2	1	1	49	8	392	
18	CRCPT 7	CR AC 35003	1	1	0	1	0	3	0	0	0	0	6	4	24	6.12
19	CRCPT 8	CR AC 34997	1	1	0	2	0	1	0	0	0	0	5	4	20	5.1
7	RP Bio 4918-230	(Swarna/*O. nivara)*	1	0	0	1	0	3	0	0	0	0	5	3	15	3.83
	Checks															
15	W 1263		0	0	0	5	0	1	1	0	0	0	7	3	21	5.36
20	Suraksha		0	0	0	5	1	1	0	0	0	0	7	3	21	5.36
25	RP 2068-18-3-5		3	0	0	2	1	2	1	0	0	0	9	5	45	11.48
10	PTB 33		3	1	0	3	2	3	0	0	0	0	12	5	60	15.31

MRI- Multiple resistance index.

PPR-Per cent Promising reaction: MRI of test entryX100/Total MRI

Valid data considered for analysis in MRST, kharif 2021

Reaction	Insect pests	Locations														NPT
GH	BPH	IIRR	LDN	MND	CBT											4
GH	WBPH	CBT	IIRR													2
Field	BPH + WBPH	GNV														1
Field	GM	IIRR-GH	CHP	JDP	RCI	WGL	PTB	ABP	GNV							8
Field	SBDH	IIRR	ADT	GNV	MSD	NVS	PNT	PSA	TTB							8
Field	SBWE	SKL (EP)	IIRR (Infested)	MSD	ADT	CHN	GNV	LDN	NVS	NWG	PNT	PSA	TTB	WGL	PTB	14
Field	LF	MSD	ADT	CHT	NVS	NWG	PNT	PSA	TTB							**8**
Field	WM	JDP	PTB													**2**
Field	RH	MLN														1
Field	CW	TTB														1

vi. IIRR-National Screening Nurseries

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 313 entries (289 AVT entries along with 10 insect checks and 14 disease checks) was evaluated at 18 locations. **IIRR-NSN 2** trial comprised of 635 entries (611 entries from IVT trials, 10 insect and 14 disease checks) was evaluated at 16 locations against 10 insect pests. **IIRR-NSN-Hills** trial consisting of 128 entries (104 hill entries + 10 insect check lines and 14 disease checks) was evaluated at 8 locations against 9 insect pests. **IIRR-NHSN** trial constituted with 125 entries (100 hybrids + 10 insect checks +14 disease checks) was evaluated at 13 locations against 7 insect pests. No damage data was received from Maruteru. The valid data in each trial are discussed pest wise:

Brown planthopper:

IIRR-NSN1: IET Nos. 28818 and 30282 recorded a Damage Score (DS) of ≤3.0 in 3 of the 5 tests in green house evaluations. PTB-33 and RP 2068-18-3-5 were resistant in 2 of the 5 tests with a DS of ≤3.0.

IIRR-NSN2: IET Nos 29390 (R), 29808, 29830, 29839, 30261, 30068 and RP 2068-18-3-5 recorded a DS of ≤3.0 in 3 of the 6 valid tests (5 greenhouse tests and one field reaction at Kaul).

IIRR-NSN hills: Entries were evaluated against BPH under greenhouse conditions at IIRR, CBT, LDN and PNT. IET 28890 exhibited a DS ≤ 3.0 at CBT and LDN out of 4 tests. IET 28882 and RP 2068-18-3-5 exhibited a DS ≤ 3.0 at IIRR and LDN only. IET No. 29657 exhibited a DS ≤ 3.0 at CBT and IIRR out of 4 tests. The resistant check, PTB33 had a DS ≤ 3.0 in 3 of the 4 tests. All the test entries were susceptible at Pantnagar when evaluated against the hopper under greenhouse conditions.

IIRR-NHSN: IET Nos. 29743, 29749 and PTB 33 were promising in 4 of the 5 tests against BPH in greenhouse reaction. IET No 29750 was promising in 3 tests with a DS of ≤3.0.

Whitebacked 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 19 entries were found promising with a DS≤ 3.0 but MO1 recorded DS 5.6.

IIRR-NSN2: Entries were evaluated in greenhouse conditions at IIRR and CBT. All the entries were susceptible to WBPH except MO1 at IIRR. IET Nos. 29939, 30128, 30147, BPT 5204 (sensitive Check) recorded DS ≤ 3.0 at Coimbatore where MO1 recorded a DS of 5.6.

*IIRR-NSN hills***:** Entries were evaluated under greenhouse conditions at IIRR and CBT. IET 28224 recorded DS ≤ 3.0 at CBT 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 at IIRR. At Coimbatore 8 entries were found promising with a DS≤ 3.0 but MO1 recorded DS 5.2.

Mixed population of Planthoppers:

*IIRR-NSN1***:** IET Nos 29235, 29246, 28972, 28128, 28982, 29000, 28343, 29347, 29343, 28524, 29345, 29328, PA 6444 (HC), 28501, 28960, 29142, 29197, 29523, 29017, 28818, 28821 (R), 28789 (R), 30253, 30254,30261, MTU 1121 (RP), 30289, 30292, 30293, 30301 and PTB33 were identified as tolerant (DS ≤ 1.0) to mixed populations of planthoppers in the field at Gangavathi where the average infestation was 262.8 planthoppers/10hills at 60 DAT. The ratio of BPH to WBPH was 1:1.29.

IIRR-NSN2: All the entries were evaluated in field against a mixed population of BPH and WBPH at Gangavathi. The ratio of BPH to WBPH was 1: 1.2 at 60-90 DAT. All the entries had a population of > 50 hoppers per hill and the average was 246.4 hoppers per hill. Under this situation 57 entries were scored DS ≤ 1.0. At Coimbatore 80 entries were evaluated in the glasshouse for seedling tolerance against the mixed population of plant hoppers (5 BPH: 1 BPH). three entries IET Nos 29998, 30004 and 29868 recorded a DS ≤ 3.0. None of the promising entries are common between both the locations.

Gall midge:

*IIRR-NSN1***:** IET No 29006 recorded nil damage against biotype 1 at IIRR and Jagdalpur. The resistant checks W1263, Kavya and RP 2068-18-3-5 were promising in 2 of 5 tests and Aganni was promising in 3 tests.

IIRR-NSN2: In field reaction at GNV all the entries were susceptible. The average damage was 19.35% SS.

IIRR- NHSN: IET No 29731, Swarnadhan, Vikramarya and W 1263 (R. Check) recorded < 10 % DP and were found promising in a field test at PTB.

Stem borer (SB):

IIRR NSN1: IET Nos 29193, 28953, 29519, 29356, 30277, 30281, 29203 (R), 30283 recorded nil stem borer damage (WE%) at 69 DAT at Pantnagar exhibiting tolerance when the average damage was 18.9 %.

IET 29430 and Swarna (RP) were promising in 4 of the 6 valid tests with nil white ear damage. In this case the data needs to be confirmed under greenhouse conditions.

IIRR NSN2: IET 30014 and 30230 had nil dead heart damage at Pantnagar at 69 DAT. Another nine entries though had nil damage they were in reproductive phase.

*IIRR NSN hills***:**

Dead heart damage: Only one entry, Vivekdhan 86 (NC) had recorded <10% dead heart damage (DS <3.0) in field reaction at Pantnagar.

White ear damage: IET No 29659, Swarnadhan and RP 2068-18-3-5 recorded nil damage. IET Nos 28897 (R), 28899(R), 28898 (R), 28892 (R), 28224, 28880 (R), 28196, 29645, 28217, 29640, 29661, 29669, 28908 (R), VL Dhan 158 (ZC for North & South), Vivekdhan 86 (NC), W1263 and Aganni recorded <5% white ear damage (DS 1.0) in field reaction at Pantnagar.

IIRR NHSN: None of the entries recorded <10 % dead heart damage at Pantnagar. IET Nos *29691 and RP 2068-18-3-5* were promising in 2 of the 5 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.

Leaf folder:

*IIRR-NSN1***:** None of the entries were promising against leaf folder in the field evaluation at PSAa at 70 DAT.

IIRR NSN2: Ten entries viz., IET Nos. 30144, 30225, 29768, 29777, 29805, 30248, 29916, 29917, 30258 and 30102 had nil damage in 2 of the 4 valid tests. Average leaf folder damage was only 10.61-18.3% DL across the 4 locations.

*IIRR NHSN***:** None of the entries were promising against leaf folder at Pattambi. Average damage was 10.5 % DL at 50 DAT.

*IIRR NSN Hills**:*** None of the entries were promising against leaf folder at Chatha. The average damage was 18.5%DL.

Whorl maggot:

IIRR NSN1: None of the entries had nil damage against whorl maggot at 35 DAT in the field evaluation at RNR. Average damage in the trial was 8.35% Dl.

IIRR NSN2: IET 29933 was the only entry with nil damage at Jagdalpur (78 DAT) and the average damage in the trial was 4.98 % DL.

IIRR-NHSN: Average damage at 30 DAT at Pattambi was 11.7% DL and none of the entries were promising.

Rice hispa:

At Malan, standard facility with technique has been developed for screening against hispa.

IIRR NSN2: None of the entries were promising against rice hispa in the field evaluation at Malan.

*IIRR NSN Hills**:*** All the entries were found susceptible at Malan when the average damage in the trial was 10.6% DL at 80 DAT.

Other pests

Gundhi bug and Grasshopper

IIRR- NSN1: IET No 28017 was the only entry which recorded nil grain damage by gundhi bug at Masodha in field evaluation at 83 DAT when the average damage in the trial was 6.7 % DG.

IIRR-NSN Hills: Average gundhi bug damage was 18.5% grain damage at Chatha though most of the entries have not flowered. Nil damage was recorded in 64 entries.

Grass hopper damage ranged from 1.8 to 2.1% DL at Khudwani and Chatha. Grass hoppers species (*Oxya nitidula, Hieroglyphus spp. Attractomorpha pscittacina* & Long-horned grasshopper*)* were observed at Khudwani. Incidence of Rice skipper ***(****Parnara guttata)* was reported from with Khudwani (average damage was 6.2%DL at 20 DAT.

IIRR- NSN2: At GGT, 3 entries viz., Shobini (National Check), IET Nos 30232 and 29770 recorded nil damage. The average damage was 6.75% DG.

Rice thrips.

IIRR-NSN1: HR 12 recorded nil damage against thrips at 50 DAT in field evaluation at Jagdalpur. The average damage in the trial was 8.92% DL.

Case worm

IIRR-NHSN: None of the entries were promising for CW at PTB.

Overall reaction

***IIRR-NSN1*:** *Evaluation of 313 entries at 18 locations in 8 greenhouse and 17 field tests against 8 insect pests identified seven entries viz., IET nos 28981, 29343, 28524, 29410, 28818, MTU 1121 (RP), and 30253, as promising in 5 tests of the 25 valid tests against four to five pests. RP2068-18-3-5 and PTB 33 were promising in 6 and 5 tests, respectively (Table 2.XXX).*

IIRR-NSN2: *Evaluation of 611 entries along with 24 checks in 24 valid tests (9 greenhouse and15 field tests) against 9 insect pests identified IET nos 29916 30068 and RP 2068-18-3-5 as promising in 5 tests, IET nos. 30163, 29808, 30232, 30248, 29830, 29834, 30258, 30261, 30102, and PTB-33 as promising in 4 tests of the 24 valid tests.*

IIRR- NSN hills*: Entries were evaluated at 7 locations in 11 valid tests (6 greenhouse and 5 valid field tests) against 6 insect pests (Table 2.XXX). Four test entries along viz., Vivekdhan 86 (NC), IET Nos 28882, 29640, 28908 (R) along with PTB 33 and RP 2068-18-3-5 were promising in 3-4 test of the 11 valid tests.*

IIRR-NHSN: *In this trial,100 hybrids along with 24 checks were evaluated in 7 greenhouse and 10 field tests against 7 insect pests at 12 locations in 17 valid tests and identified IET 29743 and PTB33 as promising in 6 tests; IET 29749 and RP 2068-18-3-5 as promising in 4 tests respectively of the 17 valid tests (Table 2. XXX).*

It is pertinent to note that since 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 2.6 Performance of the most promising cultures against insect pests in IIRR- NSN1, *kharif* 2021

Entry No.	IET NO.	IIRR	CBT	LDN	PNT	MND	**BPH**	IIRR	CBT	**WBPH**	GNV	GNV	**BPH+WBPH**	IIRR	JDP	SKL	WGL	GNV	**GM**	PNT	**SBDH**	PSA	WGL	NWG	RGL	RNR	PNT	**SBWE**	PSA	**LF**	JDP		RNR	**WM**	MSD	**GB**	**Overall**
		BPH	BPH	BPH	BPH	BPH	**NPT**	WBPH	WBPH	NPT	BPH+WBPH	BPH+WBPH	**NPT**	GMB1	GMB1	GMB4	GMB4M	GMB	**NPT**	SBDH	**NPT**	SBWE	SBWE	SBWE	SBWE	SBWE	SBWE	**NPT**	LF	**NPT**	RT	**RT**	WM	**NPT**	GB	**NPT**	**NPT**
		GH	GH	GH	GH	GH	**5**	GH	GH	2	60DT	60DT	**2**	GH	50DT	50DT	34-42DT	30/50DT	**5**	69DT	1	70DT	82-86DT	100DT	50DT	107DT	115DT	**6**	70DT	**1**	50DT	1	35DT	**1**	83DT	**1**	**25**
		DS	DS	DS	DS	DS		DS	DS		No./10h	DS		DP(%)	%DP	%DP	%DP	%SS		%DH		%WE	%WE	%WE	%WE	%WE	%WE		%DL		%DL		%DL		%DG		
34	28981	1.3	4.2	3.0	9.0	5.0	**2**	6.8	2.4	**1**	300.0	7.0	**0**	NT	0.0	90.0	40.0	13.9	**1**	19.3	**0**	17.8	11.0	9.3	0.0	8.7	11.7	**1**	13.5	**0.0**	12.0	**0.0**	4.0	**0.0**	NF	**0.0**	**5**
89	29343	4.7	4.6	8.0	7.8	5.0	**0**	9.0	5.0	**0**	145.0	1.0	**1**	0.0	90.0	100.0	50.0	5.4	**1**	18.8	**0**	14.3	12.0	12.8	0.0	0.0	0.0	**3**	13.0	**0.0**	8.2	**0.0**	8.8	**0.0**	NF	**0.0**	**5**
91	28524	0.8	7.2	8.4	8.6	7.0	**1**	9.0	6.6	**0**	157.0	1.0	**1**	PD	90.0	100.0	50.0	2.3	**0**	24.6	**0**	17.6	12.2	20.8	0.0	0.0	0.0	**3**	14.1	**0.0**	8.0	**0.0**	8.2	**0.0**	NF	**0.0**	**5**
181	29410	0.6	4.6	8.0	7.4	3.0	**2**	7.3	3.0	**1**	314.0	5.0	**0**	NT	0.0	50.0	35.0	9.4	**1**	4.5	**0**	13.5	5.0	4.2	3.7	4.3	11.1	**1**	13.9	**0.0**	11.2	**0.0**	6.7	**0.0**	9.7	**0.0**	**5**
221	28818	1.3	3.0	3.0	9.0	7.0	**3**	8.3	5.2	**0**	143.0	1.0	**1**	NT	100.0	100.0	65.0	10.0	**0**	22.9	**0**	16.4	11.1	10.4	0.0	4.4	3.3	**1**	13.4	**0.0**	7.5	**0.0**	9.2	**0.0**	7.5	**0.0**	**5**
222	MTU 1121 (RP)	2.1	4.6	3.0	8.6	5.0	**2**	8.6	2.0	**1**	236.0	5.0	**0**	NT	90.0	100.0	75.0	3.6	**0**	24.8	**0**	16.2	11.3	10.2	0.0	0.8	0.0	**2**	12.6	**0.0**	9.2	**0.0**	6.9	**0.0**	5.3	**0.0**	**5**
259	30253	5.7	3.0	4.0	9.0	7.0	**1**	7.8	5.2	**0**	212.0	1.0	**1**	NT	100.0	100.0	70.0	20.7	**0**	24.5	**0**	11.6	4.3	12.2	0.0	0.0	0.0	**3**	13.7	**0.0**	7.2	**0.0**	7.9	**0.0**	8.2	**0.0**	**5**
	Checks																																				
310	RP 2068-18-3-5	1.2	3.2	3.0	5.2	5.0	**2**	9.0	5.0	**0**	175.0	3.0	**0**	0.0	0.0	65.0	10.0	5.3	**2**	33.7	**0**	15.3	10.8	11.3	7.5	0.9	0.0	**1**	13.8	**0.0**	9.4	**0.0**	7.0	**0.0**	5.1	**0.0**	**5**
308	PTB33	1.4	3.6	2.7	4.2	5.0	**2**	4.9	3.0	**1**	165.0	1.0	**1**	50.0	60.0	95.0	5.0	2.9	**0**	29.7	**0**	13.9	4.3	14.0	0.0	0.0	1.5	**2**	14.3	**0.0**	7.8	**0.0**	5.5	**0.0**	2.9	**0.0**	**6**
	Total Tested	311	310	310	307	303		313	310		310	310		68	312	310	309	310		312		313	309	312	293	307	312		313		312		308		270		
	Max. in the trial	9.0	9.0	9.0	9.0	9.0		9.0	9.0		519.0	9.0		67.0	100.0	100.0	100.0	67.6		44.0		18.8	55.6	34.0	52.8	21.3	35.2		16.7		16.0		21.7		26.5		
	Min. in the trial	0.6	2.0	2.7	3.1	1.0		1.6	2.0		121.0	1.0		0.0	0.0	0.0	0.0	2.2		0.0		5.8	0.0	3.9	0.0	0.0	0.0		6.3		0.0		0.5		0.0		
	Ave.damage in the tr	8.0	6.6	7.7	8.3	6.7		7.9	6.4		262.8	4.7		15.6	72.5	97.4	43.2	12.9		18.9		13.9	14.3	13.4	5.4	4.0	5.5		12.7		8.9		8.5		6.3		
	Ave damage in TN1	9.0	7.8	7.8	6.5	5.0		8.8	7.8		305.0	7.0		67.0	65.0	100.0	36.7	4.9		29.4		13.6	13.0	18.5	19.7	3.0	18.6		13.5		7.6		9.3		6.0		
	Promising level	3	3	3	3	3		3	3		100	1		0	0	0	0	0		0		5	0	5	0	0	0		5		0		0		0		
	No. promising	19	22	13	0	19		1	19		0	31		36	19	2	1	0		8		0	3	10	67	43	62		0		1		0		1		

Data from JDP, WGL, PNT, CHP. WGL for BPH; PNT,JDP, WGL for WBPH; MNC,CHP,RGL, for GM; WGL,CHP , ,RGL,RNR, JDP, RPR,SKL,GNV, MSD, LDN ,NWG for SBDH; CHP,GNV,RGL,RNR, SKL, WGL, for SBWE; RGL,WGL , GNV, MSD, JDP, RGL , PSA,for LF; JDP for GLH; JDP for WM; - not considered for analysis due to low pest pressure. No data received from MTU.

Valid NSN1 data considered for analysis, *kharif* 2021

Insect pests	Reaction	Locations						Total
BPH	GH	IIRR	CBT	LDN	PNT	MND		5
WBPH	GH	IIRR	CBT					2
BPH+WBPH		GNV	GNV					2
GM	GH	IIRR						1
GM	Field	JDP	SKL	WGL	GNV			4
SBDH	Field	PNT						1
SBWE	Field	PSA	WGL	NWG	RGL	RNR	PNT	6
LF		PSA						1
RT	JDP							1
WM	RNR							1
GB	MSD							1

Valid NSN 2 data considered for analysis , kharif 2021

Insect pests	Reaction	Locations						Total
BPH	GH	IIRR	CBT	LDN	MND	PNT	KUL	6
WBPH	GH	IIRR	CBT					2
BPH+ WBPH	GH	CBT						1
BPH+WBPH	Field	GNV						2
GMB	Field	GNV						1
SBDH	Field	PNT						1
SBWE	Field	GGT	CHN	KJT				3
LF	Field	ADT	KUL	KJT	NVS			4
WM	Field	JDP						1
RT	Field	JDP						1
RH	Field	MLN						1
GGT	Field	GB						1

Table 2.7: Performance of most promising cultures against insect pests in IIRR- NSN2, kharif 2021.

NSN2 No.	IET No.	IIRR	CBT	LDN	MND	PNT	KUL		IIRR	CBT		GNV	GNV	CBT		GNV	GMB	PNT		GGT	CHN	KJT		ADT	KUL	KJT	NVS		JDP		JDP		MLN		GGT		Over all
		BPH	BPH	BPH	BPH	BPH	BPH	BPH	WBPH	WBPH	WBPH	BPH+ WBPH	PH	BPH + WBP	BPH+ WBPH	GMB	NPT	SBDH	SBDH	SBWE	SBWE	SBWE	SBWE	LF	LF	LF	LF	LF	WM	WM	RT	RT	RH	RH	GB	GB	
		GH	GH	GH	GH	GH	50DT	NPT	GH	GH	NPT	60/90DT	60/90DT	GH	NPT	33DT	1.00	69 DT	NPT	67DT	90DT	90DT	NPT	66DT	50DT	57DT	50DT	NPT	78DT	NPT	78DT	NPT	53DT	NPT	67DT	NPT	NPT
		DS	DS	DS	DS	DS	No./10h	6	DS	DS	2	No./10h	DS	DS	3	%SS	1.00	%DH	1	%WE	%WE	%WE	3	%LF	%DL	%DL	%DL	4	%DL	1	%DL	1	%DL	1	%DG	1	24
481	29916	1.3	5.6	8.0	9.0	9.0	128	1	6.1	7.2	0	149	1.0	NT	1	25.0	0.0	24.2	0	8.45	4.84	0.00	1	23.0	16.0	0.0	0.0	2	3.9	0.0	6.3	0	NT	0	7.5	0	5
560	30068	0.6	2.6	8.3	1.0	9.0	164	3	9.0	3.8	0	121	1.0	NT	1	18.8	0.0	21.8	0	NF	6.50	22.73	0	24.7	19.0	13.6	0.0	1	2.8	0.0	6.6	0	NT	0	NF	0	5
181	30163	0.8	2.0	3.4	5.0	7.0	142	2	6.2	NA	0	168	1.0	NT	1	14.3	0.0	28.6	0	8.33	0.00	23.33	1	17.8	21.6	12.5	14.3	0	6.4	0.0	5.9	0	10.8	0	9.5	0	4
323	29808	0.0	8.4	3.0	1.0	9.0	NG	3	7.8	3.6	0	121	1.0	NT	1	18.8	0.0	24.0	0	10.77	9.57	23.08	0	18.3	NG	13.0	8.3	0	4.6	0.0	7.0	0	8.8	0	5.3	0	4
347	30232	9.0	8.8	7.7	9.0	9.0	NG	0	9.0	9.0	0	141	1.0	NT	1	31.3	0.0	24.5	0	35.21	3.54	0.00	1	27.3	NG	0.0	11.8	1	3.5	0.0	10.1	0	8.8	0	0.0	1	4
371	30248	9.0	NG	NG	9.0	9.0	NG	0	7.6	NG	0	175	1.0	NT	1	21.4	0.0	NG	0	9.09	7.83	0.00	1	9.0	NG	0.0	0.0	2	4.2	0.0	8.9	0	9.7	0	10.8	0	4
385	29830	2.5	5.0	3.0	3.0	9.0	NG	3	9.0	6.0	0	406	9.0	NT	0	16.7	0.0	26.6	0	0.00	3.23	25.71	1	13.8	NG	21.7	8.9	0	5.7	0.0	8.4	0	NT	0	7.1	0	4
390	29834	1.5	5.2	8.3	1.0	9.0	NG	2	9.0	7.2	0	153	9.0	NT	0	46.4	0.0	20.0	0	5.88	13.95	0.00	1	17.6	NG	0.0	10.0	1	4.0	0.0	7.2	0	NT	0	5.8	0	4
525	30258	7.5	7.8	8.3	9.0	9.0	215	0	8.4	6.2	0	160	1.0	NT	1	13.3	0.0	22.3	0	NF	16.03	0.00	1	18.7	19.3	0.0	0.0	2	3.2	0.0	7.4	0	NT	0	NF	0	4
528	30261	0.6	7.6	3.0	3.0	9.0	84	3	9.0	5.8	0	178	3.0	NT	0	28.6	0.0	33.0	0	NF	2.44	25.00	0	14.7	19.4	0.0	13.2	1	1.7	0.0	7.9	0	NT	0	NF	0	4
596	30102	6.6	5.0	NG	5.0	9.0	129	0	8.4	NT	0	154	1.0	NT	1	12.5	0.0	28.9	0	NF	7.83	0.00	1	21.0	17.9	0.0	0.0	2	3.0	0.0	9.9	0	NT	0	NF	0	4
632	PTB 33	1.2	5.0	3.0	3.0	9.0	128	3	9.0	5.2	0	248	5.0	NT	0	18.8	0.0	16.9	0	NF	8.87	0.00	1	12.5	15.6	0.0	10.8	1	1.7	0.0	6.0	0	NT	0	NF	0	5
630	RP 2068-18-3-5	1.4	4.8	2.4	7.0	9.0	159	2	4.9	5.2	0	161	3.0	NT	0	46.4	0.0	25.0	0	NF	4.69	0.00	1	1.5	21.9	0.0	13.3	1	4.0	0.0	7.0	0	NT	0	NF	0	4
Total Tested		615	514	576	629	643	383		620	383		638	638	72		638				482	645	645		616	383	645	638		627		627		351		482		
Max. damage in the trial		9.0	9.0	9.0	9.0	9.0	222		161.0	9.0		487	9.0	9.0		64.3				82.1	33.6	41.2		37.0	25.3	69.0	23.7		11.5		24.5		45.0		26.7		
Min. damage in the trial		0.0	2.0	2.4	1.0	0.7	83		1.6	1.8		121	1.0	2.2		2.6				0.0	0.0	0.0		0.4	12.6	0.0	0.0		0.0		2.4		6.4		0.0		
Ave. damage in the trial		7.6	6.4	7.6	7.2	8.3	147.1		9.1	6.5		246.4	4.8	5.8		19.3				10.5	10.7	19.7		11.7	18.1	18.3	10.6		5.0		8.3		10.5		6.7		
Ave. damage in TN1		8.7	7.3	8.7	7.0	7.3	119.5		71.5	9.0		363.5	8.0	NT		16.7				11.3	12.7	11.1		9.2	17.5	8.5	10.7		1.8		2.9		NT		1.8		
Promising level		3	3	3	3	3	50		3	3		50	1	3		0				0	0	0		0	0	0	0		0		0		0		0		
No. promising		41	12	18	35	3	0		1	4		0	57	3		0				17	8	82		0	0	106	66		1		0		0		3		

Ratio of BPH to WBPH in Greenhouse at CBT at seelding stage is 5: 1

Ratio of BPH to WBPH at 60 DT in field at GNV is 1:1.2

Table 2.8: Performance of most Promising culturesagainst insect pests in NSN hills, Kharif 2021.

NSN-H No	IET No.	IIRR	CBT	LDN	PNT	BPH	IIRR	CBT	WBPH	PNT	SBDH	PNT	SBWE	MLN	RH	CHT	LF	CHT	GB	Over all
		GH	GH	GH	GH		GH	GH		48DT		112DT		80DT		60DT				
		BPH	BPH	BPH	BPH	NPT	WBPH	WBPH	NPT	SBDH	NPT	SBWE	NPT	RH	NPT	LF	NPT	GB	NPT	NPT
		DS	DS	DS	DS	4	DS	DS	2	%DH	1	%WE	1	%DL	1	%DL	1	%DG	1	11
5	Vivekdhan 86 (NC)	9.0	8.4	7.9	9.0	**0**	6.9	7.0	**0**	9.2	**1**	4.9	**1**	10.3	**0**	26.3	**0**	0.0	**1**	**3**
6	28882	0.0	4.3	2.8	9.0	**2**	9.0	3.8	**0**	13.9	**0**	25.4	**0**	11.4	**0**	20.3	**0**	0.0	**1**	**3**
35	29640	9.0	3.0	7.0	NG	**1**	8.7	3.9	**0**	18.3	**0**	4.5	**1**	11.3	**0**	24.2	**0**	0.0	**1**	**3**
53	28908 (R)	9.0	3.0	8.0	9.0	**1**	9.0	6.5	**0**	21.3	**0**	4.8	**1**	11.7	**0**	22.4	**0**	0.0	**1**	**3**
	Checks																			
123	PTB 33	1.4	2.6	2.6	8.5	**3**	4.9	3.0	**1**	19.8	**0**	37.0	**0**	11.9	**0**	19.2	**0**	NF	**0**	**4**
125	RP 2068-18-3-5	1.2	3.4	3.0	7.1	**2**	9.0	5.0	**0**	25.8	**0**	0.0	**1**	10.7	**0**	18.0	**0**	NF	**0**	**3**
Total Tested		128	127	128	125		128	127		128		128		128		128		101		
Min in the trial		0.0	2.6	2.4	4.4		1.6	3.0		9.2		0.0		7.4		13.0		0.0		
Max.in the trial		9.0	9.0	8.8	9.0		9.0	9.0		33.0		55.3		16.7		36.1		70.0		
Ave. damage in the trial		7.8	5.7	7.6	8.5		8.0	6.5		20.6		13.7		10.6		18.5		18.8		
Ave. damage in TN1		9.0	7.0	8.1	7.1		9.0	8.8		23.9		23.6		11.1		16.9		0.0		
Promising level		3	3	3	3		3	3		10		5		5		10		0		
No. promising		8	10	5	0		1	2		1		21		0		0		64		

Stem borer damage at PNT in PTB 33 is DH (%)

Valid data considered for analysis, NSN Hills, kharif 2021

Insect Pests	Reaction	Locations				Total
BPH	GH	IIRR	LDN	CBT	PNT	4
WBPH	GH	IIRR	CBT			2
SBDH	Field	PNT				1
SBWE	Field	PNT				1
RH	Field	MLN				1
LF	Field	CHT				1
Rice gundhi bug	Field	CHT				1
Total tests						**11**

No data was received from MTU. Pest pressure for Gr.H and rice skipper was low at KHD & CHT.

Table 2.9: Performance of most promising cultures against insect pests in NHSN, kharif 2021

NHSN No	IET No.	BPH	BPH	BPH	BPH	BPH	BPH	WBPH	WBPH	WBPH	GMB	GM	SBDH	SBDH	SBWE	SBWE	SBWE	SBWE	SBWE	SBWE	LF	LF	WM	WM	CW	CW	Over all
		IIRR	CBT	LDN	PNT	MND		IIRR	CBT		PTB		PNT		GGT	PTB	PNT	NWG	CHN		PTB		PTB		PTB		
		GH	GH	GH	GH	GH	NPT	GH	GH	NPT	50DT	NPT	47DT	NPT	110DT	50DT	110DT	Pr.H	Pr.H	NPT	50DT	NPT	30DT	NPT	30DT	NPT	NPT
		DS	DS	DS	DS	DS	5	DS	DS	2	%DP	1	%DH	1	%WE	%WE	%WE/10h	% WE	%WE	5	%DL	1	%DL	1	%DL	1	17
68	29743	2.1	2.4	2.5	9.0	1.0	**4**	9.0	3.0	**1**	42.9	**0**	28.1	**0**	3.7	0.0	9.2	13.8	8.8	**1.0**	9.7	**0**	7.7	**0**	12.4	**0**	**6**
77	29749	2.3	3.0	2.5	NG	3.0	**4**	8.6	4.8	**0**	38.1	**0**	30.3	**0**	5.1	6.3	12.7	9.6	12.5	**0.0**	9.4	**0**	17.8	**0**	12.7	**0**	**4**
Checks																											
117	PTB 33	1.4	3.0	2.6	7.4	3.0	**4**	4.4	3.0	**1**	14.3	**0**	18.2	**0**	14.1	0.0	32.3	12.1	6.5	**1.0**	8.3	**0**	14.2	**0**	8.1	**0**	**6**
119	RP 2068-18-3-5	3.9	8.8	2.6	9.0	3.0	**2**	9.0	5.0	**0**	19.0	**0**	30.7	**0**	4.8	0.0	17.2	14.5	0.0	**2.0**	6.8	**0**	10.5	**0**	13.4	**0**	**4**
	GR 11																	25.9									
Total Tested		119	118	120	107	121		119	118		119		118		122	118	118	122	121		119		118		118		
Max. damage in the trial		9.0	9.0	8.8	9.0	9.0		9.0	9.0		100.0		31.3		27.3	57.9	38.7	28.3	22.2		20.5		22.1		23.3		
Min. damage in the trial		0.9	2.4	2.5	4.1	1.0		1.6	2.0		2.7		14.8		0.0	0.0	0.0	2.4	0.0		3.5		1.7		4.9		
Ave. damage in the trial		7.8	6.8	7.0	8.4	7.9		7.9	6.4		34.4		23.6		8.1	19.4	15.0	14.3	9.2		10.5		11.7		12.1		
Ave. damage in TN1		9.0	8.8	8.0	9.0	9.0		9.0	9.0		33.3		24.8		8.6	18.0	13.3	26.8	5.0		6.9		12.2		8.6		
Promising level		3	3	3	3	3		3	3		10		10		0	0	0	5	0		0		0		0		
No. promising		6	10	5	0	5		1	9		4		0		1	9	1	7	4		0		0		0		
Stem borer damage at PNT in PTB 33 is Dead heart damage (%)																											

Valid data considered for analysis in NHSN, kharif 2021

Insect pest	Reaction	Location					Total
BPH	GH	IIRR	CBT	LDN	PNT	MND	5
WBPH	GH	IIRR	CBT				2
GM	Field	PTB					1
SBDH	Field	PNT					1
SBWE	Field	GGT	PTB	PNT	NWG	CHN	5
LF	Field	PTB					1
WM	Field	PTB					1
CW	Field	PTB					1

Data not received from MTU. Field data from PNT for PH; CHN,GGT, ,LDN ,PTB,RNR, NWG & RPR for SBDH damage; LDN, RNR,RPR for SBWE; CHN, GGT, MNC,RNR, &LDN for LF; CHN for WM, RPR, MNC for GM not considered for analysis due to low pest pressure

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, Deepwater, NIL (Drought) and NIL (Submergence). NSN1 trial constituted with 111 entries (100 AVT entries along with 11 insect checks) was evaluated at 18 locations. NSN2 trial comprised of 157 entries (146 AVT2 entries plus 11 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: Cihrang (RP) was promising in 3 of the 5 tests, whereas IET28834 and IET29100 were found promising in 2 tests against PTB-33 and RP2068-18-3-5 exhibited resistant reaction (damage score ≤3 on SES scale) in 4 and 3 tests, respectively.

NRRI-NSN2: IET30369 and IET30425 were promising in 3 and 2 locations, respectively, out of the 4 tests. RP2068-18-3-5and PTB-33 exhibited resistant reaction in all three valid tests.

Whitebacked Planthopper:

NRRI-NSN1: Cihrang (RP), IET28834 and IET29100 were found promising in 1 test against PTB-33 and RP2068-18-3-5 which were exhibited resistant reaction (SES score ≤3) in 2 and 1 tests, respectively.

NRRI-NSN2: The following IET lines viz., 30312, 30317, 30327, 30334, 30339, RSL-402 found promising in one glasshouse screening and the lines namely 30317, 30321, 30329, Vandana (NC), 30333, 30339, 30342, 29111 (R), 30415, 30358, 30366, 30367, 30369, 30374, and 30394 were found tolerant in field condition. RP2068-18-3-5and PTB-33 exhibited resistant reaction in all two locations.

Gall Midge:

NRRI-NSN1: Varalu (RP) recorded nil damage against gall midge in 2 out of the 3 tests. Aganni and W-1263 were promising in all the 3 tests.

NRRI-NSN2: In field reaction at GNV all the entries were susceptible. The average damage was 19.22% SS.

Stem borer:

NRRI-NSN1: Varalu (RP) was promising against stem borer during reproductive phase 2 out of the 2 tests.

NRRI-NSN2: IET30348 had nil White ear damage at Ghaghraghat during reproductive phase; however, it requires glass house study for confirmation.

Leaf folder:

NRRI-NSN1: Leaf folder incidence was low at the evaluation center and the damage level was <10% DL.

NRRI-NSN2: IET30332 and IET30361 had nil damage at Aduthurai at 67 DAT and average leaf folder damage was at 10.23% DL.

Whorl maggot:

NRRI-NSN1: In the field evaluation at RNR whorl maggot incidence at 44 DAT was recorded and the average damage in the trial was 6.75% Dl. Similarly, at Jagdalpur (73 DAT) the average damage in the trial was 5.54% DL.

NRRI-NSN2: In the field evaluation at Jagdalpur (73 DAT) and the average incidence in the trial was 5.71 % DL.

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

Overall reaction:

NRRI-NSN1: Evaluation of 111 entries in NSN-1 in 4 greenhouse and 7 field tests against 5 insect pests in 12 valid tests helped in identification of 4 entries as promising in 3-5 tests against 2-3 insect pest damages **(Table2.10)**. 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 157 entries in NSN-2 in 4 greenhouse and 5 field tests against 4 insect pests in 11 valid tests helped in identification of 3 entries as promising in 2-3 tests against 1-2 insect pest damages **(Table 2.11)**. 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 and W1263 for leaf folder.

Table: 2.10 Performance of most promising culture against insect pests in NRRI-NSN1, *Kharif* 2021

Sl. No	IET No.	Number of promising tests (NPT)				
		BPH	WBPH	GM	SBWE	Overall NPT
		5	2	3	2	12
1	Cihrang (RP)	3	1	1	0	5
2	28834	2	1	0	1	4
3	29100	2	1	0	0	3
4	Varalu (RP)	0	0	2	1	3
Resistant checks						
PTB-33		4	2	1	0	7
RP2068-18-3-5		3	1	0	0	4
Aganni		0	0	3	0	3
W-1263		0	0	3	0	3

*CHP, JDL for BPH; CHP, RGL for GM; GVT, CHP, JDL, NWG for SBDH; GVT, CHP, for SBWE; GVT, JDL, MSD for LF nor considered for analysis due to low insect pest pressure; PNT-No entries were found with ≤3 score for BPH.

Valid NSN1 data from locations considered for analysis

Insect pest	Locations				
BPH	CBT	GNV	MND	LDN	PNT
WBPH	CBT	GNV	-	-	-
Gall midge	GNV	JDL	SKL		-
SBWE	MSD	NWG	-	-	-

Table 2.11 Performance of most promising culture against insect pests in NRRI-NSN2, *Kharif* 2021

Sl. No	IET No.		Number of promising tests (NPT)				
		BPH	WBPH	GM	SBWE	LF	Overall NPT
		5	2	2	1	1	11
1	30369	2	1	0	0	0	3
2	30425	3	0	0	0	0	3
3	30348	0	0	0	1	0	1
Resistant checks							
PTB-33		3	2	0	0	0	5
RP2068-18-3-5		3	2	0	0	0	5
W-1263		0	0	2	0	1	3
Aganni		0	0	2	0	0	2

*JDL for BPH; CHP, JDL, KAJ, GHG for GM; ADT, GVT, JDL, KAJ, NAV, GAG, CHN for SBDH; ADT, GVT, JDL, KAJ, NAV, CHN for SBDH; ADT, GVT, JDL, KJT, NAV, GHG for LF not considered for analysis due to low insect pest pressure; PNT-No entries found with <3 damage score for BPH.

Valid NSN2 data from locations considered for analysis

Insect pest	Locations				
BPH	CBT	GNV	MND	LDN	PNT
WBPH	CBT	GNV	-	-	-
Gall midge	GNV	ADT	-	-	-
SBWE	ADT	-	-	-	-
LF	ADT	-	-	-	-

2.2. INSECT BIOTYPE STUDIES

Variation in the response of host plant/ gene differentials to different pest populations in endemic areas are monitored for two major pests viz., planthoppers and gall midge through Insect biotype studies comprising of four trials i) Gall midge biotype monitoring trial (GMBT), ii) Gall midge population monitoring (GMPM) trial and iii) Planthopper screening trial (PHSS) and iv) Planthopper population monitoring trial (PHPM). The results of the observed virulence pattern of gall midge populations during *kharif* 2021 are discussed below:

i)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 three gene pyramided lines and a new donor-INRC17470 in the 5th group and with the susceptible check TN1 in the sixth group and carried out 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 shoots. Data with >50 % plant damage at a location was considered as valid. The incidence of gall midge was low at Aduthurai, Ragolu, Ranchi, Raipur, Moncompu, Maruteru. The results of the evaluation from the valid data of 12 locations in 13 tests are summarized in **(Table 2.12)** and discussed as under.

Biotype 1: This biotype is characterized by the reaction pattern R-R-R-R-R-S. The populations at **IIRR** greenhouse (collected from Medchal, Telangana) and population at **Jagdalpur** (Chattisgarh) confirm to this reaction pattern except for variation in the reaction of few donors in group 2. Reaction at **Chiplima** (Odisha**)** and **Ambikapur** (Chattisgarh) were grouped as R-S-S- R-R-S. All differentials showed susceptibility except Kavya, W1263 (*Gm1*); Aganni, INRC 3021, and RP5925 (*Gm8*), INRC17470 recorded<10 % plant damage at both the test locations. Variation in the reaction of the other donors was observed within the groups.

Biotype 2: At **Cuttack** (Odisha) only ARC5984, Aganni, INRC17470 and RP5921(*Gm8*) were promising though earlier the population from this area was categorized as biotype 2.

Biotype 3: Earlier the populations at **Jagtial** (Telangana)conformed to the typical pattern of R-S-R-R-S for biotype 3 but this year at Jagtial, only differentials with *Gm8* gene (Aganni, INRC 3021) and INRC17470 (new gene) were promising.

Biotype 4: Gall midge populations from **Sakoli** (Maharashtra) were designated as biotype 4 from earlier studies. But this year only Aganni and INRC 3021 (both with

Gm8) showed promise, while W1263 and INRC 17470 recorded ≤10% DP at this location.

Biotype 4M: Aganni (with *Gm8*) and INRC 3021(with *Gm8*), RP5923 (*gm3*) and the new donor INRC17470 exhibited ≤10% DP at **Warangal** (Telangana) research station and also in the farmers' field which is 30 km from the research farm. But Abhaya was promising only at the research station.

Biotype5: At **Pattambi (Kerala)**, this year the infestation level was so high that all the donors exhibited susceptibility, though Kavya and W1263 (with*Gm1*) and Madhuri L9, Abhaya and INRC17470 recorded ≤10% DP.

Titabar (Assam): Earlier the population was characterized as biotype1. But this year's evaluation of the gene differentials suggested that all the donors were susceptible.

Nellore (Andhra Pradesh): Group 1 differentials, Phalguna and ARC5984 from group II had nil damage and all the other differentials were susceptible conforming to the pattern of R-R/S-S-S-S.

At **Gangavati (Karnataka)**, only ARC 6605, INRC 3021 and Phalguna recorded nil damage.

Overall reaction: *Evaluation of the gene differentials in one greenhouse and 12 field tests in 12 locations identified Aganni (Gm8), INRC 3021(Gm8) and INRC17470 as promising in 10 of the13 valid tests. W1263 (Gm1) and Kavya (Gm1) were promising in 7 and 6 tests, respectively of the valid 13 tests. The results suggest that donors with Gm8 and Gm1 gene and INRC 17470 confer resistance to gall midge in infested areas.*

Table 2.12: Reaction of gene differentials to gall midge populations in GMBT trial, kharif 2021.

Group	Entry No.	Differential	Gene	IIRR	JDP	CHP	ABK	CTC	JGT	SKL	WGL	WGL$	PTB	NLR	GNV	TTB	Overall NPT 13
				GH	50DT	30DT	50DT	30 DT	50DT	50DT	54DT	58DT	50DT	50DT	50DT	**	
				%DP	%DP	%DP	%DP	%SS	%DP	%DP	%DP	%DP	%DP	%DP	%SS	%SS	
1	1	KAVYA	*Gm 1*	0.0	0.0	10.0	0.0	18.2	100.0	20.0	25.0	70.0	0.0	10.0	16.7	11.8	**6**
	2	W 1263	*Gm 1*	0.0	0.0	0.0	0.0	33.3	100.0	10.0	25.0	30.0	4.8	0.0	5.9	10.5	**7**
	3	ARC 6605	*(?)*	NT	40.0	50.0	30.0	10.5	100.0	100.0	15.0	45.0	33.3	0.0	0.0	20.0	**2**
2	4	PHALGUNA	*Gm 2*	0.0	20.0	60.0	60.0	16.7	100.0	100.0	20.0	60.0	47.6	0.0	0.0	11.1	**3**
	5	ARC 5984	*Gm 5*	0.0	90.0	10.0	70.0	0.0	100.0	100.0	20.0	36.8	14.3	0.0	11.1	18.8	**4**
	6	DUKONG 1	*Gm 6*	NT	50.0	30.0	30.0	20.0	100.0	100.0	35.0	80.0	33.3	23.8	53.3	6.7	**1**
	7	RP 2333-156-8	*Gm 7*	NT	10.0	40.0	30.0	31.8	100.0	100.0	30.0	55.0	28.6	60.0	44.7	19.0	**1**
	8	MADHURI L 9	*Gm 9*	NT	90.0	20.0	60.0	43.5	100.0	60.0	31.6	90.0	9.5	25.0	29.4	14.3	**1**
	9	BG 380-2	*Gm 10*	NT	10.0	20.0	80.0	75.0	95.0	100.0	35.0	70.0	14.3	75.0	21.6	20.0	**1**
3	10	MR 1523	*Gm 11*	0.0	10.0	30.0	20.0	47.6	80.0	100.0	20.0	27.8	28.6	22.2	30.0	23.5	**2**
4	11	RP 2068-18-3-5	*gm 3*	0.0	10.0	10.0	40.0	27.3	20.0	70.0	15.0	35.0	19.1	55.6	27.8	20.0	**3**
	12	ABHAYA	*Gm 4*	0.0	10.0	10.0	20.0	45.8	70.0	100.0	10.0	26.3	9.5	15.0	23.7	50.0	**5**
	13	**INRC 3021**	*Gm 8*	**0.0**	**0.0**	**10.0**	**10.0**	**4.8**	**0.0**	**0.0**	**0.0**	**0.0**	**14.3**	**27.8**	**0.0**	**4.8**	**10**
	14	**AGANNI**	*Gm 8*	**0.0**	**0.0**	**10.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.0**	**0.0**	**15.0**	**16.7**	**2.4**	**4.3**	**10**
	15	INRC 15888	*Gm 8*	0.0	10.0	40.0	10.0	100.0	100.0	95.0	25.0	75.0	23.8	16.7	11.1	23.5	**3**
5	16	RP 5925-24	*Gm 8*	0.0	20.0	0.0	0.0	40.0	40.0	35.0	20.0	10.0	33.3	65.0	52.9	12.5	**4**
	17	RP 5922-21	*Gm 1*	0.0	40.0	10.0	20.0	0.0	100.0	100.0	45.0	73.7	23.8	40.0	52.6	5.9	**4**
	18	RP 5923	*gm 3*	0.0	0.0	0.0	30.0	31.6	15.0	40.0	10.0	10.0	23.8	70.0	17.2	10.0	**6**
	19	**INRC 17470**	*?*	**0.0**	**10.0**	**0.0**	**10.0**	**9.1**	**0.0**	**5.0**	**5.0**	**5.0**	**9.5**	**22.2**	**18.5**	**6.3**	**10**
6	20	TN1	*none*	80.0	100.0	60.0	70.0	95.7	100.0	100.0	50.0	78.9	38.1	30.0	44.8	66.7	**0**
Total tested				15	20	20	20	20	20	20	20	20	20	20	20	20	
Max.				80.0	100.0	60.0	80.0	100.0	100.0	100.0	50.0	90.0	47.6	75.0	53.3	66.7	
Min.				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	
Average				5.3	26.0	21.0	29.5	32.5	71.0	66.8	22.3	43.9	21.2	28.7	23.2	18.0	
TN1 damage				80.0	100.0	60.0	70.0	95.7	100.0	100.0	50.0	78.9	38.1	30.0	44.8	66.7	
promisng level				0	10	10	10	0	10	10	10	0	10	0	1	1	
No. Promising				14	12	11	7	3	3	4	5	5	5	5	3	0	

** - Pooled mean of 30 and 50 DAT. $- farmers field,Kothapalle village, Bhimadeverapalle mandal , Hanamkonda district, Telangana

Gall midge Incidence of was low at Aduthurai, Ragolu, Ranchi, Raipur, Moncompu, Maruteru.

ii) 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 females to a set of three gene differentials *viz.*, W1263 (*Gm1*), RP2068-18-3-5 (*gm3*), Aganni (*Gm8*) and Purple variety (no gene but highly susceptible) would generate information on the virulence pattern of the population. This year the trial was conducted at six locations *viz.*, Jagtial, Gangavathi, Moncompu, Pattambi, Ragolu and Warangal and the results are presented in **Table 2.13** and discussed location wise.

Gangavathi: Of the 200 female insects tested, 68% were virulent on Purple (no gene), 12.4% on W1263 (*Gm1*), 28.4% on RP2068-13-3-5 (*gm3*) and 18.4% on Aganni (*Gm8*). The sex ratio was very much skewed towards more females in all the test entries and male progeny percentage was low 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.

Jagtial: Of the 200 female insects tested, 57.3% were virulent on Purple (no resistance gene), 23.2% on W1263 (*Gm1*), 31.8% on RP2068-13-3-5 (*gm3*) and none on Aganni (*Gm8*). The sex ratio was favourable in all the differentials. Male progeny was 26.97 % on W1263 and 39.42% on RP2068-18-3-5 as compared to 41.85% on Purple. These results support the reaction of these differentials at Jagtial in GMBT trial suggesting Aganni as a promising donor.

Moncompu: Single female progeny test was done with 50 females. Of the 50 insects tested, only 6% were virulent on purple (no gene), 44% on W1263 (*Gm1*), 42.0 % on RP2068-13-3-5 (*gm3*) and 86% on Aganni (*Gm8*). Though the severity of pest was low in GMBT trial, it can be deduced that under favourable conditions there can be upsurge in the gall midge infestation at this location.

Pattambi: At this location 168 insects were tested and low virulence (27.4%) was observed only on W1263 (*Gm1*) with 11.8 % of male progeny**.**

The other two differentials and purple were highly susceptible with more than 70 % of the females being virulent with high percentage of male progeny. 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.

Ragolu: At this location, 250 single females were tested and the results suggest that the population is highly virulent on the Purple variety and the two gene differentials, W1263, RP2068-18-3-5. None were virulent on Aganni. In all the test entries the sex ratio was skewed towards males and male progeny was very high (56.5% -63.8%).

Warangal: At this location 250 insects were tested. Low virulence of tested females was recorded on Aganni (1.6%). Sex ratio was skewed towards females and no male progeny were observed in Aganni. Low virulence of test females was observed on RP2068-18-3-5 (6.4%) but the male progeny (%) was very high (47.4). The results are similar to the reaction pattern observed in GMBT trial conducted this year at this location.

Table 2.13: Virulence composition of gall midge populations in GMPM, kharif 2021

Sl. no	Location	No of females tested	Variety	Virulent females(%) of total released	Sex ratio of the progeny	
					Male : Female	% Male progeny
			Purple	68.0	1M:0.88 F	53.1
1	Gangavathi	250	W1263 (*Gm1*)	12.4	1M:15.5F	6.1
			RP 2068-18-3-5 (*gm3*)	28.4	1M:7.73F	11.5
			Aganni (*Gm8*)	18.4	1M:3.7F	21.3
			Purple	57.3	1M:1.39F	41.9
2	Jagtial	220	W1263 (*Gm1*)	23.2	1M:2.7F	27.0
			RP 2068-18-3-5 (*gm3*)	31.8	1M:1.54F	39.4
			Aganni (*Gm8*)	Nil	NIL	nil
			Purple	6.0		
3	Moncompu	50	W1263 (*Gm1*)	44.0	NT	NT
			RP 2068-18-3-5 (*gm3*)	42.0		
			Aganni (*Gm8*)	86.0		
			Purple	73.2	1M:3.43F	22.6
4	Pattambi	168	W1263 (*Gm1*)	27.4	1M:7.71F	11.8
			RP 2068-18-3-5 (*gm3*)	71.4	1M:2.78F	26.4
			Aganni (*Gm8*)	64.0	1M:4.36F	18.9
			Purple	83.6	1M:0.77F	56.5
5	Ragolu	250	W1263 (*Gm1*)	36.4	1M:0.57F	63.8
			RP 2068-18-3-5 (*gm3*)	40.8	1M:0.68F	59.6
			Aganni (*Gm8*)	Not virulent	Nil	Nil
			Purple	25.2	1M:4.29F	23.3
6	Warangal	250	W1263 (*Gm1*)	29.6	1M:3.55F	22.0
			RP 2068-18-3-5 (*gm3*)	6.4	1M:1.1F	47.4
			Aganni (*Gm8*)	1.6	0M:6F	0.0

Trial was vitiated at SKL due to squirrel damage

Studies on virulence composition of gall midge populations in GMPM trial suggest that Aganni (Gm8) holds promise at Jagtial, Ragolu and Warangal. Low virulence against W1263 (Gm1) was observed at Gangavathi, Pattambi and Warangal. However a close monitoring of the virulence pattern in endemic areas is important.

iii) 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 twelve locations *viz.*, IIRR, Aduthurai, Coimbatore, Cuttack, Gangavarhi, Ludhiana, Mandya, Maruteru, New Delhi, Pantnagar, Rajendranagar, Warangal in 12 tests in the greenhouse in standard seedbox screening test (SSST) with 2 to 3 replications. At Coimbatore, the sources were screened for both brown planthopper and whitebacked planthopper reaction and the data from NRRI, Cuttack was not considered as most of the entries did not germinate. 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 and Coimbatore. Based on SSST results presented in **(Table 2.14)**, it is revealed that two gene differentials *viz.*, PTB 33 (with *bph2*+*Bph3*+*Bph32*+unknown factors) and RP 2068-18-3-5 (with Bph33(t) gene) were promising in 10 and 9 tests respectively out of 12 tests at 11 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 only. Six gene differentials *viz.*, ARC 10550 with bph5 gene, IR-65482-7-2-216-1-2-B with Bph18(t)) gene, IR-71033-121-15 with Bph20/21 gene, MUTNS 1, OM 4498 with unknown genetics and Pokkali with bph9 gene showed susceptible reaction at all test locations.

At Pantnagar, lowest nymphal survival was observed in IR64 followed by ASD7, IR 36 and PTB33 and highest nymphal survival was observed in RP2068-18-3-5 followed by TN1. IR 36 took more days to wilt followed by PTB 33 and MUTNS1. Honeydew excretion was the lowest in MUTNS1 followed by IR-65482-7-2-216-1-2-B and Ratu Heenati and it was highest in T12. In TN1 the average honeydew excretion was 273.7 mm^2. At Coimbatore, lowest honeydew excretion was observed in PTB33 followed by Babawee, MUTNS 1 and T12

Among the 17 gene differentials evaluated, two differentials viz., PTB 33 (with bph2+Bph3+ *Bph32*+unknown factors) and RP 2068- 18-3-5 (with Bph33(t) gene) were promising in 10 and 9 tests respectively out of 11 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 only.

Table 2.14: Reaction of promising gene differentials against brown planthopper in PHSS, kharif 2021

Entry No.	Designation	Cross combination	Gene	Reaction of gene differentials (DS)												
				Brown planthopper											Whitebacked planthopper	NPT (12)
				IIRR	ADT	CBT	GNV	IAR	LDN	MND	MTU	PNT	RNR	WGL	CBT	
1	ASD7 (Acc 6303)	Karsamba Red	*bph2*	9.0	9.0	6.0	2.3	6.8	7.2	7.0	4.3	5.6	8.6	8.7	9.0	2
2	Babawee		*bph4*	7.3	9.0	5.4	3.7	7.0	5.5	9.0	5.7	7.1	4.8	8.6	8.4	2
4	IR 36	IR1561-228//4*IR661 -1-140-3- 117/ O. nivara///CR 94-13	*bph2*	8.4	9.0	9.0	2.0	7.8	8.1	7.0	2.3	7.0	8.4	8.7	9.0	2
6	IR64	IR 5657-33-2-1/IR 2061-465-1-5-5	*Bph1+*	7.8	9.0	9.0	8.3	8.0	8.1	7.0	4.3	4.9	8.3	8.9	7.8	2
16	Ratu Heenati	Land race	*Bph3+ Bph17*	8.4	9.0	5.2	0.7	8.1	5.2	7.0	5.7	8.8	4.8	8.6	5.5	2
17	RP 2068-18-3-5	Swarnadhan/ Velluthacheera	*Bph33(t)*	1.9	2.3	3.0	6.3	3.8	2.5	1.0	2.3	9.0	8.2	0.7	4.8	9
18	Swarnalatha (Acc33964	Land race	*Bph6*	7.0	3.0	3.8	5.7	6.4	5.9	5.0	5.0	8.6	7.8	8.0	8.2	4
19	T12		*bph7*	7.4	5.7	4.0	9.0	5.3	5.3	5.0	8.3	8.7	8.7	8.3	8.0	2
22	PTB33	Resistant Check	*bph2+ Bph3+*	1.4	3.0	2.2	0.3	4.0	2.1	3.0	1.0	NG	4.3	6.5	4.3	10

iv) 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 five locations *viz.*, IIRR-Rajendranagar, Coimbatore, Gangavathi, Ludhiana and pantnagar. Three gene differentials *viz.*, PTB 33 (bph 2, 3 and 32 genes), RP 2068-18-3-5 (bph 33t gene) and RP Bio4918-230S (bph39 and 40 genes) 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 **(Table 2.15 &2.15A)**.

IIRR: The females laid eggs on all the gene differentials and the number of nymphs hatched were more on TN1, the egg period was 8 days. The nymphal duration was lowest on TN1 and in other gene differentials, it was almost the same. The sex ratio was in favour of females in all gene differentials except in RP bio 4918-230S. The winged insects outnumbered the wingless insects in all the gene differentials. The macropterous adults were 70.5% and they were less in TN1 and more in RP bio 4918-230S.

Coimbatore: All the females laid eggs on all the gene differentials and the nymphs hatched were highest on TN1 and lowest on RP bio 4918-230S. The incubation period was 9 days, the nymphal survival ranged from 43-52% and was highest on RP 2068-18-3-5.

Ludhiana: All the females laid eggs on all the gene differentials and nymphs hatched were highest on TN1 and lowest on PTB33. The egg period ranged from 7 days (TN1) to 9 days (PTB33 and RP2068-18-3-5). The nymphal survival was highest and nymphal duration was shortest on TN1 and vice versa in PTB33. Males were highest in TN1 and sex ratio was in favour of females except in RP 2068-18-3-5 and RP bio 4918-230S. The macropterous adults were more (73.48%) than wingless adults and were more on RP bio4918-230S.

Gangavathi: All the females laid eggs on all the gene differentials and the nymphs hatched were highest on TN1 and lowest on PTB33. The incubation period was 9 days, the nymphal survival was highest on RP 2068-18-3-5 and lowest on RP bio 4918-230S. The male population was lowest on RP bio 4918-230S and the sex ratio is in favour of females. The brachypterous adults (59.5%) and outnumbered the winged adults and they were highest on PTB33.

Pantnagar: All the females laid eggs on all the gene differentials and the nymphs hatched were highest on TN1 and lowest on PTB33. The incubation period was 9.5

days, the nymphal survival was highest on RP 2068-18-3-5 and lowest on PTB33. The male population was lowest on PTB33 and the sex ratio is in favour of females.

The virulence monitoring studies of brown planthopper populations using the three gene differentials revealed that Gangavathi brown planthopper population was more virulent than the other four BPH populations viz., IIRR-Rajendranagar, Coimbatore, Ludhiana and Pantnagar in terms of highest fecundity, male population and highest percentage of brachypterous adults. The brown planthopper females were less virulent on PTB33 compared to others. At all the locations, all the females were virulent.

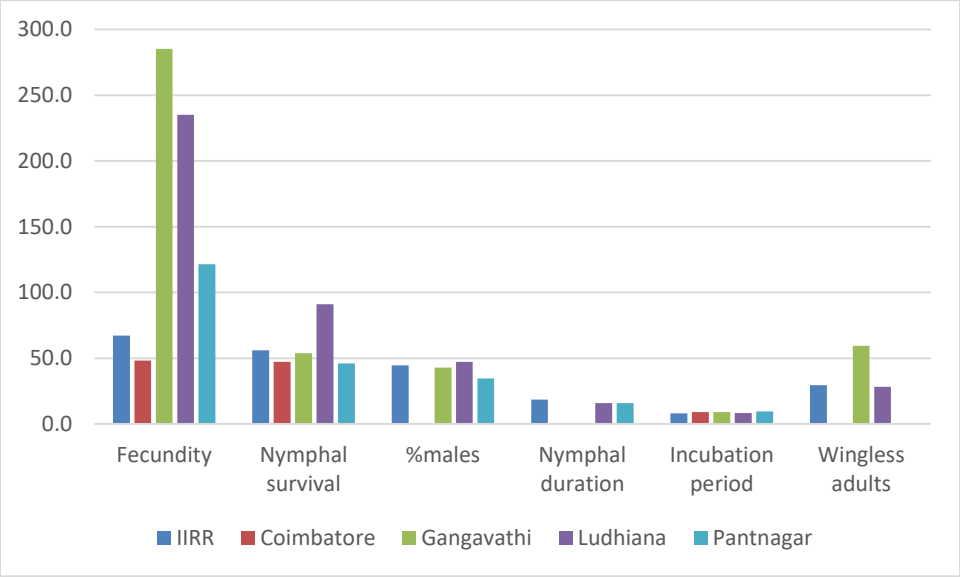


Fig . Biology of brown planthopper at different locations

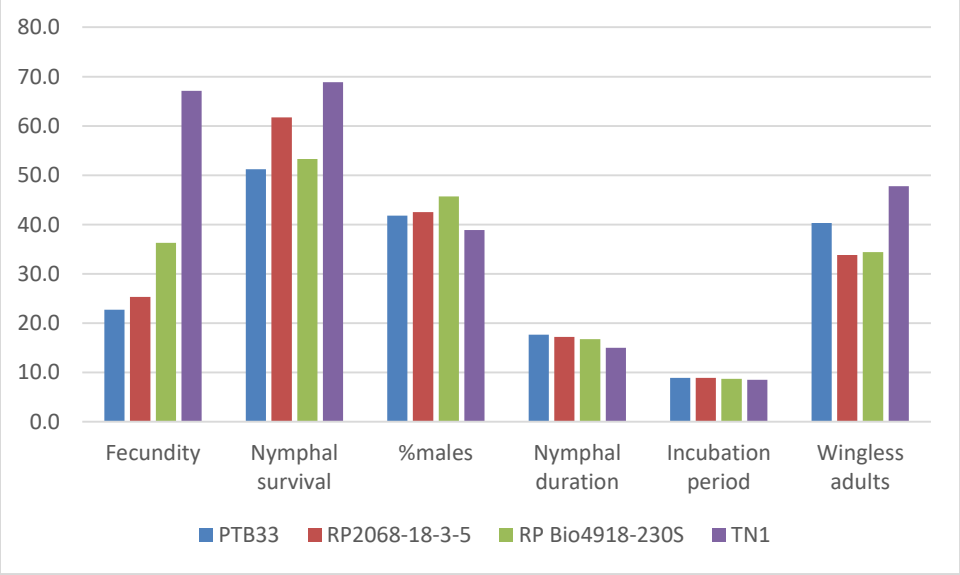


Fig . Biology of brown planthopper on gene differentials

Table: 2.15 Virulence monitoring of brown planthopper population in PHPM, kharif 2021

Locations	IIRR				Coimbatore				Gangavathi			
Gene differential	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**TN1**	**PTB33**	**RP 2068-18-3-5**	**RP bio 4918-230S**	**TN1**	**PTB33**	**RP 2068-18-3-5**	**RP bio 4918-230S**	**TN1**
No. females released	25				25				25			
Virulent females (%)	100				100				100			
No nymphs hatched/female	8.4	3.4	10.3	45.2	5.88	3.64	2.2	36.52	38.44	55.2	94.36	97.32
Total nymphs/female	67.3				48.24				285.32			
Egg period	8	8	8	8	9	9	9	9	9	9	9	9
Nymphal surival (%)	45.2	46.67	58.3	73.3	45.0	51.7	49.5	43.0	50.0	85.5	29.2	50.0
Nymphal duration	19	19.7	19.2	16	NR	NR	NR	NR	NR	NR	NR	NR
Males (%)	42.72	40.92	60.76	33.71	NR	NR	NR	NR	45.0	44.7	33.1	48.4
Sex ratio	1.27F:1.0M	1.31F:1.0M	0.87F: 1.0M	1.47F:1.0M	NR	NR	NR	NR	1.22F: 1.0M	1.24F:1.0M	2.03F: 1.0M	1.07F: 1.0M
winged females(%)	29.3	31.7	34.8	36.3	NR	NR	NR	NR	21.8	26.6	36.1	21.7
wingless females(%)	19.6	7.6	11.62	27.1	NR	NR	NR	NR	33.2	28.7	30.8	29.9
Winged males (%)	39.8	45.2	44.18	20.5	NR	NR	NR	NR	10.0	16.2	13.1	16.6
Wingless males (%)	11.3	15.5	9.4	16.1	NR	NR	NR	NR	35.0	28.5	19.9	31.8

Table: 2.15A Virulence monitoring of brown planthopper population in PHPM, kharif 2021

Locations	Ludhiana				Pantnagar			
Gene differential	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**TN1**	**PTB33**	**RP2068-18-3-5**	**RP bio 4918-230S**	**TN1**
No. females released	10				25			
Virulent females (%)	100				100			
No nymphs hatched/female	32.3	42.8	51.9	108.1	28.6	21.7	22.6	48.5
Total nymphs/female	235.1				121.4			
Egg period	9	9	8	7	9.5	9.5	9.5	9.5
Nymphal surival (%)	82.5	89.5	94.5	98	33.5	35.3	35.0	79.9
Nymphal duration	18	16	15	14	16.0	16.0	16.0	15.0
Males (%)	49.5	53.1	50.8	35.4	30.1	31.5	38.3	38.2
Sex ratio	1.02F: 1.0M	0.89F: 1.0M	0.97F: 1.0M	1.83F: 1.0M	2.17F:1.0M	1.61F:1.0M	1.62F:1.0M	2.33F:1.0M
winged females(%)	31.2	28.1	19.8	26.9	NR	NR	NR	NR
wingless females(%)	21.8	21.1	31.4	38.4	NR	NR	NR	NR
Winged males (%)	46.9	50.8	48.8	34.7	NR	NR	NR	NR
Wingless males (%)	0	0	0	0	NR	NR	NR	NR

2.3. CHEMICAL CONTROL STUDIES

These studies consisted of two trials i) Evaluation of granular insecticides for the management of gall midge (EIGM) and ii) Insecticide-Botanicals Evaluation Trial (IBET)

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

Asian gall midge (*Orseoliaoryzae* 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 yieldlosses. Need is felt to identify the effective granular insecticides/combination of granular insecticides for the management of gall midge. With this background present a trial is conducted during the *Kharif*, 2021 at 13 centres (RGL, BPT, MTU, NLR, WGL, JGT, GNV, ADT, PTB, JDP, ABP, SKL and CHP) with the following 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 transformation and to two-way ANOVA. Treatment effects across the locations (treatment*location interaction) were also estimated. Means were separated by LSD at 5 per cent level of significance.

Results:

Effect on gall midge damage at different locations:

Data were reported from 13 locations. Per cent silver shoots (SS) ranged from 0.19% (MTU) to 39.24% (GNV). Except MTU in all the centres per cent SS crossed ETL of

5% SS. Hereunder, centre wise results are described based on the mean of 35, 50, and 65 DAT.

ABP: All the treatments were significantly effective as compared to the untreated control (T14) (16.02 %SS). T11 (6.52 %SS), T12 (6.60 %SS), and T7 (6.83 %SS) were most effective as compared to the remaining treatments.

ADT: All the treatments were significantly effective as compared to the untreated control (T14) (14.94 %SS). T12 (2.85 %SS) was most effective along with T11 (3.72 %SS), T10 (4.22 %SS), T9 (4.30 %SS) and T13 (4.71 %SS) which were significantly superior as compared to the remaining treatments.

BPT: Treatment were not effective in reducing the gall midge damage. Significantly higher %SS (4.54%) were recorded in T13 as compared to all the remaining treatments including the untreated control (3.06 %SS). However, SS were less than the ETL (5 %).

CHP: All the treatments were significantly effective as compared to the untreated control (T14) (14.12 %SS) and T9 (1.29 %SS) was significantly superior to all the remaining treatments.

GNV: All the treatments were significantly effective as compared to the untreated control (T14) (39.24 %SS). Significantly lower SS were recorded in T9 (3.88%) and T10 (3.75%) as compared to rest of the treatments.

JDP: All the treatments were significantly effective as compared to the untreated control (T14) (39.93 %SS). T5 was most effective (13.23 %SS) treatment. T6 (14.39 %SS), T8 (14.31 %SS), T9 (13.47 %SS) and T12 (14.20 %SS) were at par with the best performing treatment.

JGT: Except T13, in all the treatments significantly lower number of SS were recorded as compared to the untreated control (T14) (28.94 %SS) and T9, was the best treatment with significantly lower %SS (4.42) as compared to the rest of the treatments.

MTU: Incidence of gall midge was too low (highest mean %SS-1.27), hence, valid inferences could not be drawn.

NLR: Except, T1 (7.74 %SS) and T2 (8.67 %SS) that were similar in effect with the untreated control, all the treatments were at par and effective as compared to the untreated control (T14) (10.88). In T11, comparatively lower %SS (5.10) were recorded

PTB: Except T13 (6.38 %SS) all the treatments were effective in reducing the gall midge damage as compared to untreated control (T14) (8.09 %SS). T1 was most

effective with significantly lower %SS (2.42) and was at par with remaining treatments except as compared to T5 (5.37), T9 (4.75), T13 (8.09) and T14.

RGL: All the treatments were significantly effective as compared to the untreated control (T14) (4.35 %SS). T9 was most effective (0.82 %SS) and significantly superior only to T2 (2.72), T13 (4.35) and T14 (4.35).

SKL: All the treatments were effective as compared to untreated control (35.31 %SS) and T5 was most effective (22.23 %SS).

WGL: Treatment effects were significant and in all the treatments significantly lower damage was recorded as compared to the untreated control (4.90 %SS). In T5 significantly lower %SS were recorded (1.13) as compared to T3 and T14, but was at per with the rest of the treatments.

Effect on the gall midge damage across the locations (location X treatment):
In order to arrive at unified inferences, treatment effects across the locations i.e., treatment*locations interaction effects were worked. It made clear that *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 (6.64%) as compared to rest of the treatments.

Stem borer:

Effect on stem borer damage at different locations:

ABP: All the treatments were effective and resulted in significantly lower per cent dead hearts (DH) as compared to the untreated control (6.36%). In T12 (Fipronil 0.3 GR in nursery + Chlorantraniliprole 0.4 GR in mainfield) significantly lower DH (1.53%) were recorded as compared to T1, T3, T4, T6, T10, T13 and T14 and comparable with the rest of the treatments. With respect to white ears, a similar trend was observed, T12 being the best treatment (2.10 %WE) and was significantly superior as compared to T1, T3, T6, and T10. In untreated control treatment 12.94 %WE were recorded.

ADT: T12 was most effective with significantly lower DH (3.23%) along with T9, T10, T11, and T13 as compared to rest of the treatments. In untreated control 14.08 %DH were recorded. Superiority of ST + main field and Nursery + main field treatments i.e., T9 to T13 was maintained in suppression of WE development also. T11 (3.60%) was the best treatment and was at par with T9, T10, T12 and T13. It is notable that in T1 and T2 higher number of WE (21.87% and 21.64% respectively) along with the untreated control (19.39%).

BPT: DH incidence was low hence, not inferred. In case of WE, T2 was most effective with significantly lower WE (2.29%) as compared to rest of the treatments except T3, T4, T6, T7, T9, T11 and T12.

CHP: T12 was most effective with significantly lower DH (0.02 %) as compared to treatments T1 (seed treatment alone) and T2, T3, T4 (nursery alone) and untreated control (5.65%). However, T12 was comparable with other main field alone or main field combination treatments. Similar trends were observed with WE also, T12 being the most effective treatment.

GNV: T10 was most effective with significantly lower DH (3.7%) as compared to the rest of the treatments except T9 (4.41%). In untreated control (T14) 13.73 % DH were recorded. WE damage was significantly lower in T11 (2.31%) and T10 (2.43%).

JDG: All the treatments were significantly superior to the untreated control (6.01%) and were similar in their effects, though in T11comparatively lower DH (2.03%) were recorded. For WE, all the treatments were effective except T1 (14.10%) that was at par with the untreated control (T14) (17.21%). Remaining all the treatments were effective and at par with each other and T12 was the most effective treatment (5.08%).

JGT: Treatments T12 (0.16% DH) and T13 (0.16% DH) were significantly superior to T1, T6, T9 and the untreated control (3.55% DH) and were comparable to rest of the treatments. With respective to WE, for all the treatments were effective except T1 (5.86%) that was at par with the untreated control (T14) (5.93%). Amongst the remaining treatments, T12 was the most effective treatment with lower WE (0.94%).

MTU: Mean %DH ranged between 0.32 and 1.19 hence, not considered for drawing any inferences. Due to continuous and heavy rains crop was subjected to lodging at the time of panicle emergence to grain hardening stages, hence WE data was not reported.

NLR: Treatment T9 was most effective with significantly lower DH (11.36%) as compared to T14 (19.16%) and was comparable with rest of the treatments. Whereas, none of the treatments were effective in preventing WE formation as compared to the untreated control (T14) (5.88%) and only T11 was relatively better (5.36%).

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, in T13 significantly lower damage was recorded (7.20%) followed by T11 (12.14%), T8 (18.27%) as compared to untreated control (32%) and remaining treatments were at par with the untreated control.

RGL: All the treatments were significantly superior to untreated control (T14, 4.28 %DH). However, mean differences between the treatments were insignificant, and in T6 comparatively lower DH (0.86%) were recorded. For WE, except T8 (8.32%) all the

treatments were superior to the untreated control (11.86%) and the treatment T9 was most effective (2.64%).

SKL: Treatments T7 (1.56%) and T12 (1.86%) were significantly superior to rest of the treatments except T13 (2.48%). In the untreated control (T14) 8.07 % DH were recorded. For WE, all the treatments were effective as compared to untreated control (17.50%) except T9 (8.54%) and T7 was most effective (8.54%).

WGL: All the treatments, except T3 (4.19 %DH) were significantly superior to untreated control (T14, 4.55 %DH) and T7 was the most effective one (0.78 %DH). Whereas, in preventing the WE damage no treatment was effective as compared to the untreated control (10.57%) though T7 was comparatively better (7.57%).

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

In terms of dead hearts (DH), combination treatments (T9 to T13) and T7 (chlorantraniliprole 0.4 GR in the main field) were most effective as compared ST alone or nursery alone or main field alone treatments. In T9 to T12, DH ranged from 2.98% (T9) to 3.05% (T12) and were significantly superior to rest of the treatments, except T13 (3.35%). Next best treatment was T7 (3.84% DH). In the untreated control 7.61% DH were recorded. Similar trends were observed with WE also, wherein combination treatments were significantly superior as compared to single application except T7. T9 to T14 and T7 were at par (6.28% to 7.33% WE) as compared to the rest of the treatments. In the untreated control 14.22 % WE were recorded.

Effect on whorl maggot and leaf folder damage in terms per cent damaged leaves across the locations (location X treatment):

For both the insects in all the treatments significantly lower damage was recorded as compared to the untreated control and in general, combination treatments performed better than single application. For WM, T12 and T10 (2.09% and 2.10% DL respectively) that are at par with T7 (2.17%), T13 (2.39%), and T11 (2.69%) and were significantly superior to rest of the treatments. Similarly, for LF, T9 (2.69% DL), T13 (2.83%), T12 (2.85%), and T10 (2.91%) were significantly superior with lower damage as compared to the remaining treatments.

Effect on planthoppers across the locations (locationXtreatment):

For planthoppers also all the treatments were effective with significantly lower hopper population as compared to the untreated control. For BPH, T9 was most effective (2.69) along with T13 (2.83), T12 (2.85), and T10 (2.91) as compared to rest of the treatments. Whereas, for WBPH, T9 (1.45) was most effective with significantly

lower population as compared to T1 (2.89), T12 (2.44), T13 (2.25) and the untreated control (T14) (3.03) and was at par with remaining treatments.

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.

ABP: In T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) significantly higher yield was recorded (3143.3 kg/ha) as compared to the untreated control (T14) (1988 kg/ha) and was at par with remaining treatments.

ADT: T11 (seed treatment with thiamethoxam + cartap hydrochloride granules in main field) resulted in better yield (3290 kg/ha) as compared to the untreated control (T14) (1713 kg/ha) and T3 (2106 kg/ha), but was at with the remaining treatments.

BPT: Highest yield was recorded in T13 (fipronil granules at nursery+ cartap hydrochloride granules in main field in main field) (2997.3 kg/ha) and was at par with remaining all the treatments except T3(2409.7 kg/ha).

CHP: Significantly higher yield (4308 kg/ha) was recorded in T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) as compared to remaining treatments.

GNV: In T10 (seed treatment with thiamethoxam + chlorantraniliprole granule in main field) significantly higher yield (7814.2 kg/ha) was recorded as compared to remaining treatments except T9 (7599 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.

JGT: In T9 (seed treatment with thiamethoxam + fipronil granule in main field) significantly higher yield (5536 kg/ha) was recorded as compared to untreated control (3918 kg/ha), and single application treatments (T1 to T4) and comparable with rest of the treatments.

MTU: Yield levels were erratic and ranged from 291.2 to 2173.7 kg/ha, hence no inferences are drawn.

NLR: Though in T11 higher yield was recorded (5363 kg/ha), treatment mean differences were insignificant.

PTB: In T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) higher yield was recorded (4350 kg/ha) and was significantly higher as compared to only T1 and T2 and at par with remaining treatments.

RGL: T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) (6886.7 kg/ha) was the best treatment followed by T11 (96520 kg/ha), T10 (6773.3 kg/ha) and T7 (6420 kg/ha).

SL: T12 (fipronil granules at nursery+ chlorantraniliprole granule in main field) (1378.3 kg/ha) and T7 (1280 Kg/ha) were at par and significantly superior to remaining treatments.

WGL: Plots that received two applications yielded higher as compared to the plots received one application and T12 was the best treatment (2616.7 kg/ha).

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) (2707.6 kg/ha). T12 (fipronil granules in nursery + chlorantraniliprole granules in main field) was the best treatment with significantly higher yield (3968.9 kg/ha) as compared to remaining treatments except T10 (seed treatment with thiamethoxam + chlorantraniliprole granules in main field) (3290.7 kg/ha) which was second best and is at par with the best treatment.

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 per cent silver shoots (6.34%) as compared to the untreated control (T14) (15.60%), carbofuran 3% CG (7.03%) and remaining treatments across the locations.

In case of stem borer combination treatments (T9 to T13) and T7 (chlorantraniliprole 0.4 GR in the main field) were most effective as compared ST alone or nursery alone or main field alone treatments in preventing the formation of dead hearts. In T9 to T12, DH ranged from 2.98% (T9) to 3.05% (T12) and were significantly superior to rest of the treatments, except T13 (3.35%). Next best treatment was T7 (chlorantraniliprole 0.4 GR in the main field) (3.84% DH). In the untreated control 7.61% DH were recorded. Similar trends were observed with WE also, wherein combination treatments were significantly superior as compared to single application except T7. T9 to T14 and T7 were at par (6.28% to 7.33% WE) as compared to the rest of the treatments. In the untreated control 14.22 % WE were recorded.

For whorl maggot and leaf folder, in all the treatments significantly lower damage was recorded as compared to the untreated control and in general, combination treatments performed better than single application. For WM, T12 and T10 (2.09% and 2.10% DL respectively) were most effective though were at par with

T7 (2.17%), T13 (2.39%), and T11 (2.69%). Similarly, For LF, T9 (2.69% DL), T13 (2.83%), T12 (2.85%), and T10 (2.91%) were significantly superior with lower damage as compared to the remaining treatments.

For BPH and WBPH, T9 (seed treatment with thiamethoxam + fipronil 0.4 GR in the main field) was the most effective as compared to rest of the treatments

Yield was significantly higher in all the treatments as compared to the untreated control (T14) (2707.6 kg/ha). T12 (fipronil granules in nursery + chlorantraniliprole granules in main field) was the best treatment with significantly higher yield (3968.9 kg/ha).

Table 2.16: Field efficacy of granular insecticides against rice gall midge at different locations

Treatments	Per cent silver shoots												
	ABP	ADT	BPT	CHP	GNV	JDP	JGT	MTU	NLR	PTB	RGL	SKL	WGL
Thiamethoxam 25% WG (T1)	7.57cd (4.37)	9.81cd (5.67)	2.77b (1.59)	2.83g (1.62)	35.61b (21.15)	20.54bc (12.05)	21.34cde (12.45)	0.19b (0.11)	7.74abc (4.53)	2.42e (1.39)	2.09bc (1.20)	26.51b (15.64)	1.72cd (0.98)
Carbofuran 3% CG (T2)	7.59cd (4.37)	11.42b (6.61)	3.09b (1.77)	3.74efg (2.14)	26.79d (15.60)	17.29bcd (10.11)	16.36ef (9.56)	0.19b (0.11)	8.67abc (5.08)	3.29cde (1.90)	2.72ab (1.56)	24.95bc (14.72)	1.38cd (0.79)
Fipronil 0.3 GR (T3)	9.76bc (5.63)	11.10bc (6.47)	2.52b (1.45)	3.59efg (2.06)	30.84c (18.12)	16.25bcd (9.60)	14.42f (8.38)	0.18b (0.11)	7.19bc (4.26)	3.73cde (2.15)	1.44bc (0.83)	24.13bc (14.17)	3.55b (2.04)
Chlorantraniliprole 0.4 GR (T4)	10.84bc (6.29)	9.28d (5.38)	3.36b (1.92)	7.34c (4.21)	27.06d (15.82)	15.56bcd (9.18)	23.29cde (13.65)	0.19b (0.11)	6.38bc (3.76)	3.56cde (2.07)	2.59abc (1.48)	26.25b (15.55)	1.45cd (0.83)
Carbofuran 3% CG (T5)	7.53cd (4.34)	9.34d (5.38)	3.17b (1.82)	3.52efg (2.02)	22.54e (13.09)	13.23d (7.71)	7.86gh (4.53)	0.18b (0.11)	5.74bc (3.35)	5.37bc (3.11)	1.20bc (0.69)	22.23c (13.00)	1.13d (0.65)
Fipronil 0.3 GR (T6)	7.86cd (4.52)	9.00d (5.18)	3.22b (1.85)	3.21fg (1.84)	16.91f (9.76)	14.39d (8.37)	12.72fg (7.39)	0.19b (0.11)	5.32c (3.14)	3.08de (1.77)	2.48bc (1.42)	25.02bc (14.70)	2.25cd (1.29)
Chlorantraniliprole 0.4 GR (T7)	6.83d (3.94)	7.26e (4.17)	3.33b (1.91)	8.24c (4.72)	16.80f (9.70)	16.79bcd (9.83)	30.20a (17.87)	0.49b (0.28)	5.92bc (3.46)	4.06cde (2.34)	1.44bc (0.82)	25.61b (15.09)	1.92cd (1.10)
Cartap hydrochloride 4% GR (T8)	8.81bcd (5.08)	7.02e (4.03)	3.52ab (2.02)	10.06b (5.77)	22.64e (13.16)	14.31d (8.34)	27.81ab (16.47)	0.18b (0.10)	5.22c (3.02)	2.61de (1.50)	2.71ab (1.55)	24.54bc (14.42)	1.98cd (1.14)
$T_1 + T_6$(T9)	8.64bcd (4.98)	4.30fg (2.47)	3.05b (1.75)	1.29h (0.74)	3.88i (2.22)	13.47d (7.87)	4.42h (2.54)	0.18b (0.11)	5.35c (3.09)	4.75bcd (2.75)	0.82c (0.47)	24.76bc (14.58)	1.76cd (1.01)
$T_1 + T_7$(T10)	8.99bcd (5.18)	4.22g (2.42)	3.51ab (2.01)	2.87g (1.64)	3.75i (2.15)	20.53b (12.19)	25.95ab (15.30)	0.19b (0.11)	6.79bc (4.00)	3.54cde (2.04)	1.87bc (1.07)	24.13bc (14.16)	1.44cd (0.83)
$T_1 + T_8$(T11)	6.53d (3.76)	3.72g (2.13)	2.96b (1.70)	4.07ef (2.33)	13.49g (7.77)	14.95cd (8.75)	26.26ab (15.49)	1.27a (0.73)	5.10c (3.03)	4.18cde (2.41)	1.62bc (0.93)	25.63b (15.10)	1.54cd (0.88)
$T_3 + T_7$(T12)	6.60d (3.80)	2.85g (1.64)	2.94b (1.69)	4.45e (2.55)	10.51h (6.04)	14.20d (8.27)	20.79de (12.13)	0.19b (0.11)	5.20c (3.03)	4.26bcde (2.46)	0.96bc (0.55)	26.49b (15.64)	1.80cd (1.03)
$T_3 + T_8$ (T13)	9.56bc (5.52)	4.71fg (2.70)	4.54a (2.62)	5.76d (3.30)	13.38g (7.70)	18.17bcd (10.64)	26.34ab (15.55)	0.62ab (0.36)	5.04c (2.92)	6.38ab (3.71)	1.45bc (0.83)	25.96b (15.31)	2.26cd (1.30)
Untreated Control (T14)	16.02a (9.27)	14.94a (8.66)	3.06b (1.76)	14.12a (8.12)	39.24a (23.50)	33.93a (20.10)	28.94a (17.01)	0.19b (0.11)	10.88a (6.33)	8.09a (4.71)	4.35a (2.49)	35.31a (21.74)	4.90a (2.81)

Figures in parentheses transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.17: Field efficacy of granular insecticides against rice gall midge across the locations

Crop Stage	Treatment	Per cent silver shoots			
		Location * treatment	DAT* treatment		
			35 DAT	50 DAT	65 DAT
ST alone	Thiamethoxam 25% WG (T1)	9.34cde (2.95)	10.19efg (4.57)	12.85d (5.045)	11.23ijklm (3.81)
Nursery alone (15 DAS/7DBT)	Carbofuran 3% CG (T2)	8.87cd (2.99)	7.69lmnop (3.54)	12.10def (4.771)	10.97ijklm (3.83)
	Fipronil 0.3 GR (T3)	8.67bc (3.08)	9.34def (4.73)	11.58def (4.682)	10.29lmno (3.61)
	Chlorantraniliprole 0.4 GR (T4)	9.70b (3.35)	8.29hijk (4.08)	13.15de (4.975)	11.67ghij (4.11)
Main field alone (20-25 DAT)	Carbofuran 3% CG (T5)	7.03f (2.48)	6.91opqr (3.18)	9.18ijklm (3.819)	8.54pqrs (3.11)
	Fipronil 0.3 GR (T6)	7.78ef (2.69)	6.32rstu (2.87)	10.14ijkl (3.954)	8.84qrs (3.02)
	Chlorantraniliprole 0.4 GR (T7)	9.89b (3.31)	7.72mnopq (3.38)	12.42fgh (4.482)	10.94jklmn (3.66)
	Cartap hydrochloride 4% GR (T8)	9.57b (3.35)	7.95jklmn (3.72)	13.92d (5.140)	9.78klmno (3.63)
ST + Main field	$T_1 + T_6$(T9)	6.34g (2.10)	3.98y (1.60)	7.75stuv (2.647)	6.34wx (2.08)
	$T_1 + T_7$(T10)	9.14ef (2.70)	5.85xy (1.97)	11.38lmnop (3.518)	8.54uvw (2.47)
	$T_1 + T_8$(T11)	8.63def (2.75)	6.03tuv (2.54)	11.01ijkl (3.965)	9.72qrst (3.00)
Nursery + Main field	$T_3 + T_7$(T12)	7.98f (2.51)	5.81vwx (2.29)	10.40lmnop (3.564)	8.04tuv (2.55)
	$T_3 + T_8$ (T13)	9.66bc (3.15)	7.67pqr (3.11)	11.50ghi (4.181)	10.45nopqr (3.30)
	Untreated Control (T14)	15.60a (5.69	14.99b (7.04)	20.00a (7.986)	17.53c (6.49)

Figures in parentheses are transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.18 Field efficacy of granular insecticides on stem borer in terms of dead hearts at different locations

Treatments	Per cent dead hearts											
	ABP	ADT	CHP	GNV	JDP	JGT	MTU	NLR	PTB	RGL	SKL	WGL
Thiamethoxam 25% WG (T1)	2.82cde (1.63)	9.23c (5.32)	1.48b (0.85)	11.71b (6.72)	2.36b (1.36)	2.43b (1.39)	0.34c (0.19)	15.72abc (9.56)	3.57bcd (2.06)	2.04b (1.17)	3.44bc (1.97)	2.80b (1.61)
Carbofuran 3% CG (T2)	2.47def (1.42)	11.96b (6.91)	1.20bc (0.69)	10.29c (5.90)	4.40ab (2.55)	0.45c (0.26)	0.82abc (0.47)	16.16abc (9.51)	3.43bcd (1.98)	1.58b (0.90)	4.88b (2.80)	2.08bc (1.20)
Fipronil 0.3 GR (T3)	2.90cde (1.67)	11.72b (6.83)	0.94c (0.54)	9.81c (5.63)	2.21b (1.28)	0.50c (0.29)	1.07abc (0.61)	16.14abc (9.54)	3.34bcd (1.94)	1.37b (0.78)	4.80b (2.76)	4.19a (2.41)
Chlorantraniliprole 0.4 GR (T4)	3.95bc (2.28)	9.76c (5.63)	0.41d (0.23)	8.72d (5.00)	4.40ab (2.57)	0.18c (0.11)	0.37abc (0.21)	14.73abc (8.60)	3.06bcd (1.78)	1.50b (0.86)	3.89bc (2.23)	1.97bcd (1.13)
Carbofuran 3% CG (T5)	2.29def (1.31)	9.48c (5.47)	0.30de (0.17)	8.35de (4.79)	3.13b (1.81)	0.31c (0.18)	0.36bc (0.21)	11.67c (6.76)	3.01bcd (1.74)	1.22b (0.70)	4.41b (2.53)	1.09def (0.62)
Fipronil 0.3 GR (T6)	3.37cde (1.94)	8.93c (5.14)	0.21de (0.12)	7.88ef (4.52)	2.93b (1.69)	2.77ab (1.59)	1.20abc (0.69)	12.54bc (7.28)	2.68bcd (1.55)	0.86b (0.49)	3.67bc (2.11)	1.47cdef (0.84)
Chlorantraniliprole 0.4 GR (T7)	2.02ef (1.16)	9.23c (5.32)	0.11de (0.06)	7.36f (4.22)	2.08b (1.20)	0.16c (0.09)	0.42abc (0.24)	17.48abc (10.24)	4.87ab (2.84)	1.53b (0.88)	1.56d (0.89)	0.78f (0.45)
Cartap hydrochloride 4% GR (T8)	2.43def (1.40)	8.20c (4.72)	0.29de (0.17)	8.80d (5.05)	2.73b (1.57)	0.16c (0.09)	0.32c (0.18)	13.35abc (8.20)	1.18d (0.68)	1.30b (0.74)	4.20b (2.41)	1.67cdef (0.96)
T_1 + T_6(T9)	1.87ef (1.07)	4.36d (2.50)	0.28de (0.16)	4.14hi (2.37)	3.17b (1.84)	2.47b (1.43)	0.65abc (0.37)	11.36c (6.59)	1.54d (0.88)	1.43b (0.82)	4.19b (2.41)	1.83cdef (1.05)
T_1 + T_7(T10)	2.84cde (1.63)	4.20d (2.41)	0.11de (0.06)	3.70i (2.12)	2.55b (1.47)	0.31c (0.18)	1.02abc (0.59)	15.52abc (9.39)	3.69abcd (2.17)	1.13b (0.65)	2.46cd (1.41)	0.95ef (0.54)
T_1 + T_8(T11)	2.51def (1.44)	4.02d (2.30)	0.37de (0.21)	4.71g (2.70)	2.03b (1.17)	0.84c (0.48)	0.71abc (0.41)	12.67bc (7.38)	1.68cd (0.97)	2.16b (1.24)	4.32b (2.48)	1.61d (0.92)
T_3 + T_7(T12)	1.53f (0.88)	3.23d (1.86)	0.02e (0.01)	4.67gh (2.67)	3.25b (1.87)	0.16c (0.09)	1.19ab (0.68)	15.66abc (9.19)	4.32abcd (2.49)	0.98b (0.56)	1.86d (1.07)	1.31cdef (0.75)
T_3 + T_8 (T13)	4.83bc (2.78)	4.77d (2.74)	0.20de (0.11)	5.00g (2.86)	2.61b (1.50)	0.16c (0.09)	0.32c (0.18)	14.77abc (8.70)	3.35bcd (1.95)	1.27b (0.73)	2.48cd (1.42)	1.92bcd (1.10)
Untreated Control (T14)	6.36a (3.66)	14.08a (8.17)	5.65a (3.24)	13.73a (7.90)	6.01a (3.46)	3.55a (2.04)	0.68abc (0.39)	19.16a (11.17)	6.36a (3.70)	4.28a (2.45)	8.07a (4.65)	4.55a (2.61)

Figures in parentheses are transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.19: Field efficacy of granular insecticides on stem borer in terms of white ears at different locations

Treatments	Per cent white ears											
	ABP	ADT	BPT	CHP	GNV	JDP	JGT	NLR	PTB	RGL	SKL	WGL
Thiamethoxam 25% WG (T1)	6.81bc (3.92)	21.87a (12.75)	4.18ab (2.40)	9.14b (5.24)	14.09b (8.10)	14.10ab (8.23)	5.86a (3.36)	8.68ab (5.00)	27.34abcd (16.07)	4.52bcd (2.59)	12.79bc (7.37)	12.78ab (7.42)
Carbofuran 3% CG (T2)	4.33bcd (2.49)	21.64a (12.64)	2.29d (1.31)	8.31c (4.77)	8.44c (4.84)	8.70bcd (5.02)	2.54cde (1.46)	9.23ab (5.32)	33.95ab (23.45)	5.76bcd (3.30)	10.51cd (6.04)	17.49a (10.20)
Fipronil 0.3 GR (T3)	6.17bc (3.55)	9.09efg (5.23)	2.94bcd (1.69)	7.38d (4.23)	7.62cd (4.37)	9.77bc (5.63)	3.25bcd (1.86)	6.38b (3.68)	27.40abcd (16.19)	4.89bcd (2.80)	15.42ab (8.91)	12.25ab (7.10)
Chlorantraniliprole 0.4 GR (T4)	4.01cd (2.31)	7.80fgh (4.49)	3.46bcd (1.99)	5.68fg (3.25)	6.46de (3.70)	8.09cd (4.66)	1.20ef (0.69)	10.11ab (5.83)	29.30abc (18.23)	3.51cd (2.01)	10.97cd (6.33)	15.20ab (8.83)
Carbofuran 3% CG (T5)	4.33bcd (2.48)	17.47bc (10.20)	5.19a (2.99)	5.99f (3.43)	9.10c (5.22)	5.91cd (3.40)	1.22ef (0.70)	6.52ab (3.75)	33.29ab (22.82)	2.49d (1.43)	11.94bcd (6.88)	14.71ab (8.53)
Fipronil 0.3 GR (T6)	6.11bc (3.52)	11.94de (6.88)	2.73bcd (1.57)	5.32gh (3.05)	7.42cd (4.25)	8.01cd (4.61)	4.00b (2.29)	12.91a (7.45)	23.49abcd (15.03)	3.75cd (2.15)	14.46abc (8.35)	9.63ab (5.54)
Chlorantraniliprole 0.4 GR (T7)	3.74cd (2.15)	10.29ef (5.92)	2.66cd (1.53)	4.57i (2.62)	6.40de (3.67)	3.72d (2.16)	1.26ef (0.72)	10.37ab (6.00)	27.08abc (17.25)	2.86d (1.64)	8.54d (4.92)	7.57b (4.35)
Cartap hydrochloride 4% GR (T8)	7.35b (4.23)	15.34cd (8.89)	3.96abc (2.28)	6.83e (3.92)	4.62efg (2.65)	6.34cd (3.64)cd	2.45ed (1.40)	7.79ab (4.48)	18.27bcd (11.79)	8.32ab (4.77)	14.50abc (8.37)	11.88ab (6.89)
$T_1 + T_6$(T9)	4.57bcd (2.62)	6.80fghi (3.92)	3.12bcd (1.79)	5.18h (2.97)	5.41ef (3.10)	6.40bcd (3.69)	3.86bc (2.22)	9.12ab (5.26)	26.32abcd (15.42)	2.64d (1.51)	13.56abc (7.82)	12.21ab (7.10)
$T_1 + T_7$(T10)	6.44bc (3.70)	5.22ghi (3.00)	3.97abc (2.28)	4.47i (2.56)	2.43h (1.39)	8.68cd (5.02)	2.05def (1.18)	6.04b (3.47)	28.03abc (17.56)	7.52bc (4.31)	11.84bcd (6.82)	6.46b (3.71)
$T_1 + T_8$(T11)	4.37bcd (2.51)	3.60i (2.07)	3.16bcd (1.81)	5.60fgh (3.21)	2.31h (1.32)	6.66cd (3.85)	2.49ed (1.43)	5.36b (3.08)	12.14dc (8.19)	6.59bcd (3.78)	11.62bcd (6.70)	13.76ab (7.98)
$T_3 + T_7$(T12)	2.10d (1.21)	5.27ghi (3.03)	3.08bcd (1.77)	3.45j (1.97)	3.53fgh (2.02)	5.08cd (2.93)	0.94f (0.54)	5.92b (3.40)	35.82a (24.57)	5.83bcd (3.34)	12.79bc (7.38)	8.45ab (4.86)
$T_3 + T_8$ (T13)	5.06bcd (2.92)	5.08hi (2.91)	4.12ab (2.37)	5.43gh (3.11)	3.46gh (1.98)	6.88cd (3.96)	1.39ef (0.80)	6.68ab (3.84)	7.20d (4.18)	7.15bc (4.10)	13.17bc (7.60)	10.78ab (6.21)
Untreated Control (T14)	12.94a (7.48)	19.39ab (11.25)	3.79abc (2.18)	15.50a (8.92)	18.57a (10.73)	17.21a (10.04)	5.93a (3.40)	5.88b (3.38)	32.00abc (18.99)	11.86a (6.81)	17.50a (10.11)	10.57ab (6.12)

Figures in parentheses are transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.20: Field efficacy of granular insecticides against stem borer in rice across the locations

Crop Stage	Treatment	Per cent dead hearts				Per cent white ears
		Locations* treatments	DAT* treatment			Locations* treatments
			35 DAT	50 DAT	65 DAT	
ST alone	Thiamethoxam 25% WG (T1)	4.70b (3.70)	4.06ghij (2.97)	4.94ef (3.71)	5.10d (4.42)	11.80b (2.91)
Nursery alone (15 DAS/7DBT)	Carbofuran 3% CG (T2)	4.85b (3.45)	3.96hijk (2.86)	4.48ghij (3.08)	6.11d (4.42)	11.04c (2.43)
	Fipronil 0.3 GR (T3)	4.78b (3.47)	4.69fg (3.36)	4.51gh (3.18)	5.15ef (3.88)	9.32cde (2.27)
	Chlorantraniliprole 0.4 GR (T4)	4.28b (2.90)	3.71jklmnop (2.52)	4.56ghij (3.05)	4.57gh (3.14)	8.75def (2.02)
Main field alone (20-25 DAT)	Carbofuran 3% CG (T5)	3.67de (2.57)	3.21klmnopq (2.38)	3.45lmnopqr (2.39)	4.34ghij (2.94)	9.79cde (2.27)
	Fipronil 0.3 GR (T6)	3.92cd (2.80)	3.60hijklmn (2.75)	4.05hij (2.89)	4.11hijkl (2.75)	9.10cde (2.27)
	Chlorantraniliprole 0.4 GR (T7)	3.84ef (2.30)	3.66opqrs (2.25)	3.50pqrst (2.11)	4.35jklmnop (2.55)	7.33g (1.67)
	Cartap hydrochloride 4% GR (T8)	3.58d (2.58)	2.85opqrsn (2.28)	3.82ijklmno (2.64)	4.09hijkl (2.82)	8.91cd (2.35)
ST + Main field	T_1 + T_6(T9)	2.98ghi (1.97)	2.79pqrst (2.14)	2.92tuv (1.78)	3.22qrstu (1.99)	8.20defg (2.01)
	T_1 + T_7(T10)	3.08i (1.70)	2.37uv (1.57)	3.14uv (1.56)	3.73qrstu (1.97)	7.70efg (1.94)
	T_1 + T_8(T11)	3.00ghi (1.97)	2.11uv (1.64)	3.25stuv (1.84)	3.64klmnopq (2.42)	6.37fg (1.78)
Nursery + Main field	T_3 + T_7(T12)	3.05hi (1.73)	2.60tuv (1.75)	3.00v (1.47)	3.56qrstu (1.97)	7.62fg (1.70)
	T_3 + T_8 (T13)	3.35fg (2.04)	3.07rstu (1.95)	3.54stuv (1.84)	3.43mnopqr (2.33)	6.28fg (1.86)
	Untreated Control (T14)	7.61a (6.16)	6.33c (5.13)	7.78b (5.92)	8.71a (7.44)	14.22a (3.62)

Figures in parentheses are transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.21: Field efficacy of granular insecticides on whorl maggot, leaf folder, brown planthopper and white backed planthopper across the locations

Crop Stage	Treatment	Per cent damaged leaves per hill		No. per hill	
		LF	WM	BPH	WBPH
ST alone	Thiamethoxam 25% WG (T1)	2.86bcd (5.40)	3.70b (7.08)	3.88b (9.58)	2.89b (7.54)
Nursery alone (15 DAS/7DBT)	Carbofuran 3% CG (T2)	3.16bcd (5.71)	3.53bc (7.06)	3.56bcd (9.30)	2.20ef (7.02)
	Fipronil 0.3 GR (T3)	2.81bcd (5.44)	3.71c (7.11)	3.69bc (9.37)	2.20cdef (7.13)
	Chlorantraniliprole 0.4 GR (T4)	2.64de (5.20)	3.53bcd (6.94)	3.57bcd (9.27)	1.94def (7.12)
Main field alone (20-25 DAT)	Carbofuran 3% CG (T5)	2.82bcd (5.38)	3.47b (7.13)	3.45cd (9.21)	2.50bcde (7.39)

	Fipronil 0.3 GR (T6)	3.10bc (5.56)	3.60b (7.08)	3.31cd (9.06)	1.73f (6.80)
	Chlorantraniliprole 0.4 GR (T7)	2.17e (4.96)	3.60bcd (7.02)	3.57bcd (9.34)	2.40ef (7.08)
	Cartap hydrochloride 4% GR (T8)	2.97cd (5.37)	3.15cde (6.68)	3.42cd (9.14)	2.49bcde (7.23)
ST + Main field	T_1 + T_6(T9)	2.70bcd (5.39)	2.69f (6.17)	3.36d (9.02)	1.45ef (7.03)
	T_1 + T_7(T10)	2.10e (5.00)	2.91ef (6.35)	3.45cd (9.16)	1.77bcde (7.21)
	T_1 + T_8(T11)	2.69cde (5.27)	3.42de (6.65)	3.44cd (9.12)	1.79ef (7.09)
Nursery + Main field	T_3 + T_7(T12)	2.09e (4.95)	2.85f (6.18)	3.36cd (9.10)	2.44bcd (7.48)
	T_3 + T_8 (T13)	2.39de (5.16)	2.83f (6.25)	3.39cd (9.12)	2.25bc (7.50)
	Untreated Control (T14)	3.26a (6.05)	4.08a (7.63)	4.93a (10.52)	3.03a (8.27)

Figures in parentheses are transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.22: Effect of granular insecticides on yield in rice at different locations

Treatments	Grain Yield (Kg/ha)												
	ABP	ADT	BPT	CHP	GNV	JDP	JGT	MTU	NLR		RGL	SKL	WGL
Thiamethoxam 25% WG (T1)	2447.3ab	2623.3ab	2657.7ab	3265.0g	3652.5h	3626.7e	4480.0f	1648.3abcde	5297.3a	3383.3bc	5606.7f	831.7bc	1833.3cd
Carbofuran 3% CG (T2)	2376.0ab	2666.7ab	2632.0ab	3300.0g	4607.5g	3780.0de	4892.0def	1014.8defgh	4914.3abcd	3133.3c	5833.3ef	850.0bc	2050.0abcd
Fipronil 0.3 GR (T3)	2534.0ab	2106.7bc	2409.7b	3363.0fg	4880.0fg	3638.3e	4984.0cde	1085.3cdefg	5023.0abcd	4100.0ab	5930.7def	748.3bc	1983.3bcd
Chlorantraniliprole 0.4 GR (T4)	2585.3ab	2750.0ab	2776.3ab	3500.0e	5100.0f	3943.3bcd	4672.0ef	1752.0abc	5271.0ab	3600.0abc	6133.3cde	770.0bc	1806.7cd
Carbofuran 3% CG (T5)	2794.5ab	2850.0a	2792.3ab	3358.0fg	5828.3de	3808.3de	5111.0abcde	793.5fgh	5105.2ab	3558.3abc	6160.0cde	1081.7ab	2466.7ab
Fipronil 0.3 GR (T6)	3015.0a	2866.7a	2658.0ab	3455.0ef	6113.3cd	3915.0bcd	5210.0abcd	1339.3bcdef	5047.0abc	3916.7ab	6280.0cde	860.0bc	2408.3ab
Chlorantraniliprole 0.4 GR (T7)	2834.3ab	2960.0a	2852.3ab	3725.0d	6329.2c	4066.7abc	5102.0abcde	450.3gh	4630.3bcd	4250.0ab	6420.0abcd	1280.0a	2590.0a
Cartap hydrochloride 4% GR (T8)	2910.7a	2701.7ab	2948.3ab	3433.0ef	5755.8e	4160.0ab	5009.0bcde	291.2h	4379.3d	3666.7abc	6293.3bcde	750.0bc	2485.0ab
$T_1 + T_6$(T9)	2622.3ab	3013.3a	2627.0ab	3950.0c	7599.2a	3798.3de	5536.0a	2173.7a	4451.7cd	3883.3abc	6392.0bcd	750.0bc	2490.0ab
$T_1 + T_7$(T10)	2849.3ab	2878.3a	2854.3ab	4192.0b	7814.2a	3906.7cd	5300.0abcd	2039.3ab	5066.7abc	3733.3abc	6773.3ab	1095.0ab	2466.7ab
$T_1 + T_8$(T11)	2268.3ab	3290.0a	2847.3ab	3883.0c	6851.7b	3836.7cde	5310.0abcd	1706.3abcd	5363.0a	4283.3ab	6520.0abc	773.3bc	2356.7abc
$T_3 + T_7$(T12)	3143.3a	3008.3a	2601.7ab	4308.0a	7073.3b	4240.0a	5464.0ab	1340.2bcdef	5185.0ab	4350.0a	6886.7a	1378.3a	2616.7a
$T_3 + T_8$ (T13)	2883.0ab	2885.0a	2997.3a	3933.0c	6990.8b	4160.0ab	5434.0abc	708.8fgh	4756.3abcd	3908.3abc	6373.3bcd	795.0bc	2416.7ab
Untreated Control (T14)	1988.0b	1713.3c	2500.3ab	2563.0h	2873.3i	3355.0f	3918.0g	926.8efgh	4891.7abcd	3616.7abc	4650.7g	691.7c	1510.0d

Figures in parentheses are transformed values. Means within a column followed by same alphabet are significantly not different (LSD, P<0.05).

Table 2.23: Field efficacy of granular insecticides on yield in rice across the locations

Crop Stage	**Treatment**	Yield (Kg/ha)
ST alone	Thiamethoxam 25% WG (T1)	3181.01g (6.72)
Nursery alone (15 DAS/7DBT)	Carbofuran 3% CG (T2)	3234.62g (6.78)
	Fipronil 0.3 GR (T3)	3291.28fg (6.80)
	Chlorantraniliprole 0.4 GR (T4)	3435.38ef (7.11)
Main field alone (20-25 DAT)	Carbofuran 3% CG (T5)	3516.01de (7.28)
	Fipronil 0.3 GR (T6)	3621.87cde (7.40)
	Chlorantraniliprole 0.4 GR (T7)	3653.09bcd (7.57)
	Cartap hydrochloride 4% GR (T8)	3444.95e (7.17)
ST + Main field	T_1 + T_6(T9)	3791.29cd (7.53)
	T_1 + T_7(T10)	3920.68ab (7.86)
	T_1 + T_8(T11)	3791.54bc (7.65)
Nursery + Main field	T_3 + T_7(T12)	3968.91a (8.11)
	T_3 + T_8 (T13)	3710.92bcd (7.59)
	Untreated Control (T14)	2707.6h (5.81)

Figures in parentheses are square root transformed values. Means within a column followed by same alphabet are significantly not different (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.

Sl. No.	Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
1	Ambikapur	03-07-2021	05-08-2021	25-11-2021	3	25,45 & 60
2	Bapatla	23-072021	17-08-2021	21-12-2020	3	47, 57 & 72
3	Chiplima	22-07-2021	31-08-2021	15-12-2021	3	25, 45 & 65
4	Chinsurah	23-06-2021	19-07-2021	16-11-2021	3	15, 30 & 50
5	Cuttack	25-06-2021	29-07-2021	22-11-2021	3	25, 55 & 70
6	Gangavathi	22-0702021	18-08-2021	17-12-2021	3	25,49 & 60
7	Jagdalpur	02-07-2021	31-07-2021	10-12-2021	3	35,55 & 66
8	Khudwani	12-05-2021	13-06-2021	30-09-2021	3	30,45 & 65
9	Karjat	20-06-2021	18-07-2021	16-10-2021	2	30 & 46
10	Karaikal	30-07-2021	06-09-2021	03-12-2021	2	30 & 55
11	Kaul	20-06-2021	31-07-2021	09-11-2021	4	25,35,50 & 65
12	Ludhiana	21-05-2021	21-06-2021	02-11-2021	3	55, 75 & 90
13	Malan	17-06-2021	10-07-2021	16-11-2021	3	55, 70 & 83
14	Mandya	10-08-2021	08-09-2021	15-12-2021	3	25, 45 & 60
15	Masodha	07-07-2021	07-08-2021	21-11-2021	3	28,53 & 65
16	Maruteru	03-07-2021	29-07-2021	06-12-2021	2	43 & 68
17	Nellore	20-07-2021	31-08-2021	15-12-2021	3	25,45 & 65
18	Navsari	02-07-2021	27-07-2021	14-12-2021	3	30, 50 & 65
19	Nawagam	15-07-2021	11-08-2021	13-11-2021	3	31, 46 & 63
20	New Delhi	29-06-2021	23-07-2021	21-11-2021	4	24, 40, 45 & 60
21	Pattambi	08-07-2021	30-07-2021	05-11-2021	3	15,45 & 75
22	PSAa	23-06-2021	15-07-2021	12-11-2021	3	24, 44 & 59
23	Ranchi	01-07-2021	22-07-2021	08-11-2021	3	30,50 & 90
24	Ragolu	27-07-2021	16-08-2021	20-12-2021	3	25,45 & 60
25	Rajendranagar	22-06-2021	17-07-2021	-	4	33,54 & 68
26	Raipur	13-07-2021	08-08-2021	05-12-2020	3	30, 50 & 90
27	Sakoli	01-07-2021	29-07-2021	26-11-2021	3	30,50 & 69
28	Warangal	15-06-2021	17-07-2021	25-11-2021	3	33 50 & 71
29	Titabar	09-07-2021	10-08-2021	18-11-2021	-	-

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* 2021 to evaluate their performance against major insect pests at 30 check locations.

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 2.24)

Stem borer infestation was recorded in 21 locations and damage during vegetative stage ranged from 0.2 to 13.5% dead hearts (DH) in all insecticide treatments and 1.8 to20.9% in other combination treatments compared to 4.9 to 30.4% in untreated control, during 30 to 75 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 4. 1% when compared to 12.1% in untreated control. Among other treatments, neemazal, eucalyptus oil and cartap hydrochloride combination showed lowest mean infestation of 5.7% DH.

White ears damage at heading stage in all insecticide treatment ranged from 1.0 to 11.9% compared to 4.9 to 40.1% in control across 20 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 21.6 to 27.2 % compared to a maximum of 40.1 % in untreated control. Mean WE infestation ranged from 5.0 to10.9% in treatments as compared to 16.5% in control. Among modules, all insecticides module was found to be the best with 5.0% mean white ear damage followed by neemazal, eucalyptus oil and cartap hydrochloride module with8.1% 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 11 centres of which Jagdalpur recorded highest damage ranging from 25.0 to 42.8% silver shoots (SS)in treatments and 53.5% in control at 30 DAT followed by Sakoli at 65 DAT. At other locations, the SS damage varied from 2.6 to 35.7% across treatments and 4.9 to 39.9% in control. There were significant differences in the efficacy among the treatments at 8 locations. Lowest mean infestation was recorded in all insecticides treatment (11.6%). However there was no significant difference in damage among treatments but and significantly superior to control (19.2%).

Brown planthopper incidence was recorded at very high at Maruteru (104.7-121.5 hoppers/10hills) at 50 DAT followed by New Delhi with population of 14.0 to 153.2 at 89 DAT. Across 12 locations, combination of Neemazal, neem oil and triflumezopyrim treatment was found to be the most effective one with mean number of 21.5 hoppers/10 hills followed by all botanical treatment in reducing BPH populations (25.37) and they were significantly superior to control (33.0).

White backed planthopper populations were observed at 13 locations and Maruteru recorded the highest populations ranging from 159.0 to 486.3 hoppers/10 hills across the treatments at 60 and 70 DAT. Treatment consisting of all insecticides was the most effective in reducing WBPH populations which ranged from 1. 0-246.7 across locations. Lowest mean hopper numbers (37.2/10 hills) was also recorded in all insecticide treatment. Botanical-insecticide combination treatments also showed significant efficacy against the hoppers (40.7 to48.8) compared to that of control (68.5).

Green leafhopper infestation was high at Masodha (107-158.7 hoppers/10 hills) at ADD DAT among the 8 centres. All insecticides combination was the most effective treatment showing mean population of 22.2/10 hills followed by neeamazal, neem oil and Triflumezopyrim combination (24.5)) and were superior to control (40.7hoppers/10 hills).There were significant differences in hopper populations among the treatments at 5 locations as well as in populations recorded at 65,80 and 63 DAT in Bapatla,Navsari and Ranchi respectively.**Leaf folder** damage was recorded from 19 locations and highest leaf damage was recorded in Ranchi centre (12.7 to 74.5%) during 30 and 50 DAT followed by Malan with17.1 to 38.1% at change DAT. There were significant differences in leaf damage among the treatments at 16 locations. All insecticides module was the most effective treatment showing mean leaf damage of 6.1% followed by treatment with neemazl, Eucalyptus oil and cartap hydrochloride (8.4% DL) when compared to untreated control (14. 7% DL). **Whorl maggot** infestation was recorded at 6 centres and damage in general was low. Highest foliage damage was noticed in Titabar ranging from 12.7-14.8% in control at 30-50 DAT. The lowest mean damage was recorded in insecticides treatment (4.4% DL). A damage range of 4.5-5.7% was recorded in botanical treatments compared to 8.3% in control.

Hispa damage was recorded at 3 centres *viz.*, Malan, Mandya and Ranchi. Highest leaf damage of 46.5 to 86.7% was observed in Malan at 77 DAT followed by Ranchi (13.7 to 75.5% at 35 DAT). Treatment consisting of all insecticides was the most effective one with 23.5% mean leaf damage. Other treatments were also found effective showing 30.7-32.2% leaf damage compared to 52.0% in control.

Natural enemies The populations of mirid bug, an important natural enemy of BPH, were recorded in 8 centres. High populations of 157.7 to 350.0 mirid bugs/10 hills were observed in Maruteru at at 60-80 DAT followed by Karaikal with 107.5 at 50 DAT in control. No significant difference in mirid population was noticed at Sakoli and Warangal. Mean mirid population was at par in all 4 treatments (52.0 -65.0 bugs/10hills) as compared to 73.7in control indicating that botanical and insecticide combinations were safe to the predator.

Spider populations were recorded in 9 locations, of which Maruteru reported more spider numbers (35.2-47.2 /10 hills at 60 DAT). There was significant difference in spider populations at 4 locations. There was no significant difference in mean spider population between treatments and control (12.0-13.9) indicating the safety of these treatments to spiders.

Coccinellid populations were reported from 4 centres-Bapatla, Karaikal, kaul and Pattambhi. There were significant differences in populations among various treatments and control at 3 locations. The highest mean numbers of 5.0 per10 hills were recorded in botanicals module as compared to 6.6 in control.

Grain Yield (Table 2.25)

There were significant differences in grain yield among the treatments including control at all locations except 8 locations-Ambikapur, bapatla, Chata, Nellore, Pattambhi, PSAa, Raipur and Warangal. Based on mean yield of these locations, all insecticides treatment - Chlorantraniliprole, Cartap hydrochloride, Triflumezopyrim recorded the highest grain yield of 4581.7 kg/ha with 44.2% increase over control (IOC) followed by neemazal, neem oil and triflumezopyrim with 4071 kg/ha (25.3% IOC). All the treatments were significantly superior to control plot which showed a yield of 2983.9kg/ha.

Insecticide Botanicals Evaluation Trial (IBET) was carried out at 30 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,2021. 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 all insecticides treatment. 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. Insecticide and botanical combination treatments were found moderately effective in reducing damage by hispa and whorl maggot 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 yield of 4581.7 kg/ha with 44.2% increase over control followed by treatment with applications of neemazal, neem oil and triflumezopyrim showing yield of 4071 kg/ha (25.3% IOC).

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Stem borer Damage (% Dead hearts)																			
		ABP				CHN	CHP		CTC		GNV	JDP	KJT		KRK	KUL
		45DT	50DT	60DT	65DT	55DT	55DT	75DT	30DT	60DT	50DT	70DT	30DT	50DT	50DT	45DT
1	Botanical-Insecticide 1	3.1a	2.8a	4.4b	2.8b	13.2d	3.0bc	4.7b	4.3c	3.6c	3.3a	2.6bc	6.8a	5.0b	3.4b	3.9b
2	Botanical-Insecticide 2	9.1a	7.8a	5.4a	5.6ab	16.4c	4.1b	5.2b	4.0c	3.9c	2.8ab	4.0ab	7.4a	3.1d	3.8b	3.8b
3	All Botanical	5.5a	4.2a	4.5b	3.7ab	20.4b	2.5bc	4.1bc	6.9b	5.9b	4.8a	3.1bc	7.0a	4.3c	3.5b	3.5b
4	All Insecticide	7.9a	7.3a	4.4b	2.6b	5.4e	1.2c	2.1c	2.8c	2.0d	1.0b	1.4c	6.5a	2.1e	1.3c	1.3c
5	Control (Water Spray)	9.3a	8.9a	9.0a	9.9a	30.4a	6.9a	9.5a	8.5a	7.7a	4.9a	6.0a	7.0a	7.5a	5.2a	5.3a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Stem borer Damage (% Dead hearts)															
		MND		MSD		NVS			NLR		NWG		PSA		RCI	
		30DT	50DT	30DT	50DT	30DT	50DT	65DT	55DT	75DT	30DT	50DT	30DT	50DT	30DT	50DT
1	Botanical-Insecticide 1	2.9d	1.8cd	10.8c	9.8c	13.8ab	16.6b	19.6b	4.1a	6.1a	3.6b	8.7b	6.0b	5.5c	7.1bc	4.9b
2	Botanical-Insecticide 2	7.1c	4.2bc	13.8c	5.1d	16.1ab	16.4b	17.3bc	3.7a	5.9a	3.6b	8.8b	8.7b	7.8bc	7.2bc	4.9b
3	All Botanical	11.3b	6.6b	20.9b	14.8b	15.9ab	16.4b	20.7b	7.1a	8.8a	3.5b	8.8b	9.2ab	9.0b	8.5b	5.7b
4	All Insecticide	1.80	1.0d	1.3d	0.7e	10.1a	13.1b	13.5c	2.3a	2.4a	1.9c	5.7c	6.3b	4.8c	5.1c	2.2c
5	Control (Water Spray)	15.4a	15.3a	26.5a	27.a	25.8a	29.7a	32.0a	9.2a	7.6a	5.5a	11.5a	13.5a	15.0a	14.2a	11.5a

Table 2.24: Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Stem borer Damage (% Dead hearts)																			Mean
		RNR	RPR		SKL			TTB		WGL											
		61DT	30DT	50DT	45DT	65DT	85DT	30DT	50DT	36DT	40DT	48DT	53DT	57DT	66DT	74DT	78DT	
1	Botanical-Insecticide 1	1.0b	11.7a	5.3b	5.2b	4.5cd	10.1d	5.6c	4.5c	5.2a	4.1a	4.3ab	4.0b	3.8b	3.6b	3.5a	2.6ab	5.7bc
2	Botanical-Insecticide 2	0.4b	11.6a	9.3b	7.8a	6.9b	15.4b	9.3b	8.7b	4.7a	4.7a	4.8ab	3.9b	3.5b	2.2b	3.8a	2.9ab	6.8b
3	All Botanical	0.3b	17.4a	8.5b	6.5b	6.1bc	13.7bc	12.2b	10.5b	5.4a	4.1a	4.9ab	4.4b	3.4b	4.0ab	3.4a	2.7ab	7.7b
4	All Insecticide	0.2b	10.6a	8.3b	5.7b	2.3d	12.3cd	3.5c	3.1c	5.1a	3.3a	2.6b	2.2b	2.1b	2.1b	2.9a	2.3d	4.1c
5	Control (Water Spray)	5.0a	15.3a	15.3a	11.6a	11.4a	21.6a	17.9a	21.1a	5.3a	5.8a	7.4a	7.0a	7.8a	6.4a	6.3a	5.1a	12.1a

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 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Stem Borer Damage (% White ears)											
		ABP	CHN	CHP	CTC	GNV	KJT	KRK	MND	MSD	NVS	NWG	PSA
1	Botanical-Insecticide 1	14.6b	13.4c	2.5dc	4.7c	5.2bc	3.8bc	2.5b	3.2d	5.3c	15.8ab	14.0c	5.6cd
2	Botanical-Insecticide 2	13.1b	19.0b	3.4bc	6.2c	3.3cd	2.6cd	3.2b	6.5c	4.3c	12.3b	14.3bc	7.8c
3	All Botanical	14.5b	23.3b	3.8b	9.5b	6.7ab	4.0b	3.1b	11.b	10.0b	18.5a	19.4b	12.6b
4	All Insecticide	10.4b	8.0d	1.4d	2.7d	1.6d	1.8d	1.5c	1.8d	1.0d	3.0c	9.4c	4.3d
5	Control (Water Spray)	20.1a	32.4a	9.6a	14.2a	8.6a	7.0a	4.9a	19.6a	28.6a	17.4ab	25.2a	15.6a

Table 2.24: Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Stem Borer Damage (% White ears)								Mean
		PTB	RCI	RGL	RNR	RPR	SKL	TTB	WGL	
1	Botanical-Insecticide 1	27.2a	3.9c	3.b	3.1b	14.2ab	10.7cd	5.4c	3.3ab	8.1bc
2	Botanical-Insecticide 2	26.5a	4.4b	2.8b	3.5b	15.9ab	12.6c	9.4b	2.1ab	8.7bc
3	All Botanical	24.5a	5.3b	2.6b	3.7b	15.0ab	15.6b	12.1b	3.6ab	10.9b
4	All Insecticide	21.6a	2.1c	1.6b	1.1c	11.9b	10.1d	4.1c	1.5d	5.0c
5	Control (Water Spray)	40.1a	8.9a	8.a	7.5a	18.9a	19.7a	19.6a	4.8a	16.5a

Table 2.24: Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Brown Planthoppers (No./10hills)										
		BPT				CHP		CHT		GNV		
		39DT	47DT	59DT		75DT		75DT		40DT	60DT	80DT	100DT
1	Botanical-Insecticide 1	24.2a	15.7a	9.7a		39.0b		39.0b		50.3bc	40.0bc	36.0bc	31.3bc
2	Botanical-Insecticide 2	17.7ab	14.5a	11.5a		12.3c		12.3c		42.6cd	36.0cd	32.6c	23.3cd
3	All Botanical	18.7ab	12.7a	10.5a		34.0b		34.3b		59.3ab	50.0b	42.3b	37.3b
4	All Insecticide	13.0b	12.7a	12.2a		10.3c		10.3c		38.3d	29.6d	22.0d	16.6d
5	Control (Water Spray)	18.7ab	15.7a	9.5a		68.7a		68.6a		64.0a	74.3a	81.0a	91.3a

Table 2.24: Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Brown Planthoppers (No./10hills)													
		IAR							KRK			KUL			MND
		56DT	64DT	68DT	76DT	90DT	98DT		53DT	68DT		53DT	68DT		60DT
1	Botanical-Insecticide 1	12.5a	46.7a	24.2bc	118.7b	149.7a	19.0a		67.5a	75.7a		67.5a	75.7a		17.2ab
2	Botanical-Insecticide 2	16.5a	43.2a	2.5c	6.7b	36.0b	13.0a		68.2a	10.0c		68.2a	10.0c		12.5bc
3	All Botanical	15.5a	45.2a	39.2ab	471.7a	205.5a	26.0a		66.0a	46.0b		66.0a	46.0b		21.0ab
4	All Insecticide	12.2a	38.5a	4.7c	9.7b	32.2b	10.0a		64.2a	10.7c		64.2a	10.7c		6.2c
5	Control (Water Spray)	12.5a	42.7a	54.5a	468.7a	210.2a	23.0a		74.a	83.0a		74.0a	83.0a		26.5a

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 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Brown Planthopper (No. /10hills)														
		MTU(No./20hills)					NVS			RGL			RPR		
		40DT	50DT	60DT	70DT	80DT	73DT	80DT	83DT	30DT	50DT	75DT	50DT	70DT	90DT
1	Botanical-Insecticide 1	62.0ab	938.8a	6158.0a	2694.0b	24.0b	4.5c	13.0a	8.0b	11.7ab	21.2ab	35.2b	17.0b	29.ab	37.5b
2	Botanical-Insecticide 2	61.5ab	831.3a	5575.0a	3492.0ab	22.0b	3.0d	13.0a	5.0c	9.7bc	16.7bc	31.7bc	18.5ab	15.5b	34.5b
3	All Botanical	36.2b	491.3a	3919.0a	5489.0ab	2070.3a	7.0b	13.0a	9.0b	7.7bc	11.2cd	29.5bc	17.5ab	24.0ab	39.0b
4	All Insecticide	80.2a	990.0a	3340.0a	5423.0ab	2686.5a	2.5d	12.5a	4.5c	6.7c	9.2d	15.0c	18.0ab	21.5b	35.5b
5	Control (Water Spray)	53.5ab	707.5a	4870.0a	7852.0a	1692.8ab	10.0a	14.0a	16.5a	15.7a	24.5a	52.7a	25.0a	37.0a	72.0a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Brown Planthopper (No. /10hills)												Mean
		SKL					WGL							
		49DT	53DT	64DT	68DT		40DT	48DT	57DT	66DT	74DT	80DT	86DT	
1	Botanical-Insecticide 1	21.7a	38.5b	41.5a	32.5b		2.7c	4.0b	8.5ab	34.0b	41.2b	23.0ab	19.7a	250.7a
2	Botanical-Insecticide 2	23.0a	33.7b	39.2a	35.5b		2.7c	7.7b	8.2ab	41.7b	22.5c	15.7c	14.5d	241.4a
3	All Botanical	25.0a	37.2b	40.5a	33.7b		3.0c	5.5b	9.0ab	32.0b	36.7b	20.0bc	21.0a	306.1a
4	All Insecticide	24.2a	36.5b	42.0a	34.7b		7.0b	5.2b	7.0b	38.2b	21.5c	16.7c	14.0b	296.0a
5	Control (Water Spray)	22.7a	51.0a	42.0a	48.2a		10.2a	9.5a	10.2a	61.7a	56.5a	28.0a	22.2a	387.7a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Whitebacked Planthopper (No./10hills)																
		BPT				GNV					IAR							KRK	
		39DT	47DT	59DT		40DT	60DT	80DT	100DT		31DT	36DT	47DT	52DT	56DT	64DT	68DT	53DT	68DT
1	Botanical-Insecticide 1	20.5a	10.7a	12.5a		151.3b	133.0b	108.0b	77.6b		8.2a	11.2b	22.7a	26.7a	25.0ab	15.0a	20.0bc	23.7b	24.7b
2	Botanical-Insecticide 2	24.2a	7.5a	12.2a		134.3c	115.3c	69.3c	53.3c		8.2a	13.2b	24.5a	24.0a	21.7bc	14.2a	4.0c	23.5b	5.2d
3	All Botanical	21.4a	10.5a	14.0a		166.6a	144.0b	123.3b	85.6b		10.0a	13.0b	24.7a	21.0a	31.0a	17.0a	45.2a	22.0b	17.5c
4	All Insecticide	20.0a	9.5a	15.a		118.0d	105.6c	50.6d	33.0d		12.0a	21.7a	27.5a	31.0a	16.0c	11.7a	5.5c	21.7b	4.7d
5	Control (Water Spray)	18.7a	11.2a	14.7a		161.3ab	164.6a	170.3a	175.0a		10.5a	16.7ab	21.7a	23.2a	28.2ab	11.2a	28.2ab	32.5a	32.2a

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 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Whitebacked Planthopper (No./10hills)															
		KUL		MND		MTU				NVS			NWG		
		53DT	68DT	60DT	80DT	50DT	60DT	70DT	80DT	73DT	80DT	83DT	45DT	60DT	75DT
1	Botanical-Insecticide 1	23.7b	24.7b	17.0ab	7.5b	72.0a	486.3a	159.0b	0.0b	3.0c	12.0ab	7.5b	52.0b	159.0c	33.0c
2	Botanical-Insecticide 2	23.5b	5.2d	9.7bc	3.2b	62.7a	358.8a	179.7ab	2.7b	2.0cd	12.0ab	5.0c	55.0b	152.0c	27.0c
3	All Botanical	22.0b	17.5c	19.2a	10.0b	34.2a	268.0a	244.2ab	85.0a	4.5b	11.0b	9.5b	54.0b	197.0b	160.0b
4	All Insecticide	21.7b	4.7d	6.5c	2.5b	80.0a	219.3a	246.7ab	103.0a	1.0d	11.5ab	3.0c	26.0c	113.0d	15.0c
5	Control (Water Spray)	32.5a	32.2a	23.0c	25.7a	53.5a	333.8a	312.5A	83.7a	10.0a	12.5a	14.5a	71.0a	238.0a	287.0a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Whitebacked Planthopper (No./10hills)									Mean
		RGL			RPR	SKL	WGL				
		30DT	50DT	75DT	70DT	68DT	66DT	74DT	78DT		
1	Botanical-Insecticide 1	9.7b	15.7b	27.0ab	11.0a	11.0b	10.7a	11.2a	11.0a		48.8a
2	Botanical-Insecticide 2	8.5b	14.5bc	25.2ab	10.5a	11.5b	10.5a	5.7b	6.5b		40.7a
3	All Botanical	8.0b	10.7cd	22.0b	12.0a	12.0b	11.2a	11.7a	10.5a		52.7a
4	All Insecticide	6.5b	7.7d	7.7c	4.5a	9.2b	10.5a	5.2b	6.2b		37.2a
5	Control (Water Spray)	18.5a	30.0a	35.7a	10.5a	24.0a	11.0a	13.7a	11.2a		68.5a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Gall midge Damage (% Silver Shoots)																		
		ABP						CHP		GNV		JDP			NLR	PTB	
		25DT	30DT	45DT	50DT	60DT	65DT	55DT	75DT	30DT	50DT	30DT	50DT	70DT	75DT	30DT	50DT
1	Botanical-Insecticide 1	9.6a	7.9a	10.8a	8.1a	7.9a	8.4a	13.9c	4.4c	4.7bc	7.8ab	42.8a	18.6ab	10.3b	4.1bc	7.5a	14.6a
2	Botanical-Insecticide 2	11.2a	7.5a	9.6a	7.9a	11.3a	10.8a	14.1c	3.2c	2.7bc	3.8bc	40.0ab	15.5b	8.6b	3.3bc	7.7a	5.2b
3	All Botanical	7.7a	6.2a	7.8a	5.6a	10.1a	9.0a	16.7c	5.0c	6.9ab	8.9a	40.7a	17.2b	11.7b	6.3b	5.4a	12.2ab
4	All Insecticide	10.5a	9.2a	8.8a	5.9a	8.7a	7.4a	21.5b	8.9b	0.0c	2.6c	25.0b	10.6b	9.6b	2.0c	7.9a	9.2ab
5	Control (Water Spray)	14.0a	12.1a	14.5a	12.2a	12.7a	15.2a	32.8a	15.5a	11.4a	11.9a	53.5a	28.4a	18.0a	11.5a	9.8a	15.2a

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 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Common Name	Gall midge Damage (% Silver Shoots)																	Mean
		RCI		RPR		SKL				TTB			WGL						
		30DT		50DT		45DT	65D T	80DT		30DT	50DT		36DT	40DT	48DT	53DT	57DT	66DT	86DT	
1	Botanical-Insecticide 1	6.4b		2.4bc		31.9b	40.3b	7.6b		5.7cd	4.5c		5.5a	3.3b	5.0c	12.2b	16.3b	20.0a	28.4a	12.4b
2	Botanical-Insecticide 2	8.0b		3.7ab		31.9b	40.1b	7.1b		7.6bc	8.4b		6.4a	3.3b	5.2c	11.0b	16.2b	21.1a	29.9a	12.1b
3	All Botanical	8.1b		3.1ab		30.8b	40.1b	7.6b		10.3b	10.7b		6.7a	3.4b	4.9c	12.7b	18.2ab	22.9a	27.2a	12.8b
4	All Insecticide	3.6c		1.0c		35.7ab	41.4b	7.9b		2.6d	2.4c		5.2a	4.9b	6.4b	15.7ab	20.6ab	23.9a	28.5a	11.6b
5	Control (Water Spray)	14.5a		4.9a		39.9a	49.0a	14.5a		19.6a	19.2a		6.6a	7.0a	8.4a	19.3a	25.4a	28.3a	31.5a	19.2a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Leaf folder damage (% Damaged leaves)																						
		BPT		CHN			CHT		GNV			JDP			KRK			KUL			MLN		MND			MTU
		32DT		DT1	DT2		91DT		60DT	90DT		50DT	70DT		57DT	72DT		57DT	72DT		DT		30DT	50DT		40DT
1	Botanical-Insecticide 1	5.2ab		5.0d	2.3d		24.2ba		3.5c	3.3b		2.9bc	2.9bc		4.1b	3.3c		4.2b	3.3c		18.2b		4.3c	3.2bc		1.3a
2	Botanical-Insecticide 2	5.0ab		6.8c	3.2c		24.5ba		2.8c	2.7b		3.2bc	3.2b		4.2b	4.5b		4.2b	4.5b		15.9b		5.9b	5.4bc		0.7a
3	All Botanical	5.5ab		8.6b	4.1b		22.2ba		4.7b	4.9a		5.0ab	3.4b		4.0b	4.5b		4.1b	4.5b		17.4b		7.2b	7.1b		0.6a
4	All Insecticide	4.3b		2.5e	1.0e		19.2b		1.5d	1.4c		2.0c	1.7c		1.9c	2.0d		2.0c	2.0d		17.1b		2.5d	1.8d		1.2a
5	Control (Water Spray)	6.0a		11.5a	5.6a		26.4a		6.2a	5.5a		7.3a	6.3a		6.9a	7.6a		7.0a	7.7a		38.1a		14.6a	18.50		6.6a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Leaf folder damage (% Damaged leaves)																	
		MSD		NLR		NVS			NWG			PSA			PTB			RCI	
		DT	DT		DT		30DT	50DT	65DT		45DT	60DT		30DT	50DT		45DT	60DT		30DT	50DT
1	Botanical-Insecticide 1	5.bc	5.5bc		5.8a		8.3b	10.7b	11.2c		5.9bc	10.4bc		7.9cb	4.9b		7.9a	11.0ab		72.7a	16.0c
2	Botanical-Insecticide 2	3.9c	3.9c		4.6a		8.4b	9.4b	10.4d		5.9bc	10.2bc		8.9abc	5.9b		7.1a	10.4ab		73.5a	19.7c
3	All Botanical	6.6b	6.6b		8.4a		8.1b	10.1b	12.5b		6.3b	12.2ab		10.1ab	11.4a		6.7a	14.7a		71.3a	35.2b
4	All Insecticide	1.7d	1.7d		4.0a		4.1c	4.1b	6.5e		4.5c	7.5c		6.7c	4.4b		4.6a	6.9b		69.7a	12.7c
5	Control (Water Spray)	14.1a	14.1a		9.3a		10.3a	13.9a	15.8a		10.7a	15.1a		11.1a	13.3a		9.3a	8.0ab		74.5a	66.5a

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 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Leaf folder damage (% Damaged leaves)						Mean
		SKL				TTB		
		37DT	57DT	72DT		30DT	50DT	
1	Botanical-Insecticide 1	4.6a	2.6b	3.5b		5.2c	4.6c	8.4b
2	Botanical-Insecticide 2	3.8a	2.1b	3.8b		7.9bc	6.0c	8.6b
3	All Botanical	4.0a	2.2b	4.4b		9.7b	8.4b	10.2ab
4	All Insecticide	1.6b	1.8c	1.2c		2.2d	2.4d	6.1b
5	Control (Water Spray)	4.5a	5.2a	7.1a		16.4a	14.9a	14.7a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Green Leaf hopper (No./10hills)										
		BPT					GNV					JDP	
		39DT	47DT	59DT	65DT		40DT	60DT	80DT	100DT		30DT	50DT
1	Botanical-Insecticide 1	39.2a	28.0a	17.5a	15.2a		30.6c	25.3c	20.6c	15.3bc		8.0b	15.2b
2	Botanical-Insecticide 2	36.0a	22.7a	19.7a	14.2a		27.0c	19.6d	16.0c	11.0cd		7.0b	6.5c
3	All Botanical	36.2a	25.0a	20.0a	8.2b		39.3b	32.3b	27.6d	19.3b		10.5ab	8.5c
4	All Insecticide	34.2a	25.0a	22.7a	14.2a		21.0d	15.0d	10.0d	6.6d		8.2b	10.2bc
5	Control (Water Spray)	41.5a	28.0a	21.0a	14.7a		48.0a	50.6a	54.0a	41.6a		14.5a	27.5a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Green Leaf hopper (No./10hills)								Mean
		JDP	MSD	NVS		RCI		RGL	SKL	
		70DT	DT	80DT	83DT	63DT	67DT	50DT	68DT	
1	Botanical-Insecticide 1	18.0b	126.2b	12.0a	6.0c	55.8a	14.7c	11.5b	11.0b	26.1a
2	Botanical-Insecticide 2	16.2b	128.5b	12.0a	5.0c	59.7a	19.5c	10.0b	10.2b	24.5a
3	All Botanical	14.0b	120.7bc	12.5a	7.5b	53.2a	2.0b	8.2b	10.2b	25.3a
4	All Insecticide	17.5b	110.7c	12.5a	3.5d	65.5a	7.7d	3.2c	11.0b	22.2a
5	Control (Water Spray)	36.2a	158.7a	12.5a	15.5a	62.5a	64.7a	17.5a	23.2a	40.7a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Whorl Maggot (%Damagaed Leaves)										
		CHN		IAR						JDP		
		DT1		31DT	36DT	47DT	52DT	56DT		30DT	50DT	70DT
1	Botanical-Insecticide 1	5.1c		5.0a	6.2a	5.3a	3.8a	5.6a		5.0c	3.6b	2.6a
2	Botanical-Insecticide 2	6.0c		5.4a	6.8a	5.4a	4.0a	4.3a		6.1bc	5.1b	3.4bc
3	All Botanical	7.3b		4.4a	6.1a	5.4a	4.4a	4.9a		8.1ab	4.6b	4.1b
4	All Insecticide	2.9d		4.1a	6.4a	5.8a	4.8a	5.2a		6.2bc	4.0b	1.4d
5	Control (Water Spray)	9.7a		5.4a	5.6a	6.2a	4.9a	5.6a		9.2a	10.0a	8.0a

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)

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Whorl Maggot (% Damaged Leaves)						Mean
		RNR		PTB			TTB	
		41DT		15DT	25DT		30DT	50DT
1	Botanical-Insecticide 1	4.2a		7.1a	2.0b		3.4cd	3.6c	4.5b
2	Botanical-Insecticide 2	5.4a		7.4a	1.3b		4.9c	5.1c	5.0b
3	All Botanical	4.2a		7.1a	1.9b		8.4b	8.5b	5.7b
4	All Insecticide	5.3a		7.0a	3.1b		2.2d	2.9c	4.4b
5	Control (Water Spray)	6.0a		9.6a	8.5a		14.8a	12.7a	8.3a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Hispa damage (% Leaf Damage)				Mean
		MLN	MND	RCI		
		DT	60DT	29DT	35DT	
1	Botanical-Insecticide 1	11.2b	3.0bc	66.5a	42.2b	30.7a
2	Botanical-Insecticide 2	12.3b	4.5abc	69.0a	41.0b	31.7a
3	All Botanical	11.5b	6.2ab	70.2a	40.7b	32.2a
4	All Insecticide	13.2b	1.7c	65.2a	13.7c	23.5a
5	Control (Water Spray)	55.8a	8.7a	68.0a	75.5a	52.0a

Table 2.24:Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Grasshopper						Mean
		KHD						
		30DT	33DT	45DT	48DT	65 DT	68DT	
1	Botanical-Insecticide 1	7.8b	5.6c	7.8b	3.0b	8.0b	1.0b	5.5b
2	Botanical-Insecticide 2	7.5bc	5.7c	7.5bc	2.0c	7.5b	1.3b	5.3b
3	All Botanical	7.3bc	13.0b	7.5bc	3.7b	7.8b	1.7b	6.8b
4	All Insecticide	6.3c	5.0c	6.3c	2.0c	6.3b	0.3b	4.4b
5	Control (Water Spray)	9.4a	29.3a	19.0a	33.0a	34.6a	36.6a	27.0a

Table 2.24: Insect pests incidence in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Gundhi Bug (% Damage)				Mean
		NVS				
		70DT	73DT	80DT	83DT	
1	Botanical-Insecticide 1	9.0c	12.0b	15.5d	8.5d	11.3bc
2	Botanical-Insecticide 2	7.0d	9.0c	20.0c	13.0c	12.2bc
3	All Botanical	11.5b	13.0b	24.0b	16.0b	16.1ab
4	All Insecticide	6.0d	7.0d	11.0e	7.0d	7.8c
5	Control (Water Spray)	17.5a	25.0a	31.0a	19.5a	23.3a

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 2.24:Incidence of Natural enemies in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Mirid bugs/10hills							
		BPT							KRK
		24DT	30DT	39DT	47DT	59DT	65DT		75DT
1	Botanical-Insecticide 1	9.2a	4.7b	52.2a	23.0ab	18.2c	12.0a		3.5c
2	Botanical-Insecticide 2	8.2ab	4.7b	54.5a	24.2a	24.7ab	13.7a		5.0b
3	All Botanical	5.5b	6.7a	49.5a	23.7ab	20.0bc	14.5a		7.5a
4	All Insecticide	6.7ab	5.5ab	49.5a	19.0b	21.2abc	14.2a		2.5c
5	Control (Water Spray)	9.2a	4.5b	57.5a	21.7ab	26.7a	15.0a		5.7b

Table 2.24:Incidence of Natural enemies in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Mirid bugs/10 hills									Mean
		MTU					SKL			WGL	
		50DT	60DT	70DT	80DT		60DT	75DT		86DT	
1	Botanical-Insecticide 1	132.0a	300.5a	187.2ab	5.2b		14.0a	22.7a		3.7a	56.3a
2	Botanical-Insecticide 2	120.5a	249.0a	180.0b	2.7b		13.0a	23.7a		3.7a	52.0a
3	All Botanical	68.0a	184.5a	303.5ab	160.2a		12.0a	23.7a		4.0a	63.1a
4	All Insecticide	124.0a	163.7a	287.2ab	174.7a		13.7a	24.7a		4.0a	65.0a
5	Control (Water Spray)	107.5a	234.2a	350.0a	157.7a		13.2a	24.7a		3.5a	73.7a

Table 2.24:Incidence of Natural enemies in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Coccinellids (No. /10hills)											Mean
		BPT				KRK		KUL		NVS		PTB	
		30DT	39DT	47DT		75DT		75DT				50DT	75DT
1	Botanical-Insecticide 1	6.7a	3.5a	5.2a		3.0bc		3.0bc		10.5c		3.0b	4.6ab	4.1b
2	Botanical-Insecticide 2	6.5a	4.2a	6.5a		4.0ab		4.0ab		6.5d		1.3b	2.3b	4.1b
3	All Botanical	6.7a	4.5a	6.7a		4.5a		4.5a		14.5b		4.0b	4.0b	5.0ab
4	All Insecticide	6.5a	4.7a	6.5a		2.2c		2.2c		4.5e		4.3b	4.6ab	4.4b
5	Control (Water Spray)	8.0a	4.7a	6.2a		5.0a		5.0a		18.5a		10.0a	7.0a	6.6b

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 2.25:Grain Yield in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Yield (Kg/ha)													
		ABP	BPT	CHN	CHP	CHT	CTC	GNV	IAR	JDP	KHD	KJT	KRK	KUL	LDN
1	Botanical-Insecticide 1	2627.5a	2536.0a	6325.0b	4308.7b	2986.7a	4050.0b	6804.0bc	4905.0ab	4677.5ab	5000.0c	2420.0b	2820.0cd	2820.0cd	7662.1b
2	Botanical-Insecticide 2	2997.5a	2468.9a	5850.0b	4318.4b	3040.0a	3750.0c	7600.0ab	4787.5b	4435.0bc	6000.ab	3120.0a	3110.0b	3110.0b	7615.7bc
3	All Botanical	3297.5a	2248.0a	5087.5c	4142.2b	2933.3a	3366.7d	5333.3cd	5023.8ab	4306.3c	5166.7bc	2530.0b	2970.0bc	2970.0bc	7488.4c
4	All Insecticide	3347.5a	2589.6a	8425.0a	4935.4a	3000.0a	4166.7a	8666.7a	5596.3a	4965.0a	6666.7a	3220.0a	3390.0a	3390.0a	7997.7a
5	Control (Water Spray)	2252.5a	2373.0a	4475.0c	3589.9c	2360.0a	2716.7e	4266.7d	4947.5ab	3763.8d	1666.7d	1690.0c	2560.0d	2560.0d	6990.7d

Table 2.25:Grain Yield in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Yield (Kg/ha)												
		MLN	MND	MTU	MSD	NLR	NVS	NWG	PTB	PSA	RCI	RGL	RNR	RPR
1	Botanical-Insecticide 1	2734.4ab	4258.0b	1856.0ab	4500.0b	2471.9a	3906.9c	2680.0ab	4694.0a	5863.6a	4735.0ab	6295.0b	3586.1a	6260.0a
2	Botanical-Insecticide 2	2604.2ab	3672.0c	2311.5a	4175.0c	2582.4a	4052.2b	2738.4ab	6792.0a	5164.8a	4512.5bc	6380.0b	2840.1b	5707.5a
3	All Botanical	2734.4ab	3245.0c	1478.3b	3837.5d	2210.2a	3779.6d	2274.8b	6167.0a	4409.1a	3912.5c	6870.0ab	2656.9bc	5575.0a
4	All Insecticide	2994.8a	4863.0a	1500.1b	5212.5a	2812.1a	4299.1a	3158.4a	6014.0a	5558.7a	5412.5a	7370.0a	3783.4a	6300.0a
5	Control (Water Spray)	2161.5b	2481.0d	1430.5b	2662.5e	2184.1a	3456.8e	2144.8b	3792.0a	4020.8a	2575.0d	3840.0c	2311.6c	5467.5a

Table 2.25: Grain Yield in different treatments, IBET, *Kharif* 2021

Sl. No.	Treatment details	Yield (Kg/ha)			Mean	IOC (%)
		SKL	TTB	WGL		
1	Botanical-Insecticide 1	911.2	4259.0	1935.2	3663.4	35.0
2	Botanical-Insecticide 2	591.2	3810.0	2005.5	3701.5	36.4
3	All Botanical	593.7	3562.0	1794.9	3393.1	29.1
4	All Insecticide	1147.5	4608.0	2060.4	4165.5	53.6
5	Control (Water Spray)	448.7	2570.0	1758.2	2713.1	35.0

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. ECOLOGICAL STUDIES

These studies consisted of two trials i) Influence of Establishment Methods on Pest Incidence (IEMP), ii) Cropping Systems Influence on Pest Incidence (CSIP) and iii) Evaluation of Pheromone Blends for Insect pests of Rice (EPBI).

i Influence of Establishment Methods on Pest Incidence (IEMP)

Depleting water resources is forcing rice scientists to explore ways of producing rice with less water for food security. A number of alternative rice establishment methods like direct seeding, aerobic rice and mechanical transplanting are already being adopted by farmers. Keeping this in view, a collaborative trial with Agronomy section was continued with an objective to assess the influence of crop establishment methods on insect pest incidence.

During *Kharif* 2021, the trial was conducted at ten locations, *viz,* Aduthurai, Ganagavathi, Jagdalpur, Moncompu, Nawagam, Pantnagar, Pattambi, Pusa, Rajendranagar and Titabar. Standard procedures were adopted to record insect pest incidence in different treatments. The results are summarized below.

At Aduthurai, ADT 53 variety was grown in three crop establishment methods, *viz.*, mechanical transplanting, direct seeding and normal transplanting methods. Incidence of stem borer, gall midge, leaf folder, whorl maggot, thrips and brown planthopper was low in all the three methods of rice cultivation **(Table 2.26)**.

Table: 2.26 Influence of Crop Establishment Methods on Pest Incidence at Aduthurai, *Kharif* 2021

Treatments	% DH		% WE	% SS	% LFDL	% WMDL	% RTDL	BPH/5hills
	45 DAT	60 DAT	Pre har	45 DAT	75 DAT	60 DAT	15 DAT	90 DAT
T1 = Mechanical transplanting	2.1 (1.6)b	2.8 (1.8)a	6.4 (2.6)a	1.2 (1.2)a	1.4 (1.4)b	2.5 (1.7)b	2.1 (1.5)a	3.0 (2.0)a
T2 = Direct seeding	5.1 (2.3)a	4.6 (2.2)a	6.8 (2.6)a	3.1 (1.7)a	3.8 (2.0)a	5.1 (2.4)a	3.6 (1.9)a	6.6 (2.6)a
T3 = Normal transplanting	3.4 (1.9)ab	3.9 (2.0)a	10.9 (3.3)a	1.6 (1.4)a	2.3 (1.7)ab	3.1 (1.9)b	3.1 (1.8)a	4.4 (2.0)a
LSD (0.05)	***0.44***	***0.51***	***0.92***	***0.60***	***0.41***	***0.22***	***0.53***	***0.96***
CV(%)	***15.61***	***17.29***	***22.29***	***28.67***	***16.65***	***7.72***	***20.96***	***29.92***

At Gangavathi, BPT 5204 was grown in this trial. Rice establishment methods, viz., mechanical transplanting, direct seeding, normal transplanting, system of rice intensification (SRI), aerobic rice and semi-dry rice were taken up at this location. Incidence of hispa was significantly high in mechanical transplanting method (16.9%) compared to other methods. BPH numbers were significantly low in aerobic rice (2.2-3.4), SRI (6.6-11.6) and semi-dry rice (17-20.8) compared to normal transplanting, direct seeding and mechanical transplanting at both 75 and 90 DAT. Similarly, white backed planthopper (WBPH) incidence was low in aerobic and semi-

dry rice as against normal transplanting and direct seeding and machine transplanting methods **(Table 2.27)**.

Table: 2.27 Influence of Crop Establishment Methods on Pest Incidence at Gangavathi, *Kharif* 2021

Treatments	% DH	% WE	% SS	% LFDL	% HDL	BPH / 5 hills		WBPH	
	45 DAT	Pre har	30 DAT	75 DAT	30 DAT	75 DAT	90 DAT	75 DAT	90 DAT
M1=Mechanical transplanting	2.0 (1.5)ab	5.3 (2.4)b	2.4 (1.6)ab	0.9 (1.2)ab	16.9 (4.1)a	30.0 (5.5)c	61.6 (7.8)c	69.2 (8.3)c	95.0 (9.7)b
M2=Direct seeding	2.4 (1.6)ab	16.1 (3.9)a	2.8 (1.6)ab	1.2 (1.3)a	2.7 (1.8)bc	70.4 (8.4)b	89.6 (9.5)b	136.0 (11.6)b	141.6 (11.9)a
M3=Normal transplanting	2.1 (1.5)ab	15.3 (3.9)a	6.3 (2.5)a	0.6 (1.1)abc	4.6 (2.2)b	84.8 (9.2)a	123.4 (11.1)a	187.4 (13.7)a	93.6 (9.7)b
M4 = SRI	0.6 (1.0)b	11.7 (3.4)a	1.3 (1.3)b	0.4 (09)c	2.9 (1.9)bc	6.6 (2.6)e	11.6 (3.4)e	25.0 (5.0)d	70.0 (8.4)c
M5 = Aerobic rice	1.1 (1.1)b	5.3 (2.3)b	1.1 (1.1)b	0.4 (0.9)bc	0.1 (0.8)d	2.2 (1.6)f	3.4 (1.9)f	1.8 (1.5)f	4.8 (2.2)e
M6 = Semi dry rice	4.7 (2.2)a	12.8 (3.6)a	3.2 (1.7)ab	0.8 (1.1)abc	1.4 (1.3)cd	20.8 (4.5)d	17.0 (4.2)d	13.8 (3.7)e	15.8 (4.0)d
LSD (0.05)	***0.85***	***0.97***	***1.16***	***0.25***	***0.67***	***0.78***	***0.73***	***0.81***	***1.15***
CV(%)	***23.70***	***22.53***	***24.29***	***17.43***	***25.40***	***11.13***	***8.76***	***8.40***	***11.36***

At Jagdalpur, incidence of stem borer, leaf folder, gall midge, thrips and whorl maggot was observed in all the three establishment methods in Durgeshwary variety **(Table 2.28)**. Incidence of gall midge was significantly low in unpuddled direct seeding (22.0 – 25.6% SS) and normal transplanting method (18.2 – 20.5% SS) compared to puddled direct seeding method (27.2 – 32.2% SS) at 45 and 60 DAT. However, at 75 DAT, damage was significantly low in puddled direct seeding method (24.4% SS) followed by normal transplanting (26.4% SS) and unpuddled direct seeding (31.9% SS). The gall midge incidence was high (>25% SS) and was at par in all the sub-plot treatments. Among the interactions, the gall midge damage was significantly high in puddled direct seeding followed by unpuddled direct seeding methods. The incidence of stem borer and leaf folder was below the ETL in all the treatments. However, the incidence of thrips and whorl maggot was above ETL and was at par in all the main plots with establishment methods and sub-plots with weed management practices.

At Moncompu, Uma variety was grown in two establishment methods, viz, direct seeding with drum seeder and normal transplanting method and two weed control methods. Incidence of stem borer, gall midge, leaf folder, hispa, BPH, WBPH and GLH was low in all the treatments **(Table 2.29)**.

Table:2.28 Influence of Crop Establishment Methods on Pest Incidence at Jagdalpur, *Kharif* 2021

Main plots		% DH		% WE	% LFDL	% SS			% THDL	% WMDL
		45 DAT	75 DAT	Pre har	90 DAT	45 DAT	60 DAT	75 DAT	60 DAT	60 DAT
M1 = Normal transplanting		3.6(2.0)b	6.0(2.5)b	6.8(2.7)a	8.9(3.0)a	18.2(4.3)b	20.5(4.6)b	26.4(5.2)b	10.2(3.3)a	10.8(3.4)a
M2 = Puddled direct seeding		8.4(2.9)a	8.8(3.0)a	7.2(2.8)a	7.5(2.8)b	27.2(5.1)a	32.2(5.6)a	24.4(4.9)c	12.4(3.6)a	11.0(3.4)a
M3 = Unpuddled direct seeding		6.8(2.6)a	8.6(3.0)ab	7.0(2.7)a	8.3(3.0)ab	22.0(4.7)ab	25.6(5.1)ab	31.9(5.7)a	13.4(3.7)a	13.5(3.7)a
LSD (0.05)		**0.46**	**0.50**	**0.55**	**0.21**	**0.79**	**0.68**	**0.19**	**0.51**	**0.68**
CV(%)		**14.12**	**13.50**	**15.40**	**5.46**	**12.81**	**10.17**	**2.71**	**11.02**	**14.80**
Sub-plots										
S1 = Weedy check		6.8(2.6)a	8.5(2.9)a	7.0(2.7)a	9.1(3.1)a	24.4(4.9)a	28.9(5.3)a	30.2(5.5)a	12.9(3.7)a	12.0(3.5)a
S2 = Mechanical weeding		6.9(2.7)a	7.9(2.9)a	6.9(2.7)a	7.6(2.8)b	27.2(5.2)a	26.8(5.2)a	26.7(5.2)a	12.0(3.5)a	12.4(3.6)a
S3 = Chemical weed control		5.0(2.2)a	7.0(2.7)a	7.2(2.8)a	7.9(2.9)ab	15.8(4.0)b	22.5(4.8)a	25.8(5.1)a	11.2(3.4)a	10.9(3.5)a
LSD (0.05)		**0.70**	**0.35**	**0.39**	**0.22**	**0.52**	**0.55**	**0.47**	**0.40**	**0.33**
CV(%)		**27.22**	**12.06**	**13.91**	**7.40**	**10.89**	**10.58**	**8.66**	**10.96**	**9.11**
M1 = Normal transplanting	S1	3.9(2.1)bc	5.5(2.4)d	7.9(2.9)a	8.4(3.0)abc	18.5(4.4)b	20.3(4.6)c	26.1(5.2)bcde	11.9(3.5)ab	12.0(3.5)ab
	S2	3.5(2.0)bc	6.4(2.6)bcd	6.5(2.6)a	9.6(3.1)ab	19.0(4.3)b	21.8(4.7)bc	23.8(4.9)cde	9.5(3.2)ab	10.6(3.3)ab
	S3	3.4(1.8)c	6.0(2.5)cd	6.1(2.5)a	8.6(3.0)abc	17.3(4.2)b	19.5(4.5)c	29.4(5.5)abc	9.3(3.1)b	9.9(3.2)b
M2 = Puddled direct seeding	S1	8.4(2.9)ab	8.4(3.0)abcd	7.3(2.8)a	8.7(3.0)abc	39.9(6.4)a	47.8(6.9)a	31.2(5.6)ab	14.2(3.8)ab	11.5(3.5)ab
	S2	10.6(3.3)a	8.0(2.9)abcd	6.7(2.7)a	6.5(2.7)c	30.5(5.5)a	27.5(5.3)bc	21.7(4.7)de	11.4(3.5)ab	10.7(3.4)ab
	S3	6.3(2.6)abc	10.1(3.2)ab	7.6(2.9)a	7.2(2.8)bc	11.3(3.5)b	21.2(4.6)bc	20.2(4.5)e	11.7(3.5)ab	10.9(3.4)ab
M3 = Unpuddled direct seeding	S1	8.2(2.9)abc	11.6(3.4)a	5.8(2.5)a	10.3(3.3)a	14.9(3.9)b	18.8(4.3)c	33.4(5.8)ab	12.5(3.6)ab	12.6(3.6)ab
	S2	6.7(2.7)abc	9.2(3.1)abc	7.4(2.8)a	6.8(2.7)c	32.1(5.7)a	31.0(5.6)b	34.5(5.9)a	15.2(3.9)a	15.8(4.0)a
	S3	5.5(2.2)bc	5.0(2.3)d	8.0(2.9)a	7.8(2.9)abc	18.9(4.4)b	26.9(5.2)bc	27.7(5.3)abcd	12.6(3.6)ab	12.1(3.5)ab
LSD (0.05) M in S		**1.20**	**0.61**	**0.67**	**0.39**	**0.91**	**0.96**	**0.81**	**0.69**	**0.57**
LSD (0.05) S in M		**1.10**	**0.70**	**0.77**	**0.38**	**1.07**	**0.43**	**0.69**	**0.75**	**0.32**

Table: 2.29 Influence of Crop Establishment Methods on Pest Incidence at Moncompu, *Kharif* 2021

Main plots	Sub plots	% DH			% LFDL		BPH	WBPH	GLH
		30 DAT	45 DAT	60 DAT	45 DAT	60 DAT	90 DAT	90 DAT	90 DAT
Drum seeding	Cono weeding	0.34 ± 0.34	1.12 ± 0.76	0.53 ± 0.32	2.20 ± 0.49	0.14 ± 0.09	6.80 ± 2.89	1.00 ± 0.45	0.20 ± 0.20
	Chemical weed control	0.41 ± 0.41	0.76 ± 0.47	0.29 ± 0.29	0.29 ± 0.19	0.06 ± 0.06	2.60 ± 1.78	0.60 ± 0.40	1.20 ± 0.58
Transplanting	Cono weeding				0.21 ± 0.21	0.10 ± 0.10	10.40 ± 1.12	1.00 ± 0.32	0.40 ± 0.24
	Chemical weed control	2.25 ± 1.49	4.09 ± 1.33	1.22 ± 0.83	0.58 ± 0.26	0.49 ± 0.15	10.40 ± 1.08	0.40 ± 0.40	0.40 ± 0.24

At Nawagam, GAR14 variety was grown in three establishment methods, *viz.,* mechanical transplanting, direct seeding and aerobic rice. Incidence of dead hearts caused by stem borer was significantly low in mechanical transplanting (4.9-10.0%) as compared to direct seeding (10.1 – 16.6%) and aerobic rice (10.3 – 14.5%) at 45 and 60 DAT. However, the white ear incidence was at par in all the three establishment methods. WBPH incidence was also observed in all the methods but in low numbers **(Table 2.30)**.

Table:2.30 Influence of Crop Establishment Methods on Pest Incidence at Nawagam, *Kharif* 2021

Treatments	% DH			% WE	% LFDL	WBPH / 5 hills
	45 DAT	60 DAT	75 DAT	Pre har	75 DAT	75 DAT
T1 = Mechanical transplanting	4.9(2.3)b	10.0(3.2)b	18.5(4.3)a	20.2(4.5)a	6.4(2.6)a	10.0(3.2)a
T2 = Direct seeding	10.1(3.2)a	16.6(4.1)a	20.4(4.5)a	27.3(5.2)a	7.8(2.8)a	5.1(2.3)b
T3 = Aerobic rice	10.3(3.3)a	14.5(3.8)a	20.8(4.6)a	28.0(5.3)a	7.6(2.8)a	5.0(2.3)b
LSD (0.05)	***0.65***	***0.59***	***0.79***	***1.14***	***0.31***	***0.09***
CV(%)	***15.19***	***10.94***	***12.12***	***15.69***	***7.67***	***31.73***

At Pantnagar, PD 24 variety was grown in four establishment methods, *viz.,* wet direct seeding, direct seeding, normal transplanting and aerobic rice. Dead heart incidence was significantly low in direct seeding (5.2%) as compared to normal transplanting method (16.2%) but was at par in aerobic rice (10.4%) and wet direct seeding (9.4%) at 45 DAT. However, the incidence of white ears, leaf folder, whorl maggot and hispa was low in all the methods **(Table 2.31)**.

Table:2.31 Influence of Crop Establishment Methods on Pest Incidence at Pantnagar, *Kharif* 2021

Establishment methods	% DH		% WE	% LFDL	% WMDL	%HDL
	45 DAT	75 DAT	Pre har	75 DAT	45 DAT	45 DAT
Wet DSR	9.4(3.0)ab	3.2(1.7)b	3.6(2.0)a	1.0(1.1)a	3.4(1.9)a	4.3(2.0)a
Direct seeding	5.2(2.0)b	9.4(3.1)a	4.0(2.0)a	1.4(1.2)a	2.4(1.7)a	4.0(2.0)a
Normal transplanting	16.2(4.0)a	12.7(3.5)a	7.6(2.7)a	2.9(1.8)a	3.1(1.8)a	3.5(2.0)a
Aerobic rice	10.4(3.3)ab	8.1(2.8)ab	5.7(2.3)a	0.7(1.0)a	1.9(1.4)a	2.0(1.6)a
LSD (0.05)	**1.27**	**1.16**	**1.27**	**0.83**	**0.74**	**0.97**
CV(%)	**29.87**	**30.1**	**21.13**	**20.47**	**21.62**	**27.32**

At Pattambi, three methods of crop establishment were evaluated, viz., mechanical transplanting, direct seeding and normal transplanting with Aishwarya variety. Incidence of stem borer, gall midge, leaf folder, whorl maggot, case worm and blue beetle was recorded in all the methods of rice cultivation. Gall midge incidence was significantly low in direct seeding (5.3% SS) and mechanical transplanting (2.5% SS) methods compared to normal transplanting method (24.6% SS). Low incidence of leaf folder and whorl maggot was reported in all the methods. The incidence of caseworm and blue beetle was significantly low in direct seeding than in normal and mechanical transplanting methods **(Table 2.32)**.

Table: 2.32 Influence of Crop Establishment Methods on Pest Incidence at Pattambi, *Kharif* 2021

Treatments	% DH	% WE	% SS	% LFDL	% WMDL	% CWDL	%BBDL
	45 DAT	Pre har	30 DAT	45 DAT	15 DAT	15 DAT	15 DAT
T1 = Mechanical transplanting	1.3(1.2)a	11.7(3.7)b	2.5(1.7)b	0.9(1.1)b	6.6(2.7)a	10.1(3.3)a	13.5(3.7)a
T2 = Direct seeding	1.9(1.2)a	14.1(3.8)ab	5.3(2.1)b	4.2(2.1)a	3.6(2.0)b	5.4(2.4)b	1.3(1.3)b
T3 = Normal transplanting	0.8(1.1)a	19.2(4.4)a	24.6(5.0)a	0.4(0.9)b	6.9(2.7)a	8.3(2.9)ab	13.5(3.7)a
LSD (0.05)	***1.21***	***0.8***	***1.00***	***0.73***	***0.43***	***0.65***	***0.39***
CV(%)	***21.26***	***14.2***	***23.35***	***26.94***	***12.06***	***15.59***	***9.17***

At Pusa, Rajendra saraswati variety was grown in three establishment methods, *viz.,* puddled direct seeding, direct seeding and normal transplanting methods. Incidence of dead hearts and white ears were significantly low in normal transplanting method (3.6 % DH & 11.1% WE) compared to direct seeding and puddled direct seeding methods and were at par with each other **(Table 2.33)**. Leaf folder incidence was relatively high in normal transplanting method initially but was at par in all the three methods at 75 DAT (>20%).

Table: 2.33 Influence of Crop Establishment Methods on Pest Incidence at Pusa, *Kharif* 2021

Treatments	% DH		% WE	% LFDL	
	45 DAT	75 DAT	Pre har	45 DAT	75 DAT
T1 = Puddled direct seeding	14.8(3.8)a	16.4(4.0)a	15.9(4.0)a	11.7(3.4)b	20.1(4.5)a
T2 = Direct seeding	14.7(3.7)a	16.4(4.0)a	15.9(4.0)a	11.7(3.4)b	20.1(4.5)a
T3 = Normal transplanting	3.6(1.5)b	9.9(2.9)a	11.1(3.4)b	16.3(4.1)a	21.1(4.6)a
LSD (0.05)	***0.78***	***1.85***	***0.39***	***0.68***	***0.56***
CV(%)	***15.1***	***19.83***	***5.88***	***10.99***	***7.15***

At Rajendranagar, Jagtial Vari 1 (JGL 24423) variety was grown in two methods of rice cultivatioin, *i.e.,* mechanical transplanting and direct seeding using drum seeder with four sub-plot treatments. Incidence of stem borer and whorl maggot was observed in all the treatments in both protected and unprotected conditions. Both dead heart and white ear damage caused by stem borer was low in both unprotected

and protected plots **(Table 2.34)**. Whorl maggot damage was significantly low in direct seeded rice (5.6% DL) as compared to mechanical transplanting method (20.5% DL) in both protected and unprotected plots. Whorl maggot damage was at par in all the sub-plot treatments under unprotected conditions while the damage was significantly low in chemical weed control plot (2.3% DL) as against weed free (13.9% DL), weedy check (13.6% DL) and mechanical weeding (15.7% DL). Similar trend was observed in interactions of methods vs sub-plots.

Table: 2.34 Influence of Crop Establishment Methods on Pest Incidence at Rajendranagar, *Kharif* 2021

Main plots		Unprotected				Protected		
		% DH	% WE	% WMDL		% DH	% WE	% WMDL
		79 DAT	Pre har	79 DAT		79 DAT	Pre har	79 DAT
M1 = Mechanical transplanting		0.4(0.9)a	3.9(2.1)a	20.5(4.5)a		0.5(0.9)a	2.3(1.7)a	16.8(3.7)a
M2 = Direct seeding - drum		0.2(0.8)a	4.0(2.1)a	5.6(2.5)b		0.3(0.8)a	2.0(1.5)b	6.0(2.5)b
LSD (0.05)		0.59	0.77	1.94		0.53	0.09	0.99
CV(%)		**18.75**	**21.08**	**21.81**		**13.26**	**3.45**	**18.26**
Sub-plots								
S1 = Weed free		0.0(0.7)a	5.2(2.4)a	13.4(3.6)a		0.8(1.1)a	3.0(1.9)a	13.9(3.7)a
S2 = Weedy check		0.4(0.9)a	4.7(2.3)a	10.5(3.2)a		0.0(0.7)c	3.5(1.9)a	13.6(3.5)a
S3 = Mechanical weeding		0.5(0.9)a	3.5(2.0)b	14.3(3.5)a		0.4(0.9)b	1.1(1.3)b	15.7(3.8)a
S4 = Chemical weed control		0.4(0.9)a	2.6(1.7)b	14.1(3.6)a		0.4(0.9)ab	1.1(1.2)b	2.3(1.5)b
LSD (0.05)		**0.35**	**0.29**	**0.72**		**0.20**	**0.53**	**1.00**
CV(%)		**12.22**	**11.00**	**16.54**		**17.58**	**26.90**	**25.46**
M1 = Mechanical transplanting	S1	0.0(0.7)a	6.4(2.6)a	19.3(4.4)ab		0.3(0.9)a	3.2(1.9)ab	20.7(4.5)a
	S2	0.4(0.9)a	3.5(2.0)a	15.7(4.0)abc		0.0(0.7)a	2.8(1.8)ab	22.0(4.7)a
	S3	0.4(0.9)a	2.9(1.8)b	24.0(4.8)a		0.8(1.1)a	1.4(1.4)bc	24.3(4.8)a
	S4	0.8(1.1)a	2.9(1.8)b	23.0(4.8)a		0.8(1.1)a	1.7(1.5)abc	0.0(0.7)c
M2 = Direct seeding - drum	S1	0.0(0.7)a	3.9(2.1)a	7.4(2.8)abc		1.3(1.3)a	2.9(1.9)ab	7.2(2.8)b
	S2	0.4(0.9)a	5.9(2.5)a	5.3(2.4)bc		0.0(0.7)a	4.1(2.1)a	5.1(2.4)b
	S3	0.5(0.9)a	4.0(2.1)a	4.5(2.2)c		0.0(0.7)a	0.8(1.1)c	7.0(2.8)b
	S4	0.0(0.7)a	2.3(1.6)b	5.3(2.4)bc		0.0(0.7)a	0.4(0.9)c	4.6(2.4)b
LSD (0.05) M in S		**0.49**	**0.41**	**1.02**		**0.28**	**0.75**	**1.41**
LSD (0.05) S in M		**0.69**	**0.81**	**2.03**		**0.55**	**0.65**	**1.51**

At Titabar, four establishment methods *viz.*, mechanical transplanting, direct seeding, normal transplanting and aerobic rice were evaluated for pest incidence with Ranjit Sub-1 variety. Low incidence of stem borer, leaf folder, gall midge, whorl maggot and caseworm was observed in all the crop establishment methods **(Table 2.35)**.

Table: 2.35 Influence of Crop Establishment Methods on Pest Incidence at Titabar, *Kharif* 2021

Establishment methods	% DH	% WE	%SS	% LFDL	% WMDL	% CWDL
	45 DAT	Pre har	45 DAT	30 DAT	45 DAT	45 DAT
Mechanical transplanting	6.8(2.5)a	3.0(1.9)a	5.8(2.4)a	8.6(2.8)a	2.8(1.6)a	3.2(1.7)a
Direct seeding	6.9(2.7)a	4.3(2.2)a	2.7(1.6)ab	5.0(2.2)a	4.6(2.1)a	3.6(1.9)a
Normal transplanting	3.5(2.0)a	3.9(2.1)a	3.0(1.8)ab	1.2(1.2)b	2.3(1.6)a	1.2(1.2)a
Aerobic rice	3.7(1.8)a	4.3(2.2)a	1.8(1.3)b	1.7(1.3)b	2.5(1.6)a	1.7(1.3)a
LSD (0.05)	**1.14**	**0.5**	**0.93**	**0.89**	**0.56**	**0.97**
CV(%)	**16.7**	**17.49**	**17.85**	**14.41**	**10.51**	**25.44**

Across the locations, 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 pests was relatively high in machine transplanting, normal transplanting and direct seeding methods as compared to other methods. Incidence of dead hearts was significantly high in wet DSR (10.95%) followed by aerobic rice (9.84%) and direct seeding (8.62%) as compared to other methods (Fig…). White ear incidence was significantly high in semi-dry rice (12.80%) and was at par with normal transplanting method (11.89%), SRI (11.70%) and aerobic rice (10.83%) as compared to machine transplanting (5.34%), direct seeding (9.74%) and wet DSR (9.75%). Gall midge incidence was significantly high in direct seeding (17.72%), followed by normal transplanting (14.37%) and semi dry rice (12.80%) compared to other methods.

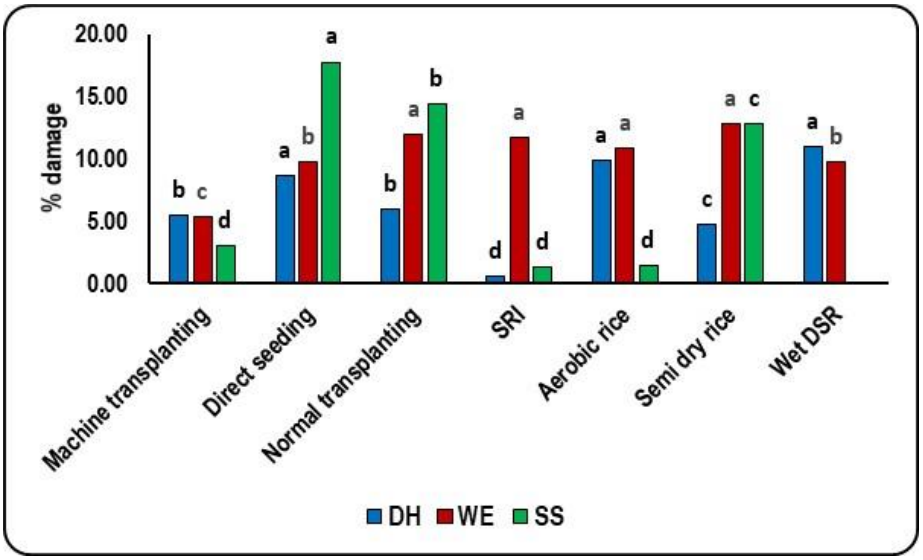


Fig 2.2 Incidence of stem borer and gall midge in different crop establishment methods across locations

Among the leaf feeding insects, leaf folder incidence was significantly high in normal transplanting method (10.93% LFDL), whorl maggot and hispa incidence in machine transplanting method (8.10% WMDL & 16.90% HDL) as compared to other methods. Blue beetle and caseworm incidence was significantly high in machine transplanting and SRI methods compared to direct seeding **(Fig 2.2)**.

Among the sucking pests, BPH incidence was found significantly high in direct seeding (55.53/5 hills) while WBPH incidence in normal transplanting method (90.50/5 hills) as compared to other crop establishment methods.

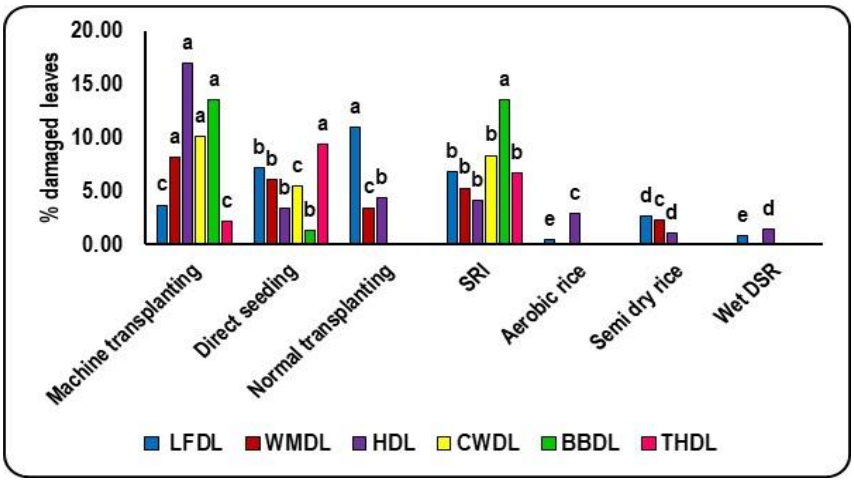


Fig 2.2A Incidence of leaf feeding insects in different crop establishment methods across locations

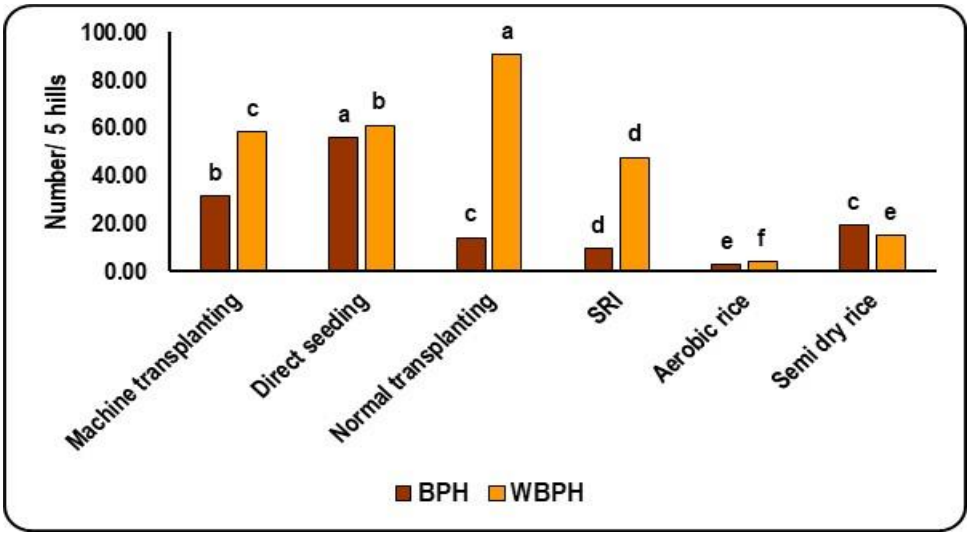


Fig 2.3 Incidence of sucking pests in different crop establishment methods across locations

Influence of crop establishment methods on pest incidence (IEMP) trial, a collaborative trial with Agronomy, was conducted at ten locations during Kharif 2021. Across the locations, incidence of dead hearts caused by stem borer was significantly high in wet DSR while white ears were high and at par in semi dry rice, normal transplanting, SRI and aerobic rice methods. Gall midge incidence was high in direct seeding while leaf folder damage was high in normal transplanting method. Hispa, whorl maggot, caseworm and blue beetle incidence was high in machine transplanting method. BPH incidence was high in direct seeding while WBPH in normal transplanting method across locations. In general, the incidence of pests was relatively high in machine transplanting, normal transplanting and direct seeding methods as compared to SRI, aerobic rice and semi dry rice methods.

ii) Cropping Systems Influence on Pest Incidence (CSIP)

Rice based cropping system is the major cropping system practiced in India wherein rice is grown as the major food crop in rotation with different cereals, pulses, oil seeds, vegetables and fibre crops. The occurrence of insect pests, their carry over and further spread depends on these crops grown in a cropping system. Adoption of water saving technologies like wet direct seeding, dry direct seeding and aerobic rice by farmers is also changing the pest scenario in these cropping systems. Incorporation of rice straw acts as a good source of nutrients for crop growth and the presence of 1-2% potassium in rice straw also affects the pest incidence. Keeping these in view, a trial on Cropping Systems Influence on Pest incidence (CSIP) was initiated last year in collaboration with 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).

The field trial was laid out in split plot design with three replications. Main plot treatments comprised of three different crop establishment methods (M1: Normal transplanting, M2: Wet seeding (line sowing under puddled conditions) and M3: Aerobic rice (Dry rice cultivation). The sub plot treatments comprised of three different residue/straw management techniques (S1: No residue, S2: Incorporation of 15 cm height of rice straw from ground, S3: Incorporation of 30 cm height of rice straw from ground) to be superimposed for *Rabi* crops. During *Kharif* 2021, the trial was conducted at two locations, *viz,* Karjat and Titabar. The results are summarized below.

At Karjat, variety Karjat 3 was grown in this trial. The incidence of stem borer and leaf folder was observed low in different treatments and straw incorporated sub-plots **(Table 2.36)**.

At Titabar also, low incidence of stem borer, leaf folder, whorl maggot and case worm was reported in Ranjit Sub-1 variety and was found at par in all the treatments **(Table 2.37)**.

Cropping system influence on insect pest incidence (CSIP), a collaborative trial with Agronomy was conducted at two locations during Kharif 2021. 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.

Table 2.36: Influence of cropping systems on pest incidence at Karjat, *Kharif* 2021

Treatments		% DH	% WE	% LFDL
		75 DAT	Pre har	60 DAT
M1= Transplanting	S1	7.2(2.8)ab	6.7(2.7)a	0.8(1.1)a
	S2	6.6(2.6)ab	6.1(2.5)a	1.0(1.2)a
	S3	8.6(3.0)a	5.6(2.4)a	0.8(1.1)a
M2 = Wet seeding	S1	6.3(2.6)ab	3.9(2.0)a	0.9(1.2)a
	S2	7.8(2.9)ab	2.8(1.7)a	0.8(1.1)a
	S3	4.6(2.2)b	3.3(1.9)a	0.8(1.1)a
M3 = Aerobic rice	S1	7.8(2.9)ab	5.7(2.3)a	0.7(1.1)a
	S2	7.5(2.8)ab	5.4(2.4)a	0.5(1.0)a
	S3	8.3(3.0)a	5.5(2.4)a	0.8(1.1)a
LSD (0.05)	**M in S**	**0.64**	**1.15**	**0.22**
	S in M	**0.67**	**1.23**	**0.33**
Main plots				
M1= Transplanting		7.5(2.8)ab	6.1(2.5)a	0.8(1.1)a
M2 = Wet seeding		6.2(2.6)a	3.3(1.9)a	0.8(1.1)a
M3 = Aerobic rice		7.9(2.9)a	5.5(2.4)a	0.7(1.0)a
LSD (0.05)		0.43	0.80	0.28
CV (%)		12.01	26.92	18.87
Sub plots				
S1 = No residue		7.1(2.7)a	5.4(2.3)a	0.8(1.1)a
S2 = 15 cm ht. of rice straw		7.3(2.8)a	4.8(2.2)a	0.7(1.1)a
S3 = 30 cm ht of rice straw		7.1(2.7)a	4.8(2.2)a	0.8(1.1)a
LSD (0.05)		**0.37**	**0.67**	**0.13**
CV (%)		**11.07**	**28.70**	**11.07**

Table 2.37: Influence of cropping systems on pest incidence at Titabar, *Kharif* 2021

Treatments		% DH	% WE	% LFDL	% WMDL
		45 DAT	Pre har	60 DAT	45 DAT
M1= Transplanting	S1 = No residue	7.6 ± 1.4	3.8 ±0.8	4.0 ± 0.7	2.6 ± 1.1
	S2 = 15 cm ht. of rice straw	5.0 ±1.5	4.0 ± 0.6	1.4 ± 0.6	1.5 ± 0.6
	S3 = 30 cm ht of rice straw	6.9 ±1.1	4.3 ± 0.7	3.9 ± 0.7	4.6 ± 1.5
M2 = Wet seeding	S1 = No residue	3.7 ±1.5	4.3 ± 0.6	2.3 ± 1.0	2.5 ± 1.0
	S2 = 15 cm ht. of rice straw	3.5 ±0.7	3.9 ± 0.7	3.2 ± 0.8	2.3 ± 0.7
	S3 = 30 cm ht of rice straw	3.7 ±0.6	4.3 ± 0.7	2.0 ± 0.6	2.3 ± 0.6
M3 = Dry converted wet system	S1 = No residue	6.9 ±1.1	5.4 ± 0.8	3.9 ± 0.7	4.6 ± 1.5
	S2 = 15 cm ht. of rice straw	3.6 ±1.8	3.0 ± 0.5	4.1 ± 0.7	3.1 ± 0.8
	S3 = 30 cm ht of rice straw	5.1 ±1.6	3.1 ± 0.9	2.9 ± 0.9	2.9 ± 0.9

iii) Evaluation of Pheromone Blends for Insect pests of Rice (EPBI)

Monitoring of insect pests forms a key component in devising strategies for the Integrated Pest Management in rice. Use of pheromones has lot of potential in monitoring and management of insect pests in rice. The specificity of pheromones to the target pest and safety to natural enemies makes them highly compatible with other methods for application in IPM strategy. A trial on evaluation of pheromone blends for insect pests of rice was continued for the second year with assessment of normal and slow release pheromone blends against yellow stem borer, leaf folder, pink stem borer and rice ear cutting caterpillar.

The trial was conducted at 9 locations for yellow stem borer (YSB) blends, 11 locations for leaf folder (RLF) blends, 2 locations for pink stem borer and one location for rice ear cutting caterpillar during *Kharif* 2021. The field trial was constituted with two blends, viz., normal and slow release blends of rice leaf folder, yellow stem borer, pink stem borer and ear cutting caterpillar along with multispecies blend of both RLF and YSB pheromone combination. All the lures were placed randomly in delta traps, installed in the field and each blend was replicated five times. Observations were recorded on adult catches in each trap at weekly interval, for four weeks 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 were high in slow release blend compared to normal blend in all the locations **(Fig 2.4)**. The peak mean catch was 23 moths/ week, at Pattambi followed by IIRR (16/week) and Ludhiana (14/week). Visual count (11) and sweep net (13) counts were also high at Pattambi compared to all other locations.

For leaf folder, peak catches were reported from slow release blend at Aduthurai (33/ week) followed by IIRR (18/week), significantly different from other locations **(Fig 2.5)**. The catches recorded in Titabar and Jagdalpur were at par with more catches observed in normal blend. At Pattambi, due to the occurrence of another species of leaf folder, *Marasmia patnalis* in high numbers compared to *C. medinalis,* the catches were very low in case of both blends. However, the field population of leaf folder was high with high adult counts in disturb and count method (DCM - 33) and sweep nets (17), At Coimbatore also, similar results were recorded with presence of two species of leaf folders probably leading to low catches in pheromone traps.

Evaluation of multispecies pheromone blends at 10 locations **(Fig 2.6)** revealed that more stem borer adults were caught in traps compared to leaf folder at all the locations. Catches were high at IIRR (12/week) followed by PSAa and Raipur in slow release blend (11/ week) compared to the normal blends (3-4/week). At all the

locations, higher catches were recorded in slow release blends compared to normal blends.

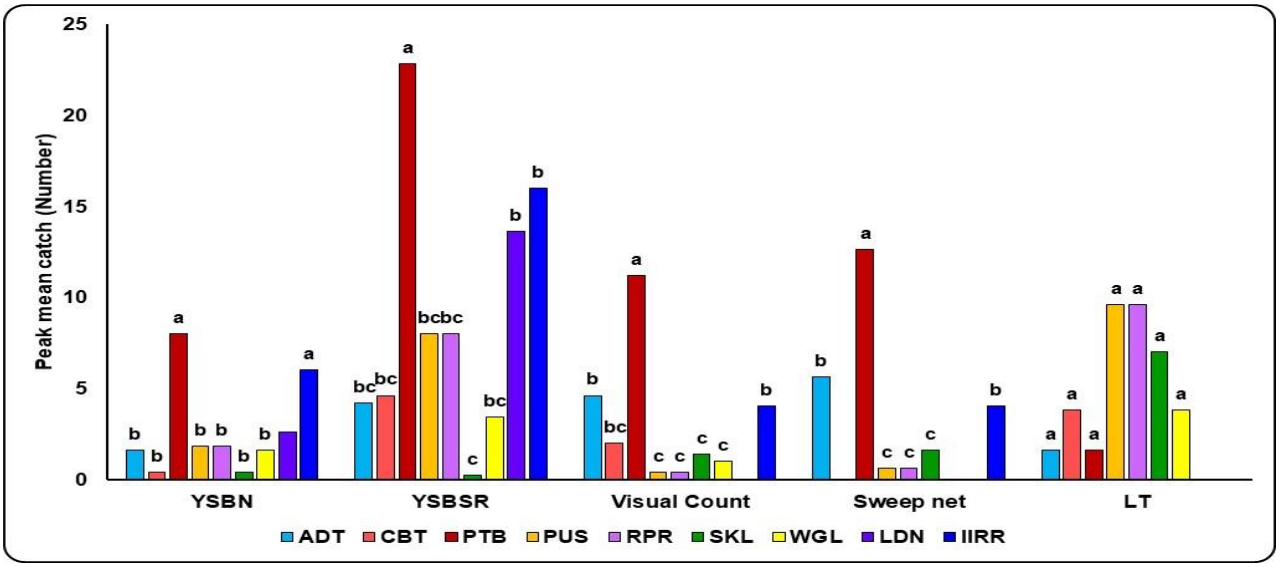


Fig 2.4: Evaluation of Yellow stem borer pheromone blends at different locations, *Kharif* 2021

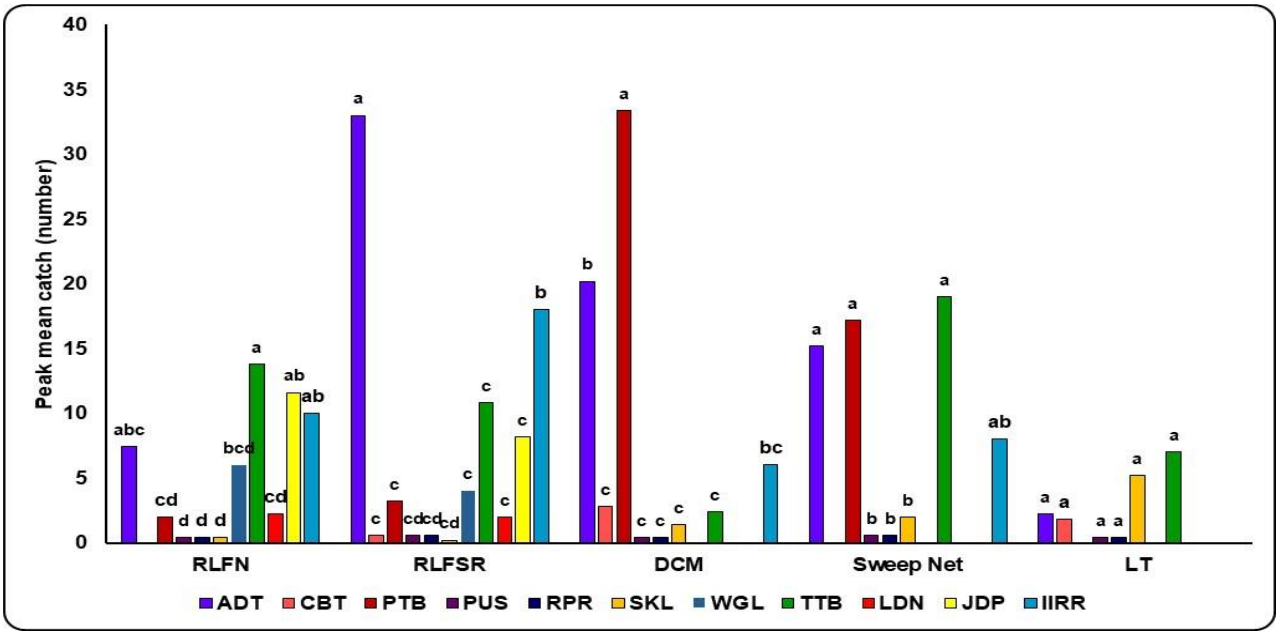


Fig 2.5: Evaluation of rice leaf folder, *Cnaphalocrocis medinalis* pheromone blends at various locations, *Kharif* 2021

Pheromone blends of pink stem borer (PSB), *Sesamia inferens* were evaluated at Ludhiana and Warangal. There was very low incidence of PSB at both the locations. Evaluation of pheromone blends of ear cutting caterpillar, *Mythimna separata at* Ludhiana reported high catches in slow release blend (32/ week) as compared to normal blend (15/ week) **(Fig 2.7)**.

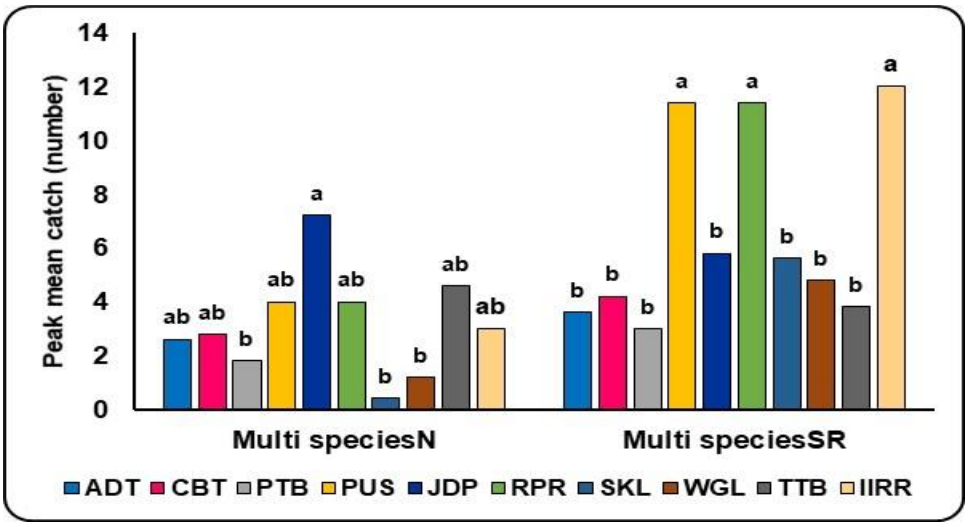


Fig 2.6: Evaluation of multispecies blends at different locations, *Kharif* 2021

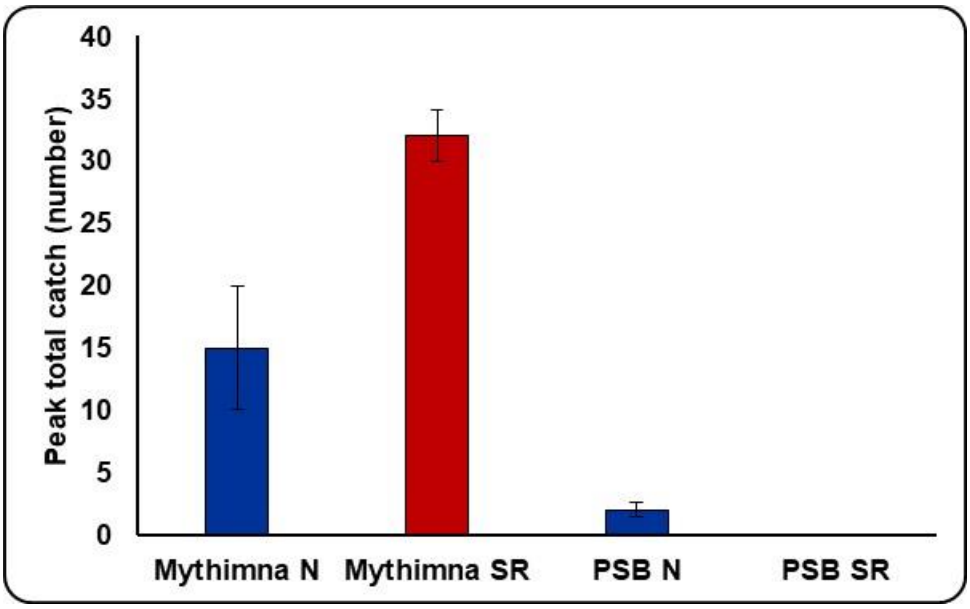


Fig 2.7: Evaluation of pheromone blends of pink stem borer and ear cutting caterpillar at Ludhiana, *Kharif* 2021

Evaluation of pheromone blends for insect pests of rice (EPBI) trial was conducted at 11 locations during Kharif 2021.The field trial was constituted with normal and slow release blends of yellow stem borer, rice leaf folder and multispecies blend of both RLF and YSB pheromone compounds, as well as pink stem borer (PSB) and ear cutting caterpillar. The slow release blends recorded maximum catches compared to normal blends in case of all pests across locations. The peak mean catches of leaf folder per week were maximum at Aduthurai (33) followed by IIRR (18), while yellow stem borer, catches were maximum at Pattambi (23) followed by multispecies blend at IIRR (12), PSAa and Raipur (11). The slow release blend of ear cutting caterpillar, Mythimna separata recorded higher cumulative total catches (32) than the normal blend (15), at Ludhiana.

2.5 BIOCONTROL AND BIODIVERSITY STUDIES

These studies consisted of two trials i) Ecological Engineering for Planthopper Management (EEPM) and ii) Bio-intensive Integrated pest management (BIPM).

i) Ecological Engineering for Planthopper Management (EEPM)

This trial has the objective of habitat management through non-pesticidal methods along with floral diversity to increase natural biological control. Data were recorded on insect pests mainly hoppers and their natural enemies and analyses were done using the independent 't' test or ANOVA. The trial was conducted at eight locations during *kharif* 2021 *viz.*, Bapatla, Coimbatore, Gangavati, Malan, Mandya, Moncompu, New Delhi and Warangal.

1. *Bapatla*

The population of hoppers were very low and well below ETL over six dates of observation **(Table 2.38)**. The number of natural enemies was also on par in both treatments. The yields were low due to rains during the flowering phase and was on par in both treatments with 3062 kg/ ha and 3456 kg/ha in EE (Ecological Engineering) and FP (Farmers Practice) plots **(Table.2.39)**

Table 2.38: Effect of ecological engineering on population of hoppers at Bapatla, EEPM, *kharif* 2021

Parameters	Population of hoppers (No./ hill)					
	WBPH		BPH		GLH	
	EE	FP	EE	FP	EE	FP
Mean	1.10	1.28	1.65	1.92	3.14	4.20
t value	0.01^{NS}		1.63^{NS}		1.28^{NS}	
df	58		58		8	
P - value	1.00		0.10		0.07	

WBPH – white backed planthopper; BPH – Brown planthopper; GLH – green leafhopper

Table 2.39: Effect of ecological engineering on natural enemies and yield at Bapatla, EEPM, *kharif* 2021

Parameters	Population of natural enemies (No./hill)						Yield*	
	Green mirids		Spiders		Coccinellids		Kg/ ha	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	1.75	1.67	0.82	0.83	0.48	0.46	3062	3456
t value	0.10^{NS}		0.43^{NS}		2.10^{NS}		1.47^{NS}	
df	58		58		58		8	
P - value	1.00		0.10		0.07		0.17	

*Projected yield

2. Coimbatore

The EE plots were planted with two rows of marigold on the bunds. The mean population of hoppers observed over four dates of observation, was significantly lower in EE plots (2.72/hill) as compared to 3.47/ hill in FP plots **(Table 2.40)**. In case of natural enemies, significantly higher population was observed in the ecological engineering plots. Coccinellids, spiders, mirids, drynids and rove beetles were observed at 10.75, 13.85, 9.65 3.10 and 4.28 per ten hills respectively in the EE

treatment as compared to 7.90, 8.05, 5.75, 1.80 and 13.80 per ten hills in the FP treatment.

Table 2.40: Effect of ecological engineering hoppers and its natural enemies at Coimbatore, EEPM, *kharif* 2021

Para-meters	Hoppers (No./hill)		Mirids (No./10 hills)		Spiders (No./10 hills)		Coccinellids (No./10 hills)		Drynids (No./10 hills)		Rove Beetle (No./10 hills)	
	EE	FP	EE	FP	EE	FP	EE	FP	EE	FP	EE	FP
Mean	2.72	3.47	9.65	5.75	13.85	8.05	10.75	7.90	3.10	1.80	19.80	13.80
t value	4.18**		4.96**		6.13**		2.92**		2.83**		3.05	
df	38		38		38		38		38		8	
P-value	<0.01		<0.01		<0.01		<0.01		0.01		0.01	

3. Gangavati

The EE plots had alleyways and were planted with cowpea and marigold on the bunds. The mean population of hoppers observed over four dates of observation, was significantly lower in FP plots (18.36/hill) as compared to 43.10/ hill in EE plots **(Table 2.41)**. However, natural enemies were significantly higher in the ecological engineering plots. Coccinellids, spiders, and mirids were observed at 10.20, 13.40 and 49.0 per ten hills respectively in the EE treatment as compared to 6.65, 8.20 and 15.20 per ten hills in the FP treatment.

Egg parasitisation in hoppers was assessed by two techniques. In the baiting techniques the parasitisation was 33.11 and 31.25 % in EE and FP plots and were on par. Plants were destructively sampled from field and observed for parasitisation on 30, 45 and 60 DAT. The parasitsation was on par and ranged from 22.16 to 32.35 percent of eggs in both treatments across all dates of observation. Three parasitoids observed were viz., *Anagrus*, *Oligosita* and *Gonatocerus* accounting for 45.20, 32.41 and 22.39 of the species-composition respectively. The population structure did not differ between the two treatments **Table 2.42)**.

Table 2.41: Effect of ecological engineering on hoppers and its natural enemies at Gangavati, EEPM, *kharif* 2021

Parameters	Hoppers(No./hill)		Mirids(No./hill)		Spiders (No./10 hills)		Coccinellids (No./10 hills)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	43.10	18.36	4.90	1.52	13.40	8.20	10.20	6.65
t value	7.38**		7.42**		4.41**		3.40**	
df	38		38		38		38	
P - value	<0.01		<0.01		<0.01		<0.01	

Table 2.42: Effect of ecological engineering on natural enemies at Gangavati, EEPM, *kharif* 2021

Parameters	% parasitisation by baiting		% parasitisation in field collected samples					
			30 DAT		45 DAT		60 DAT	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	33.11	31.25	25.22	31.38	32.35	30.68	27.05	22.16
t value	0.30^{NS}		1.56^{NS}		0.29^{NS}		1.06^{NS}	
df	48		48		48		48	
P - value	0.76		0.13		0.78		0.29	

4. Malan

At Malan three treatments were tested in natural farming systems *viz.*, (i) with bund flora of French marigold along with recommended fertilizers (ii) with bund flora of French marigold with Azolla application and without fertilizers (iii) only natural farming and compared with a treatment that had recommended fertilizers and insecticide application. The key pest observed was the leaffolder and the percent damaged leaves varied significantly among the treatments on one observation date. The mean maximum leaf damage (23.37 %) was found in the treatment with natural farming **(Table 2.43)** which was on par with EE with bund cropping along with azolla application (11.79%). The mirid bug population was highest in bund cropping treatment with marigold (8.02/ hill) and significantly lower (4.22/ hill) in plots with natural farming.

Table 2.43: Effect of ecological engineering on leaffolder incidence at Malan, EEPM, *kharif* 2020

Treatment	% leaves damaged by Leaffolder				Mirids
	I observation	II observation	III observation	Mean	Mean No. /hill
With bund flora (Marigold) + Azola and no RFD	15.58 (23.25)	16.47 (23.95)	23.02 (20.48)	13.77 (21.78)	8.02
RFD + insecticides	15.94 (23.53)	15.71 (23.35)	11.79 (14.33)	10.86 (19.20)	7.15
Natural Farming application of Gnana amrit and bijamrit	17.12 (24.44)	17.35 (24.61)	23.37 (20.63)	14.46 (22.34)	4.22
CD (p=0.05%)	NS	NS	1.24	1.38	1.98

5. Mandya

The interventions followed in EE plots were application of vermicompost, alleyways, floral diversity through growing cowpea and marigold on the bunds and use of pheromone traps for monitoring and mass trapping. The mean population of hoppers was on par in both treatments with 5.34 and 4.57 /hill in EE and FP plots respectively **(Table 2.44)**. However, in case of natural enemies significantly higher population was observed in the ecological engineering plots. Coccinellids, spiders and mirids were observed at 3.40, 4.68 and 3.95 per ten hills in the EE treatment as compared to 2.27, 3.12 and 1.76 in the FP treatment.

Table 2.44: Effect of ecological engineering on hoppers and their natural enemies at Mandya, EEPM, *kharif* 2020

Parameters	Hoppers (No./hill)		Green mirids (No./10 hills)		Spiders (No./10 hills)		Coccinellids (No./10 hills)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	5.34	4.57	3.95	1.76	4.68	3.12	3.40	2.27
t value	1.427		5.85**		6.34**		4.23**	
df	38		38		38		38	
P - value	NS		0.01		0.01		0.05	

6. Moncompu

Bund planting of marigold and application of organic manuring was taken up in EE plots. The population of pests were however low in both plots. The pooled analysis

revealed that number of hoppers was very low **(Table 2.45)**. Among the natural enemies recorded spiders (4.67/10 hills) was significantly higher in EE treatment as compared to 2.87/10 hills in FP treatment.

Table 2.45: Effect of ecological engineering on hoppers and their natural enemies at Moncompu, EEPM, *kharif* 2020

Parameters	Hoppers(No./10 hills)		Green mirids(No./10 hills)		Spiders(No./10 hills)		Coccinellids (No./10 hills)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	4.53	4.73	2.65	2.48	4.67	2.87	3.33	2.47
t value	0.24^{NS}		0.54^{NS}		2.44**		1.31^{NS}	
df	28		28		28		28	
P - value	0.81		0.59		<0.01		0.19	

7. New Delhi

Five treatments were tested at this location. Four of these had bund plantings of (i) flower crops- Marigold, Balsam and Gaillardia (ii) oil crops - Sesamum, Soybean, Sunflower, (iii) combination of oil crops and flowering crops (iv)natural weeds (V) control with no border crop. Observations were recorded on damage by stemborer, leaffolder, whorl maggot and population of hoppers and their natural enemies over the crop period. A mixed population of brown planthopper and white backed planthoppers were observed. The BPH population peaked from 70-80 DAT and mean ranged from 38.07-67.73/hill among the various treatments. Though lower population was observed in the plots with border crops, the numbers were on par in all treatments **(Table 2.46)**. A similar trend was observed for al pests with no significant differences **(Table 2.47)**. Population of natural enemies such as spiders, mirids and rove beetles was also on par.

Table 2.46: Effect of ecological engineering on peak abundance of pests at New Delhi, EEPM, *kharif* 2021

Treatment	% WM	BPH (No./10 hills)		WBPH	% WE
		70 DAT	80 DAT	(NO./10 hills)	
Oil Crops (Marigold, Balsam, Gaillardia)	9.93 (18.28)	53.07	40.70	2.64	1.375 (6.63)
Flowers - (Sesamum, Soybean, Sunflower)	11.60 (19.88)	46.53	38.07	2.29	2.082 (8.05)
Oil Crops + Flowers	11.80 (19.89)	37.10	51.93	2.70	1.441 (6.77)
Natural Weeds	14.13 (22.03)	45.57	41.60	2.80	2.289 (8.70)
CONTROL	11.49 (19.80)	42.47	67.73	3.17	2.021 (8.07)
CD (p=0.05%)	NS	NS	NS	NS	NS

WM – whorl maggot; BPH –brown planthopper; WBPH- white backed planthopper; WE- White ears

Table 2.47: Effect of ecological engineering on abundance of natural enemies and yield at New Delhi, EEPM, *kharif* 2021

Treatment	Spiders (No./ 10 hills)	Rove beetles (No./ 10 hills)	Mirids (No./ 10 hills)	Yield (Kg/plot)
Oil Crops (Sesamum, Soybean, Sunflower)	16.79	0.71	26.10	10.83
Flowers - (Marigold, Balsam, Gaillardia)	16.83	0.96	36.71	10.88
Oil Crops + Flowers	17.88	0.58	33.52	11.62
Natural Weeds	18.04	1.42	41.86	10.90
CONTROL	19.50	1.83	36.91	11.54
CD (p=0.05%)	NS	NS	NS	NS

8. Warangal

Three treatments- Farmers' practice plots with chemical interventions (FP), Ecological engineering plots with and without alternate wetting and drying (EEP 1 and EEP 2 respectively) were tested. Please define what is EEP2 Practices followed in EE plots were, alleyways, alternate wetting and draining of water, increase in floral diversity on bunds by planting marigold in addition to no chemical plant protection measures. Five observations were recorded on the two planthoppers and their natural enemies through the crop period. A mixed population of BPH and WBPH was observed. The population of brown planthopper reached a peak at 80 and 90 DAT and was highest in the FP treatment 50.67 and 80.27/10 hills respectively. EEP I and II were on par on 80 DAT, but significantly lower population was observed in in ecological engineering treatment with alternate wetting and drying EEP I (with alternate wetting and drying) (42.60/10 hills) (Table 2.xx). The hopper numbers were consistently lower in the EEP-I treatment plots indicating that alternate wetting and drying along with ecological engineering can reduce hopper population. The mean populations of spiders and coccinellids were on par in EEP I and II while the lowest population was observed in the FP treatment (16.10 and 3.14/ 10 hills respectively). Mirid bugs were on the other hand significantly higher in FP plot (7.92/ 10 hills) while it was lowest in EEP-I (4.99/10 hills) **(Table 2.48)**.

The EEP-I plots yielded higher (3675.49 kg /ha) while the FP plots yielded an average of 3097.30 kg/ha **(Table 2.49)**. The B: C ratio was also higher in the ecological engineering plots than FP plots and the highest BCR of 1.67 was observed in EEP-I plots with alternate wetting and drying. FP plots showed lowest B: C ratio of 1.28.

Table 2.48: Effect of ecological engineering on populations of hoppers and their natural enemies at Warangal, EEPM, *kharif* 2020

A. Hoppers

Treatments	BPH (No./ 10 hills)			WBPH (No. /10 hills)	
	80 DAT	90 DAT	Mean	80 DAT	Mean
EEP-I	31.20	42.60	19.59	8.93	3.489
EEP-II	30.47	52.27	22.81	11.40	4.111
FP	50.67	80.27	40.12	13.40	6.367
CD (0.05)	12.89	4.33	9.14	3.37	1.06

BPH –brown planthopper; WBPH- white backed planthopper

B. Natural enemies of hoppers

Treatments	Spiders (No. /10hills)	Coccinellids (No. /10 hills)	Mirids (No. /10 hills)
	111 DAT	111 DAT	111 DAT
EEP-I	**19.47**	**3.89**	**4.99**
EEP-II	**19.62**	**3.16**	**6.90**
FP	**16.10**	**3.14**	**7.92**
CD (0.05)	2.67	0.60	1.08

Table 2.49: Grain Yield and Benefit cost ratio of Ecological engineering at Warangal, EEPM, *kharif* 2020

Treatment	Grain yield (Kg/ha)	B:C ratio
EEP-I	3675.49	1.67
EEP-II	3219.72	1.46
FP	3097.30	1.28
CD (0.05)	102.05	0.07

Low populations of mirids, coccinellids and spiders were also observed on the marigold plants grown on the bunds indicating a sharing of natural enemies. The spider population was the highest (7.0 /10 plants) in both EEP I and II while the coccinellid numbers ranged from 1.20-1.37/10 plants; mirids ranged from 1.43-1.90/ 10 plants.

Ecological engineering for pest management was taken up in eight locations with a combination of interventions such as organic manuring, alleyways, spacing management, water management and growing of flowering plants on bunds. The results indicated that water management along with ecological engineering significantly reduced hopper population at Warangal (4.26/hill) when compared to farmers practice (8.03/hill) while increasing yields. Habitat interventions increased the natural enemy populations like mirids, spiders and coccinellids at many locations – Coimbatore, Gangavati, Malan, Mandya, Moncompu and Warangal. While pest incidence was at par in Mandya, Moncompu, New Delhi and Bapatla, hoppers were increased in EE plots at Gangavati. At Warangal, the benefit cost was also significantly higher with ecological engineering and water management (1.67) when compared to Farmers' practice (1.28).

iii) Bio-intensive pest management trial (BIPM)

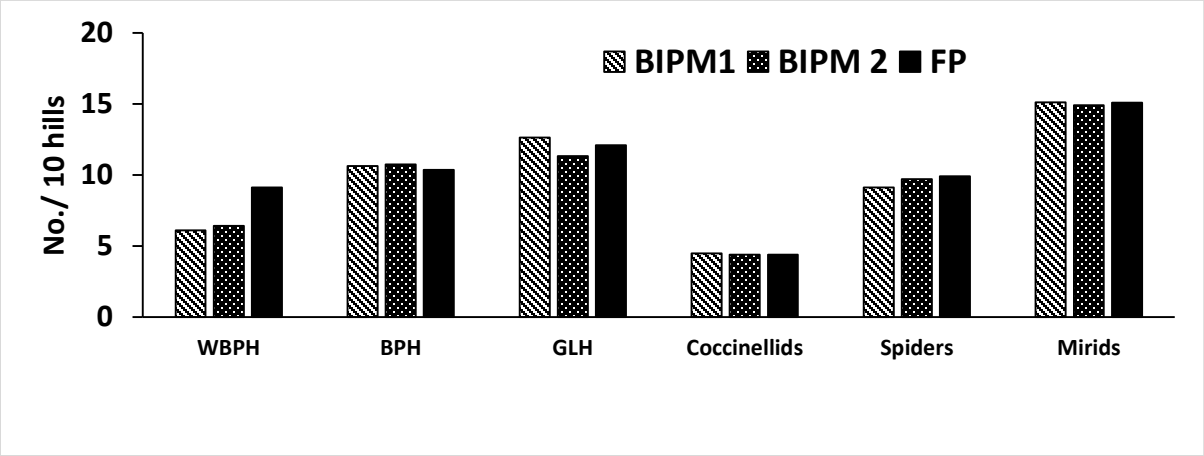
This trial was initiated to generate comprehensive plant protection and soil health data to validate adoption of pest management practices for use as an integral component of organic rice cultivation. The trial was taken up at thirteen centres *viz.*, Bapatla, Chinsurah, Gangavati, Jagdalpur, Karjat, Karaikal, Ludhiana, Moncompu, Masodha, Pattambi, Ranchi, Raipur and Titabar.

The trial involved mainly two treatment blocks *viz.*, i) Bio-intensive pest management (BIPM) which was again split into - one sub block receiving seed treatment and application of *Trichoderma* (BIPM 1) and - another sub block with *Pseudomonas* (BIPM 2) and ii) Input intensive pest management or Farmers Practice block (FP) spread over an area of a minimum of half acre for each block planted with a local popular variety of the region. The results of the trials at various locations are given below.

1. Bapatla

The practices under BIPM were seed treatment with *Pseudomonas* or *Trichoderma*, installation of pheromone traps, release of *Trichogramma* sp., application of neem oil twice during the season and installation of bird perches. Observations were recorded on incidence of leaffolder, hoppers and their natural enemies. The pest incidence was low during the kharif season, with negligible leaffolder damage. All the three hoppers were observed, and populations were very low ranging from 6.1 to 12.63 per 10 hills and there was no difference between the treatments. Similarly, the population of beneficial insects was on par in all treatments. The yield was 2406, 2858 and 3700 kg/ha in BIPM 1, BIPM 2 and FP treatments respectively and were on par **(Fig 2.8)**.

Fig 2.8: Population of hoppers and natural enemies under Bio-intensive pest management trial at Bapatla, *kharif* 2021



* BPH –brown planthopper; WBPH- white backed planthopper; GLH – green leafhopper

2. Chinsurah

Observations were recorded on the damage by whorl maggot and stem borer and natural enemies like spiders and coccinellids. Whorl maggot incidence was low. The dead heart damage by stem borer was significantly higher in FP plots (10.80%) than that of BIPM plots (5.40%). A high incidence of white ears was recorded. A similar trend was observed with 14.17 % damage in BIPM plots as compared to 25.25 % in FP plots **(Table 2.50)**.

Table 2.50: Pest incidence under Bio-intensive pest management trial at Chinsurah, *kharif* 2021

Parameters	DH		WE	
	(% damage)		(% damage)	
	BIPM	FP	BIPM	FP
Mean	5.40	10.80	14.17	25.25
t value	5.52**		5.83**	
df	22		10	
P - value	<0.01		<0.01	

* DH – Dead heart; WE- white ears

The number of spiders and coccinellids (5.62 and 4.04/10 hills respectively) was on par with that of FP plots (5.04 and 3.46/10 hills respectively) **(Table 2.51)**.

Table 2.51: Population of natural enemies under Bio-intensive pest management trial at Chinsurah, *kharif* 2021

Parameters	Spiders		Coccinellids	
	(No./10 hills)		(No./10 hills)	
	BIPM	FP	BIPM	FP
Mean	5.62	5.04	4.04	3.46
t value	0.71		0.96	
df	46		46	
P - value	NS		NS	

3. Gangavati

The trial was taken up for the first time at Gangavati. The BIPM practices followed were seed treatment with *Pseudomonas fluorescens*, Biochar in nursery, application of vermicompost and neem cake, clipping of seedlings, Pheromone traps for monitoring; release of *Trichogramma japonicum*; Two application of *M. anisopliae* and foliar spray of *P fluorescens.* The pests observed were BPH, WBPH, GLH, hispa and stemborer. The population of hoppers were significantly higher in BIPM plots (55.76 and 26.67/ hill) as compared to plots with insecticide sprays (20.06 and 9.34 / hill) **(Table. 2.52)**. However, the incidence of natural enemies showed an opposite trend with coccinellids, spiders and mirids being significantly higher in BIPM plots 19.30, 16.50 and 17.80 / 10 hills respectively as compared to 2.90, 2.30 and 2.60/ 10 hills in insecticide treated plots **(Table. 2.53)**. The stem borer egg mass parasitisation was also higher in BIPM treatment. The species composition was similar in both treatments, consisting of three species *Trichogramma*, *Telenomus* and *Tetrastichus schoenobii*. with Trichogramma accounting for 65.24 and 64.52 per cent.

Table 2.52: Pest incidence under Bio-intensive pest management trial at Gangavati, *kharif* 2021

Parameters	No./ hill				Per cent damage by	
	BPH		WBPH		WE	
	BIPM	FP	BIPM	FP	BIPM	FP
Mean	55.76	20.06	26.67	9.34	3.93	2.64
t value	7.05**		4.55*		2.55*	
df	46		46		46	
P - value	<0.01		<0.01		0.05	

* BPH –brown planthopper; WBPH- white backed planthopper; WE- White ears

Table 2.53: Incidence of natural enemies under Bio-intensive pest management trial at Gangavati, *kharif* 2021

Parameters	No./10 hills							
	Coccinellids		Spiders		Mirids		% Egg Parasitisation (SB)	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	19.30	2.90	16.50	2.30	17.80	2.60	64.91	61.12
t value	18.23**		17.91**		17.82**		2.84**	
df	46		46		46		24	
P - value	0.13		0.04		0.01		0.01	

4. Jagdalpur

Incidence of whorl maggot, thrips, leaffolder, stem borer, BPH and GLH were observed. The pest incidence was on par in the two treatments for all pests. The damage by whorl maggot, leaffolder and stem borer was low in both treatments, while the damage by gall midge and thrips was higher, but on par **(Table 2.54)**. FP plots yielded significantly higher (4168.80 kg/ha) than that of BIPM plots (3712.20 kg/ha).

Table 2.54: Pest incidence and yield under Bio-intensive pest management trial at Jagdalpur, *kharif* 2021

Parameters	Per cent damage by				Yield (Kg/ ha)	
	Thrips		SS			
	BIPM	FP	BIPM	FP	BIPM	FP
Mean	10.56	9.60	17.61	15.60	3712.20	4168.80
t value	1.04^{NS}		2.76^{NS}		2.44*	
df	70		70		70	
P - value	0.30		0.04		0.04	

* SS – silver shoots

5. Karjat

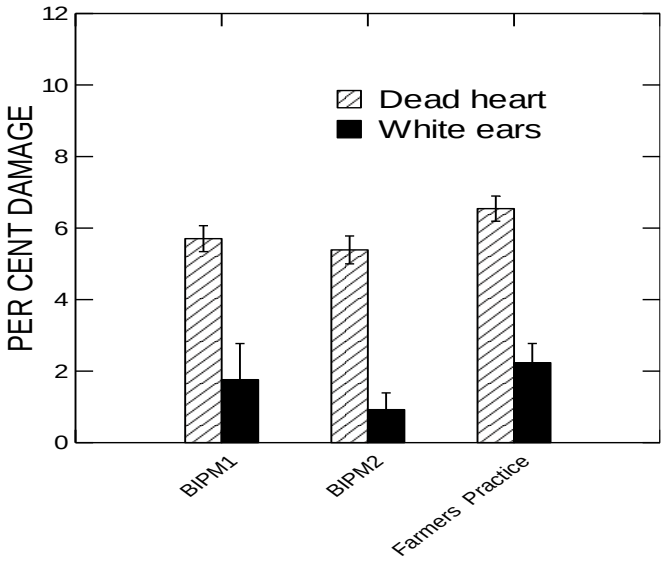
At this location, three modules were tested in a farmer's field in in Vanjale village. The BIPM 1 and 2 differed in spraying with two organisms, *Trichoderma* and *Pseudomonas* respectively and were similar in all other bio intensive interventions.

Observations were recorded on the incidence of leaffolder and stem borer. The mean damage caused by stem borer and leaffolder were low and on par in all treatments **(Fig 2.9)**. The yield was significantly higher F=66.04; P=<0.01) in the BIPM plots (3546.67 and 3393.33 kg/ha) compared to FP treatment (2746.67 kg/ha).

6. Karaikal

Three modules were tested and observations were recorded on the incidence of leaffolder stem borer and natural enemies. The mean damage caused by stem borer and leaffolder were low and on par in all treatments **(Fig 2.10)**.

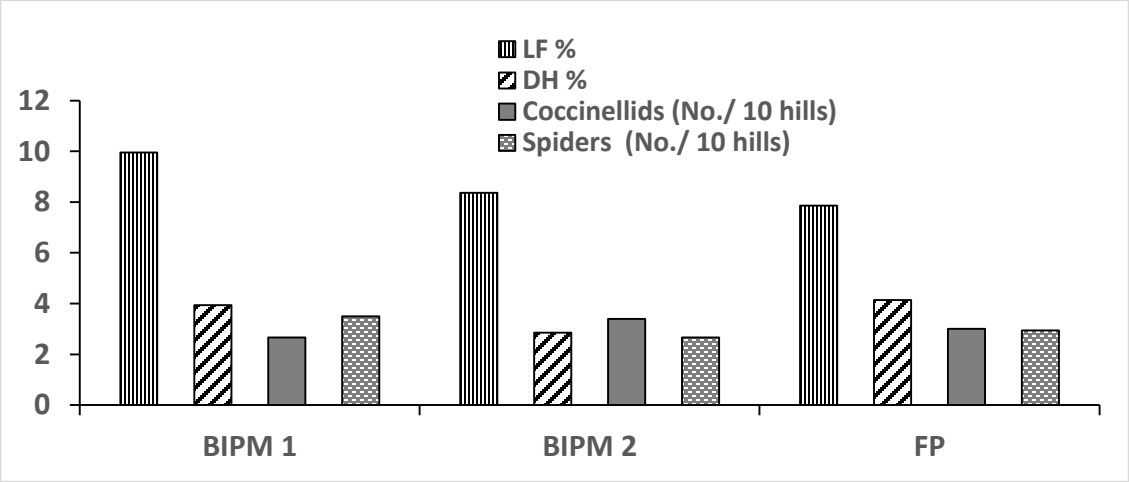
Fig 2.9: Pest incidence under Bio-intensive pest management trial at Karjat, *kharif* 2021



6. Karaikal

Three modules were tested and observations were recorded on the incidence of leaffolder stem borer and natural enemies. The mean damage caused by stem borer and leaffolder were low and on par in all treatments **(Fig 2.10)**.

Fig 2.10: Pest and natural enemy incidence under Bio-intensive pest management trial at Karaikal, *kharif* 2021



LF-Leaffolder; WE- white ear

7. Ludhiana

The BIPM practices followed were application of vermicompost and rice husk in the nursery beds, Seed dressing with phosphorus solubilizing microorganisms (PSM) and root dipping with PSM and *Pseudomonas subtallis* and *P. argentinensis,* incorporation of weed and straw into soil, vermicompost and neem cake as basal and top dressing, clipping of leaf tips before field transplanting, pheromone traps for mass trapping of stem borers and flowering plants of marigold, soyabean, cowpea, mash, moong, sesame, red gram on bunds for conserving natural enemies. Spray of

P. fluorescens, need based application of nimbicidine and water management for planthoppers was taken up. The pests observed were BPH, WBPH, leaffolder and whorl maggot along with natural enemies. Pest incidence was low and on par in both treatments. The population of coccinellids and spiders were significantly higher in BIPM plots (1.33 and 4.64/10 hills) as compared to plots with insecticide sprays **(Table 2.55)**. Similarly, the incidence of parasitoids such as ichneumonids and braconids sampled through sweep nets were significantly higher in BIPM plots (8.48 and 7.21/ 10 sweeps) respectively as compared to 6.02 and 5.50/ 10 sweeps in FP treatment. The yield was on par in both treatments.

Table 2.55: Natural Enemy incidence and yield under Bio-intensive pest management trial at Ludhiana, *kharif* 2021

Parameters	Coccinellids (No./ 10 hills)		Spiders (No./ 10 hills)		Ichnuemonid (No./10 sweeps)		Bracon (No./10 sweeps)		Yield (kg/ha)	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	1.33	0.83	4.64	3.17	8.48	6.02	7.21	5.5	7258	7135
t value	2.69**		3.94**		5.71**		4.29**		1.41^{NS}	
df	12		12		12		12		10	
P - value	0.01		0.01		0.01		0.01		0.19	

8. Moncompu

Incidence of stem borer, leafolder and natural enemies were observed in BIPM and Farmers' practice plots. The incidence of dead hearts in BIPM (8.11 %) was on par with that of farmer's practice plots (10.69 %) (Table 2. xxx). Likewise, white ear damage in FP (9.70%) was on par with the damage in BIPM treatment (8.36%). The number of coccinellids per 10 hills (3.75) and mirids (14.40/10 hills) though higher in BIPM was not significantly different from FP (3.12) **(Table 2.56)**. The spider population per 10 hills was significantly higher in BIPM (3.75). The grain (5332 & 5788 kg/ha) and straw yield were on par in both treatments **(Table 2.57)**.

Table 2.56: Pest incidence under Bio-intensive pest management trial at Moncompu, *kharif* 2021

Parameters	DH (% damage)		WE (% damage)	
	BIPM	FP	BIPM	FP
Mean	8.11	10.69	8.36	9.70
t value	0.97 ^{NS}		0.64 ^{NS}	
df	10		22	
P - value	0.33		0.24	

* DH-Dead Heart; WE- white ear

Table 2.57: Natural enemies and Yield parameters under Bio-intensive pest management trial at Moncompu, *kharif* 2021

Parameters	Coccinellids (No./ 10 hills)		Spiders (No./ 10 hills)		Mirids (No./ 10 hills)		Grain Yield (kg/ha)		Straw Yield (kg/ha)	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	3.63	3.1	3.75	2.4	14.4	12.3	5332	5788	6166	7195
t value	0.16^{NS}		2.51**		1.06		1.01^{NS}		2.93 ^{NS}	
df	46		46		46		10		10	
P - value	0.39		0.01		0.29		0.05		0.06	

9. Masodha

Incidence of whorl maggot, stem borer, hispa, leaffolder and natural enemies were observed. Whorl maggot damage was low but significantly lower in BIPM plots **(Table 2.58)**. Hispa and Leaffolder damage ranged from 9.33 to 9.62 and 12.28 to 14.10 % in BIPM and FP plots (Table 2.xxx). Though damage was lower in BIPM treatment they were statistically on par. Likewise, a significantly lower incidence of stem borer damage in the form of dead hearts (21.29 %) and white ears (19.61 %) was observed in the BIPM treatment as compared to 29.08 and 25.01% in FP plots. The beneficials such as spiders and coccinellids recorded in BIPM plots were significantly higher in numbers in BIPM plots (2.10 and 2.48/hill respectively) as compared to FP treatment. The yield was also higher in BIPM (5002.67 kg/ha) as compared to 3366.67 kg/ha in FP plots. **(Table 2.59)**

Table 2.58: Pest incidence under Bio-intensive pest management trial at Masodha, *kharif* 2021

Parameters	Per cent damage						Stemborer			
	WM		LF		Hispa		% Dead hearts		% White ears	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	3.90	5.31	9.33	9.62	12.28	14.10	21.29	29.08	19.61	25.10
t value	2.80**		1.95^{NS}		3.33^{NS}		3.52**		4.44**	
df	22		22		22		22		22	
P - value	0.01		0.80		0.49		<0.01		<0.01	

* WM – Whorl maggot; LF- leaffolder

Table 2.59: Natural enemies and yield parameters under Bio-intensive pest management trial at Masodha, *kharif* 2021

Parameters	Coccinellids (No./ hill)		Spiders (No./ hill)		Grain Yield* (kg/ha)	
	BIPM	FP	BIPM	FP	BIPM	FP
Mean	2.10	1.35	2.48	1.71	5002.67	3366.67
t value	5.01**		4.48**		4.48**	
df	58		58		10	
P - value	0.01		0.01		0.01	

* Projected Yield

10. Pattambi

The practices followed in BIPM plots were application of Neem cake + Vermicompost as recommended; growing cowpea on bunds and application of Azadirachtin 0.003% at 15, 30, 45, 60 and 75 DAT. Incidence of whorl maggot, gall midge, leaffolder, caseworm, stem borer and predators like spiders and coccinellids was recorded. The mean per cent leaves damaged by leaffolder was on par in BIPM and FP plots **(Table 2.60)**. Damage by gall midge was significantly higher in BIPM plots (17.78%) as compared to farmers' practice (12.99%). Stem borer damage assessed as white ear per cent was high 22.43-23.29 per cent, though on par in both treatments. The population of spider and coccinellids in the BIPM plots though higher was statistically on par with that of Farmers' practice plots **(Table 2.61)**. However, yields were low in both treatments 3414.50 kg/ha in BIPM plots and 3705 kg/ha in FP plots.

Table 2.60: Population of pests and yield under Bio-intensive pest management trial at Pattambi, *kharif* 2021

Parameters	Leaffolder (% damage)		Gall Midge (% SS)		Whorl maggot (% damage)		Stem borer (% WE)	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	10.70	10.39	17.78	12.99	9.72	8.61	22.43	23.29
t value	0.43^{NS}		2.33*		1.41^{NS}		0.43^{NS}	
df	22		22		10		10	
P - value	0.10		0.02		0.16		0.67	

* SS –silver shoots; WE – white ears

Table 2.61: Population of natural enemies under Bio-intensive pest management trial at Pattambi, *kharif* 2021

Parameters	Spiders (No./10 hills)		Coccinellids(No./10 hills)		Yield* (kg/ha)	
	BIPM	FP	BIPM	FP	BIPM	FP
Mean	7.50	7.08	8.00	7.39	3414.5	3705.0
t value	0.51^{NS}		0.71^{NS}		1.32^{NS}	
df	34		34		38	
P - value	0.61		0.48		0.10	

*Projected yield

12. Raipur

Two BIPM modules with variations of *Pseudomonas* (BIPM1) and *Trichoderma* (BIPM2) treatments and two farmers' practices, one without crop protection (F1) and another with crop protection (F2) were tested. The interventions in BIPM modules included seed and seedling treatment followed by sprays of either *Trichoderma* or *Pseudomonas*, green manuring with Daincha, poultry manure, vermicompost and neem cake as organic manuring, flowering plants on bunds, release of *Trichogramma* and spray of *Metarhizium*. Incidence of pests such as whorl maggot, case worm, hispa, and leaffolder was low and did not differ significantly between the treatments. Incidence of whorl maggot ranged from 5.58 -7.19 per cent, the highest being recorded in the FP1 module. All three hoppers were recorded. However, the incidence of brown plant hopper reached a peak at 95 DAT with the population ranging from 6.63-12.68/ hill among the treatments **(Table 2.62)**. The significantly high population of 12.68/hill was observed in FP1 with recommended fertilizer application, but no insecticide use. Predators like spiders, coccinellids were recorded throughout the crop growth period but were on par in all treatments. Stem borer damage was on par in all four modules with per cent dead hearts ranging from 12.28 to 16.19 % and white ears ranging from 2.93 in F2 module to 5.39 in BIPM 2 with *Pseudomonas* application.

Table 2.62: Pest incidence under Bio-intensive pest management trial at Raipur, *kharif* 2021

Treatments	Stem borer		Hispa	Whorl Maggot	BPH
	% Dead hearts	% White ears	% damage	% damage	(No./hill)
BIPM1	13.26(21.13)	4.34(11.22)	4.31	6.04	6.63
BIPM 2	12.28(20.38)	5.39(12.60)	4.14	6.16	6.73
FP 1	16.19(23.65)	3.29(7.98)	4.75	7.19	12.68
FP 2	13.39(21.33)	2.93(8.61)	4.66	5.58	9.30
CD (p=0.05%)	NS	NS	NS	NS	1.50

Table 2.63: Population of natural enemies and yield under Bio-intensive pest management trial at Raipur, *kharif* 2021

Treatments	Coccinellids (No./10hills)	Spiders (No./10 hills)	Yield (Kg/ha)
BIPM1	4.33	3.50	6846.00
BIPM 2	3.17	2.33	6705.33
FP 1	4.17	2.00	6390.67
FP 2	3.33	3.50	7356.00
CD (p=0.05%)	NS	NS	0410.56

*BPH –brown planthopper

The egg parasitisation of stem borers was assessed and the egg mass parasitisation ranged from 44.01 % in FP2 with insecticide use to 79.18 % in FP1 without insecticides and recommended application of fertilizers. Three egg parasitoids - *Tetrastichus*, *Telenomus* and *Trichogramma* were observed accounting for 35.70, 35.70 and 35.46 per cent of the parasitoids respectively. The yield was highest in FP2 (7356 kg/ha) followed by BIPM 1 (6705.33 kg/ha) **(Table 2.63)**.

11. Ranchi

Incidence of hispa, stem borer, leaffolder and gall midge were recorded throughout the crop growth period. Pest incidence was generally low though it was slightly higher in BIPM plots. A similar trend was observed with dead heart symptoms with 6.35% recorded in BIPM compared to 4.05% in FP plots. There were no significant differences in the damage pests between the two treatments. Yield was also on par with 4051 and 4461 kg / ha recorded in BIPM and FP plots respectively **(Table 2.64)**.

Table 2.64: Pest incidence under Bio-intensive pest management trial at Ranchi, *kharif* 2021

Parameters	Hispa % damage		LF % damage		DH % damage		SS (No./10 hills)		WE % damage		Yield Kg/ha**	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP		
Mean	4.55	3.55	5.41	3.89	6.35	4.05	6.08	3.61	4.77	3.71	4051	4461
t value	2.74^{NS}		3.50^{NS}		3.21^{NS}		1.66^{NS}		1.59^{NS}		4.48^{NS}	
df	38		18		18		28		18		18	
P - value	0.08		0.10		0.09		0.10		0.11		0.45	

* DH – Dead heart; LF- leaffolder; SS –silver shoots; WE – white ears: ** Projected Yield

13. Titabar

The practices followed in BIPM plots were Clipping of rice seedlings before transplanting, mass trapping of stem borer by installing pheromone traps @ 20 numbers/ ha; release of *Trichogramma japonicum* 5 cc egg cards/ha, six times weekly from first week after transplanting, *T. chilonis* for leaf folder management at weekly intervals from 20 days after transplanting; Neemazal @1ml/ litre of water sprayed at 50 DAT when stem borer and leaf folder infestation were observed; foliar spray of *P. fluorescens* on the foliage @ 20 g/ litre of water; planting of redgram and marigold in border. The pest incidence observed at 15, 30, 45, 60 DAT showed that by damage by leaffolder (5.09, 4.56, 1.58 and 1.81%) was significantly lower than that observed in FP plots (15.9, 20.3, 17.73, and 9.82%). Similar trends were observed for damage by caseworm (**Table 2.65)**. Dead hearts caused by stem borer

Table 2.65: Pest incidence under Bio-intensive pest management trial at Titabar, *kharif* 2021

Parameters	Leaffolder (% damage)								Caseworm (% Damage)						
	15 DT		30 DT		45 DT		60 DT		15 DT		30 DT		45 DT		60
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM
Mean	5.09	15.91	4.56	20.30	1.58	17.73	1.81	9.82	2.98	9.55	3.77	24.74	2.01	10.88	1.55
t value	7.34**		18.19**		23.23**		20.69**		5.96**		23.27**		16.72**		19
df	10		10		10		10		10		10		10		
P - value	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01		<0

Table 2.66: Pest incidence under Bio-intensive pest management trial at Titabar, *kharif* 2021

Parameters	Whorl maggot (% damage)						Stem borer							
							% Dead hearts						% White
	15 DT		30 DT		45 DT		15 DT		30 DT		45 DT		60 DT	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	3.96	8.02	5.09	18.10	1.85	14.75	1.81	9.82	2.98	9.55	3.77	24.74	2.01	10.88
t value	4.93**		13.96**		18.59**		20.69**		5.96**		23.27**		16.72**	
df	10		10		10		10		10		10		10	
P - value	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01	

WE- White ears

Table 2.67: Population of natural enemies and yield under Bio-intensive pest management trial at TITABAR, *kharif* 2021

Parameters	Spiders (No./10 hills)		Coccinellids (No./10 hills)		Mirid (No./10 hills)		
	BIPM	FP	BIPM	FP	BIPM	FP	
Mean	2.32	0.76	1.96	0.76	0.54	0.48	
t value	18.78**		16.83**		1.40*		
df	58		58		58^{NS}		
P value	<0.01		<0.01		0.05		

* ProjectedYield

in BIPM treatment at 15, 30 and 45 DAT were 8.3, 9.12, 2.58 % respectively compared to the significantly higher damage of 23.37, 40.42 and 27.42 % in FP plots **(Table 2.66)**. Simlar trends were also observed for whorl maggot which were significantly lower in BIPM plots as compared to FP plots. The abundance of natural enemies was also found to be higher in BIPM treatment. The spider and coccinellid numbers per hill were significantly higher in BIPM plots (2.32 and 1.96 respectively) as compared to 0.76 and 0.76 in FP treatment

The yield was higher in BIPM (4298 kg/ha than FP plots (2540 kg/ha) **(Table 2.67)**. The egg parasitisation of stem borers was assessed and a mean egg mass parasitisation of 50.00 % observed in BIPM plot was on par with 46.25% in FP plots. Three parasitoids were observed *viz.*, *Tetrastichus*, *Telenomus* and *Trichogramma*, each accounting for 32.8, 33.47 and 33.65 per cent respectively.

Bio intensive pest management trial was initiated to explore the feasibility of bio-intensive approaches for managing pests for organic rice cultivation. The trial was conducted in 13 locations this year. Low pest incidence was observed in Bapatla, Karjat, Karaikal, Ludhiana and Ranchi. Pests such as stem borer incidence was reduced in BIPM plots as in Chinsurah (14.17%), Masodha (19.61 and Titabar (1.55 %) as compared to farmers practice where it was 25.25, 25.10, 30.22 and 8.08 % respectively. Pests such as leaffolder, whorl maggot and caseworm were also reduced in BIPM plots at Masodha and Titabar. The natural enemies such as spiders and coccinellids were higher in BIPM plots at Chinsurah, Gangavati, Ludhiana, Moncompu, Masodha and Titabar. In Jagdalpur, Moncompu and Raipur, the pest incidence was on par with that of Farmers' practice. Yields were higher in BIPM practices at Gangavati, Karjat, Moncompu, Masodha and Titabar indicating the economic sustainability of BIPM interventions.

2.6 INTEGRATED PEST MANAGEMENT STUDIES

Integrated Pest Management Special Trial (IPMs)

In recent years, intensive cultivation of rice has led to the frequent occurrence of biotic stresses as major constraints in rice production resulting in 25-30% yield losses. Integrated management of theses biotic stresses including insect pests, diseases and weeds in a holistic way is of major concern to the farmers. Though the concept of IPM is old and widely accepted by all the stakeholders, implementation at farmers' level is limited. IPM implementation involves certain skills and knowledge for taking decisions and selecting IPM options for the sustainable management of pests. In order to overcome these limitations, participatory IPMs trial was continued in collaboration with agronomists and plant pathologists with an objective to validate IPM practices from a basket of options available and demonstrate to farmers the management of pests encompassing insects, diseases and weeds, in a holistic way.

During *Kharif* 2021, IPMs trial was conducted zone-wise in 19 locations in 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 here:

Zone I – Hilly areas

Himachal Pradesh, Malan: In Zone I, IPMs trial was conducted in Sri Santokh Singh's field at Hatwas village, Kangra district, Himachal Pradesh State. HPR 2880 was grown in IPM field and Jheni, a local variety was grown in FP plot. Incidence of hispa was above ETL starting from 15 DAT onwards in FP plot and increased with crop growth reaching maximum damage (29.17%HDL) at 71 DAT. In IPM plot, hispa damage increased till 57 DAT (25.14% HDL) and later decreased due to IPM interventions (**Fig 2.11**). Dead hearts caused by black beetle was significantly higher in FP plot (51.72%) compared to IPM plot (23.03%). The dry weed biomass was lower in IPM implemented fields by 5.67 and 50.08% respectively (**Table 2.68**). High grain yield was recorded in IPM plot (34.48 q/ ha) resulting in higher gross returns and BC ratio compared to farmers' practices (**Table 2.69**).

Table 2.68: Practices followed in IPMs trial at Malan, *Kharif* 2021

	IPM Practices	Farmers Practices
Area	10 ha	10 ha
Variety	HPR 2880	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

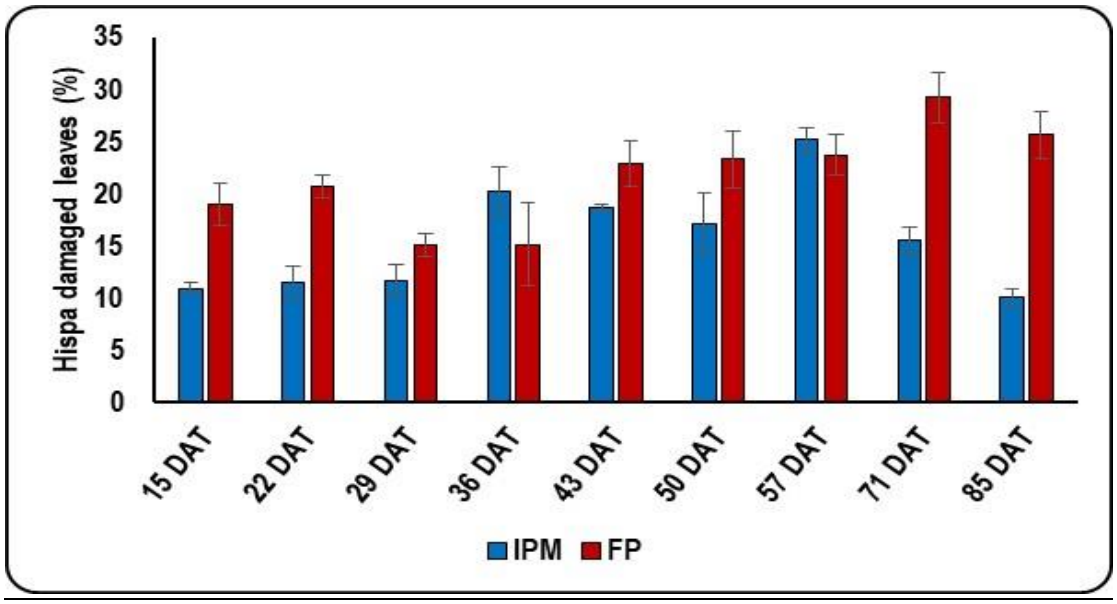


Fig 2.11: Incidence of Hispa in IPMs trial at Malan, *Kharif* 2021

Table 2.69: Pest incidence, grain yield and BC ratio in IPMs trial at Malan, *Kharif* 2021

Treatments	% DH due to black beetle	% HDL	Weed population (No./m2)		Weed dry biomass (g/m2)		Yield (kg/ ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC Ratio
	29DAT	71DAT	Veg stage	PI stage	Veg stage	PI stage					
IPM	23.03 ± 2.95	15.45± 1.26	16.1	15.4	18.3	17.6	3448± 170	62064	45861	16203	1.35
FP	51.72 ± 7.38	29.17± 2.40	28.6	50.8	17.3	35.3	2136 ± 48	38448	34686	3762	1.11

Price of Paddy = Rs. 1800/q

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	Rasina/Kaithal	Sri. Mohinder singh
2	Haryana	Kaul	Sambi/Karnal	Sri Ram Kumar
3	Haryana	Kaul	Kaul/Kaithal	Sri Pardeep Kumar
4	Punjab	Ludhiana	Sudhar/Ludhiana	Sri Inderjeet Singh
5	Uttarakhand	Pantnagar	Durgapuri No-1, Dineshpur/Udham Singh Nagar	Sri Dileep Mandal
6	Uttarakhand	Pantnagar	Panchananpur, Dineshpur/Udham Singh Nagar	Sri Prabhash Sarkar
7	Uttarakhand	Pantnagar	Panchananpur, Dineshpur/Udham Singh Nagar	Sri Prakash Sarkar

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

Table 2.70: Practices followed in IPMs trial in Zone II (Northern areas*), Kharif* 2021

Practices followed in IPMs trial at Kaul, *Kharif* 2021		
1) Sri Mohinder Singh, village – Rasina, Kaithal district, Haryana 2) Sri Ram Kumar, village – Sambhi, Karnal district, Haryana 3) Sri Pardeep Kumar, village – Kaul, 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 @ 600 ml/ acre • Release of Trichogramma chilonis @ 40000/ acre, 3-4 times starting at 31 DAT • Installation of bird perches @ 10/ acre • Mid-season drainage of field • Sprayed Flubendiamide 20 WG @ 50 g/ acre • Applied Lustre (flusilazole + carbendazim) @ 400 ml/ acre for sheath blight control • Sprayed Propiconazole @ 1 ml/ liter water • Application of Triflumezopyrim 10 SC @ 94 ml/ acre at 55 DAT • Applied streptocycline @15 g/ha + copper oxicloride @ 500g/ha	• Application of 150 kg urea as top dressing • Application of Pretilachlor @ 600 ml/ acre • Application of cartap hydrochloride @ 10 kg/ acre • Applied Streptocycline @ 15g/ha + Copper oxycloride @ 500g/ha • Two sprays of Buprofezin @ 330 ml per acre • Spray of 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* 2021		
4) Sri Inderjeet Singh, village Sudhar, Ludhiana district, Punjab		
Area	Half acre	Half acre
Variety	PR 121	PR 121
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 marigold, soybean, cowpea, moong, sesamum on bunds • Water management for planthoppers	• Applied urea 120 kg and zinc sulphate 25 kg/ acre • Application of Butachlor @ 1.2 L/ acre • Application of Mortar @ 170 g/ acre • Sprayed imidacloprid (Confidor) 17.8 SL @ 40 ml/ acre • Sprayed Tilt + Nativo (tebuconazole and trifloxystrobin) @ 200 + 80 ml/ acre
Practices followed in IPMs trial at Pantnagar, *Kharif* 2021		
5) Sri Dileep Mandal, 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/ ha, urea @ 120 kg/ 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 @ 1.5 L/ 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; Propiconazole 25%EC @ 1 ml/liter water • Installed pheromone traps for YSB @ 8/ ha	• Application of Pretilachlor 50 EC @ 1.5 liter/ ha; Nominee gold @ 200 ml/ ha • Applied Fertera (chlorantraniliprole) @ 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(Tilt) @ 500 ml/ha
6) 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 Pretilachlor @ 1.5 L/ 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, Biozyme granules @ 10 kg/ ha • Applied Pretilachlor @1.5 liter/ha, Nominee gold (bispyribac sodium) 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
7) Sri Prakash Sarkar, 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 and Urea 120 kg • Application of Pretilachlor @ 1.5 L/ 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 • 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 @ 500 ml/ha

Incidence of stem borer, leaf folder, BPH, WBPH, leaf blast, neck blast, bacterial leaf blight (BLB), sheath blight, false smut and brown spot was observed in both IPM and FP plots in all the farmer's fields in this zone. The incidence of dead hearts, leaf folder and BPH was significantly low in IPM plot as compared to FP plot while WBPH was low in FP plot across farmers (**Table 2.71 & Fig 2.12).** Leaf folder damage was significantly less in all the FP plots in three farmers' fields at Kaul (23.2–25.3%) compared to IPM plots (2.4–2.6%). Similarly, FP plots also showed higher population of BPH (62.9–78.5/5 hills) than that of IPM plots (18.5–22.1/5 hills). Adoption of IPM practices effectively reduced the disease progression of leaf blast (148), BLB (17), sheath blight (94, 237) and brown spot (26) when compared to farmers' practices (**Table 2.72**). Incidence of neck blast and false smut was at par in both

IPM and FP plots. The weed population at active vegetative stage and panicle initiation stage in IPM plots was lower than farmers' practice by 100% and 50%, respectively at Kaul. Grain yield was significantly high in IPM plots in all the locations resulting in higher gross returns and BC ratio (**Table 2.73).**

Table 2.71: Insect Pest incidence in IPMs trial in Zone II (Northern), *Kharif* 2021

Treatments			% DH/WE	% LFDL	BPH (No./5hills)	WBPH (No. /5hills	Yield kg/ha
T1 = IPM			5.1(2.9)b	2.0(1.9)b	17.8(3.7)b	12.3(6.2)a	5250.1(38.3)a
T2 = FP			7.7(4.6)a	11.5(6.9)a	39.8(6.9)a	10.7(5.2)b	4784.3(35.1)b
LSD(0.05,216 df)			0.24	0.21	0.28	0.42	145
DAT							
D1 = 50 DAT			6.7(3.2)c	7.3(5.3)a	34.3(5.7)b	9.4(4.7)b	
D2 = 64 DAT			6.6(3.6)b	8.3(5.5)a	35.2(6.7)a	13.6(6.7)a	
D3 = 85 DAT			6.5(3.9)ab	7.1(4.3)b	16.9(3.5)c		
D4 = 99 DAT			6.0(3.9)ab	5.8(3.6)c			
D5 = 113 DAT			6.2(4.1)a	5.3(3.4)c			
LSD(0.05,216 df)			0.39	0.34	0.34	0.42	
Farmer							
KUL	F1 = Mohinder Singh	IPM	4.6(2.5)	2.4(0.8)	21.2(2.7)	19.5(12.4)	3848(16)
		FP	7.5(4.0)	25.3(9.0)	62.9(8.1)	22.1(14.0)	3272(13)
KUL	F2 = Ram Kumar	IPM	3.9(3.2)	2.4(0.9)	18.5(2.6)	15.0(3.9)	3952(8)
		FP	6.6(5.5)	23.8(9.3)	69.8(9.8)	20.0(5.1)	3328(7)
KUL	F3 = Pardeep Kumar	IPM	4.6(4.1)	2.6(1.4)	22.6(1.8)	21.2(5.2)	3728(9)
		FP	7.9(7.2)	23.2(12.7)	78.5(6.3)	23.0(5.6)	3216(7)
LDN	F4 = Inderjeet Singh	IPM	3.7(4.7)	5.1(6.4)	12.9(8.1)	23.4(11.5)	7200(45)
		FP	5.5(4.0)	6.3(7.9)	16.7(10.4)	3.4(1.7)	6980(44)
PNT	F5 = Dileep Mandal	IPM	6.2(2.3)	0.2(0.8)	15.5(4.1)	2.7(1.6)	5833(25)
		FP	8.9(3.3)	0.3(1.3)	14.7(3.9)	2.6(1.6)	5472(23)
PNT	F6 = Prabhash Sarkar	IPM	7.9(2.8)	0.7(1.2)	13.2(2.8)	2.6(2.6)	6190(129)
		FP	9.7(3.5)	0.8(1.3)	13.7(2.9)	3.1(3.1)	5647(118)
PNT	F7 = Prakash sarkar	IPM	5.0 (6.0)	0.7(1.2)	20.5(5.2)	1.5(1.3)	5999(37)
		FP	7.7(7.1)	0.9(1.4)	22.1(1.8)	0.5(1.1)	5575(34)

Table 2.72: Severity of rice diseases in Zone II (Northern), *Kharif* – 2021

Farmer	Treatments	Area Under Disease Progressive Curve (AUDPC) Values						
		Pantnagar				Kaul		
		Leaf Blast	Neck blast	BLB	Sheath blight	Sheath blight	False smut	Brown spot
F 1	IPM	157	25	13	96	204	12	26
	FP	204	26	27	142	428	15	68
F2	IPM	142	24	18	88	226	13	26
	FP	180	19	23	117	374	16	66
F 3	IPM	146	27	20	98	280	12	26
	FP	180	25	25	124	444	16	75
IPM		**148**	**25**	**17**	**94**	**237**	**12**	**26**
FP		**188**	**23**	**25**	**128**	**415**	**16**	**70**

Table 2.73: Returns and BC ratio in IPMs trial in Zone II (Northern), *Kharif* 2021

Location	Farmers	Treatments	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
KUL	F1- Sri Mohinder Singh	IPM	38.48	148725	50200	98525	2.96
		FP	32.72	126463	53500	72963	2.36
KUL	F2 - Sri Ram Kumar	IPM	39.52	159898	50450	109448	3.17
		FP	33.28	134651	54000	80651	2.49
KUL	F3- Sri Pardeep Kumar	IPM	37.28	146883	49700	97183	2.96
		FP	32.16	126710	51625	75085	2.45
LDN	F4 - Sri Inderjeet Singh	IPM	72.00	134496	40970	93526	3.28
		FP	69.80	130386	44960	85426	2.90
	IPM		**46.82**	**147500**	**47830**	**99670**	**3.09**
	FP		**41.99**	**129552**	**51021**	**78531**	**2.55**

Price of Paddy: F1 = Rs.3865/q; F2 = Rs. 4046/q; F3 = Rs. 3940/q; F4 = Rs. 1868/q;

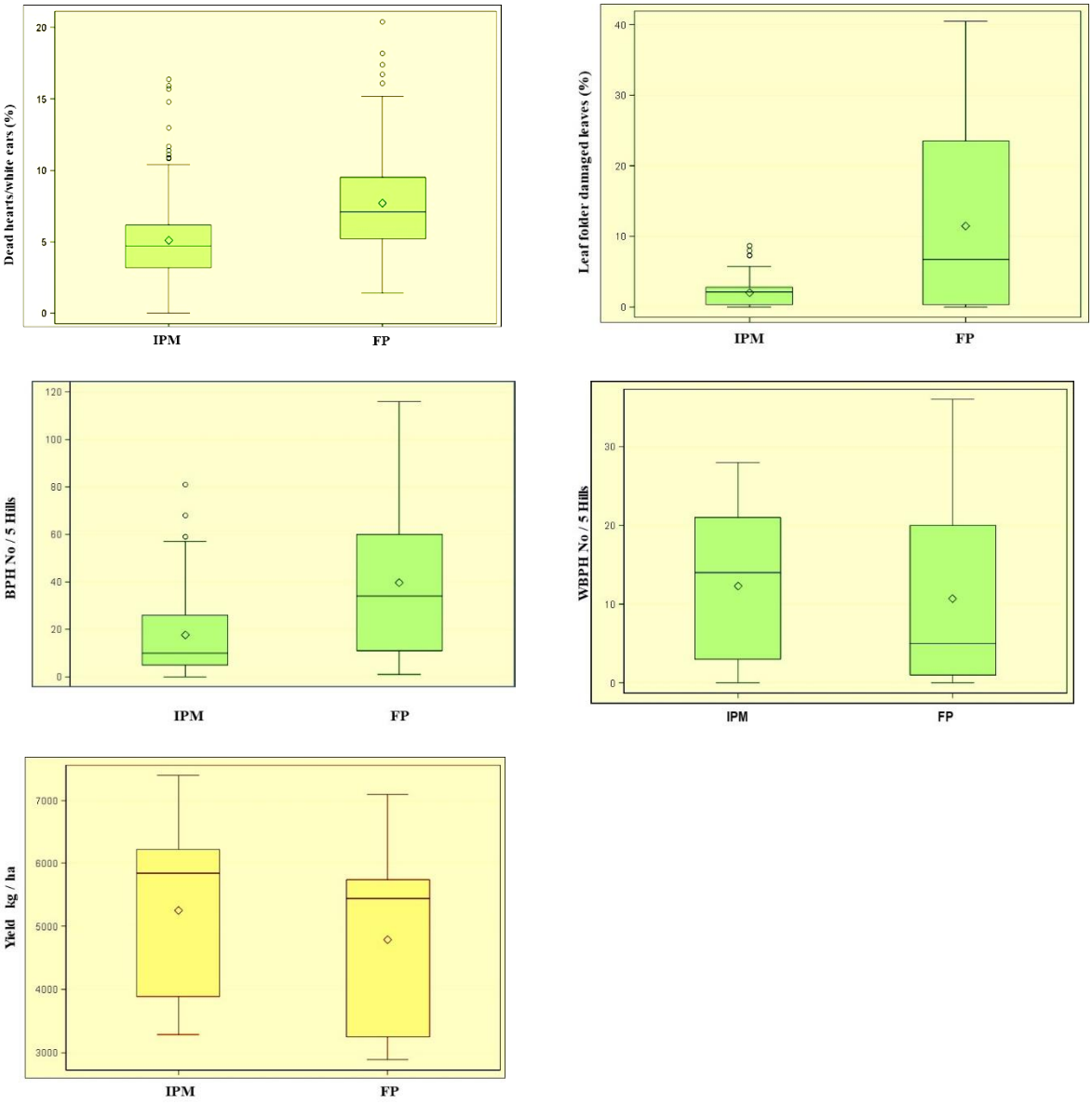


Fig 2.12: Incidence of dead hearts, leaf folder damage, BPH, WBPH and grain yield in IPM and FP plots across locations in Zone II (Northern)

Zone III – Eastern areas

IPMs trial was conducted in four farmer's fields at 4 locations and details are given below:

S. No	State	Location	Village/district	Farmer Name
1	Odisha	Sambalpur	Garmunda/ Sambalpur	Sri. Tarakanta Pradhan
2	West Bengal	Chinsurah	Bele, Radhanagar, Pandua block/Hooghly	Sri Narayan Chandra Mondal
3	Uttar Pradesh	Masodha	Jhopiya, Tapeshipah, Namipur Siroli/ Jarwal/ Bahraich	Sri Ram Narayan
4	Bihar	PSAa	Sanapur, Singhwara block/Darbhanga	Sri Ramsagar Bhagat

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

Table 2.74. Practices followed in IPMs trial in Zone III (Eastern areas), *Kharif* 2021

Practices followed in IPMs trial at Chiplima, *Kharif* 2021		
	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. • Application of Ferterra (chlorantraniliprole)@4kg/ acre • Fertilizers (NPK) applied @ 100:50:50. • Applied NeemAzal @ 2 ml/ liter water at 40 DAT • Sprayed Kasugamycin 3 SL @ 1000 ml/ha at 50 DAT for blast management • Applied Rynaxypyr (chlorantraniliprole) 20 SC @ 150 ml /ha at 55 DAT • 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 Acephate 75 SP @ 1000 g /ha at 40 DAT • Sprayed Cartap hydrochloride 50 SP @ 750 g/ha at 55 DAT • Sprayed validamycin 3 SL @ 1500 ml/ha at 55 DAT • Sprayed Fipronil 5 SC @ 1500 ml /ha at 65 DAT • Sprayed Dinotefuran 20SG@250g/ha at 70 DAT
Practices followed in IPMs trial at Chinsurah, *Kharif* 2021		
Area/ variety	1 acre; Swarna	1 acre; Swarna
Nursery	• Application of 8 kg of 10:26:28 complex • Application of mustard cake @ 3 kg	• Application of mustard cake @ 3 kg
Main field	• Application of 105:100:27 kg urea, SSP & MOP • 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 80 kg10-26-26; Urea 40 kg • Hand weeding two times • 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* 2021		
Area	5 acre	5 acre
Variety	NDGR 201	NDGR 201
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: ZnSo4 and 10 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.	• Applied 150:40 N: P and 5 t/ha FYM • Applied Nominigold @ 100 ml/ acre

	• 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	
Practices followed in IPMs trial at PSAa, *Kharif* 2021		
Area	1 acre	1 acre
Variety	Rajendra Mahsuri	Rajendra Mahsuri
Main Field	• Seed treatment with Carbendazim @ 2 g/ kg seed • Transplanting at 20 x 15 cm spacing • Application of RDF • Application of Butachlor @ 1.5 kg ai/ ha after one week of transplantation • 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

Incidence of stem borer, gall midge, leaf folder, BPH, leaf blast, neck blast, BLB and sheath blight was recorded in both IPM and FP plots at all the farmers' fields **(Table 2.75)**. Incidence of dead hearts and white ears caused by stem borer, gall midge and leaf folder was significantly high in farmers' practices across the locations whereas BPH incidence was low and at par in both the IPM and FP plots (**Fig 2.13)**.

Table 2.75: Insect Pest incidence in IPMs trial in Zone III (Eastern), *Kharif* 2021

Treatments			**%DH/WE**	**%SS**	**%LFDL**	**BPH (No./ 5hills)**	**Yield kg/ha**
IPM			2.0(2.1)b	0.4(0.2)b	2.1(2.7)b	9.9(4.1)a	5366.8(19.8)a
FP			6.5(5.3)a	8.3(6.8)a	6.2(7.5)a	8.3(3.5)a	4185.2(15.9)b
LSD (0.05,112)			**0.31**	**0.52**	**0.45**	**0.97**	**280.13**
DAT							
D1 = 29/30 DAT			4.6(4.1)a	2.9(2.6)b	4.4(5.3)ab	13.1(5.4)a	
D2 = 43/50 DAT			4.3(4.1)a	4.9(3.9)a	4.3(5.3)a	5.1(2.1)b	
D3 = 71 DAT			4.7(4.3)a	5.3(3.9)a	3.7(4.7)b		
D4 = Pre har			3.3(2.3)b				
LSD (0.05,112)			**0.44**	**0.63**	**0.56**	**0.97**	
Location	**Farmer**						
SBP	**F1 = Sri Tarakanta Pradhan**	**IPM**	0.5(0.7)	0.8(0.4)		9.9(4.1)	5120.0(20.7)
		FP	2.0(2.7)	8.7(3.8)		8.3(3.5)	4480.0(18.1)
CHN	**F2 = Sri Narayan Chandra Mondal**	**IPM**	0.5(0.3)	0.0(0.0)	0.2(0.2)		4937.6(9.8)
		FP	8.5(5.3)	8.0(9.9)	1.1(1.1)		3658.4(7.2)
MSD	**F3 = Sri Ram Narayan**	**IPM**	2.6(1.1)		1.1(0.9)		5680.8(13.1)
		FP	8.4(3.6)		4.6(3.9)		3940.8(9.1)
PSA	**F4 = Sri Ramsagar Bhagat**	**IPM**	4.4(6.0)		5.1(7.1)		5728.8(35.7)
		FP	7.0(9.7)		12.7(17.6)		4661.6(29.1)

Adoption of IPM Practices like spraying of Kasugamycin 3%SL@ 2ml/l at Chiplima, reduced the leaf blast disease severity up to 10.67 % (60 DAT) as compared to farmers' practices (without the fungicide spray) where in the disease severity was 37.33%. Significant reduction in the disease progression of neck blast, bacterial blight and sheath blight was recorded at Masodha. Adoption of IPM practices reduced the AUDPC value of 172 to 35; 246 to 53 and 239 to 65 in

diseases *viz.*, neck blast, bacterial blight and sheath blight, respectively **(Table 2.75)**.

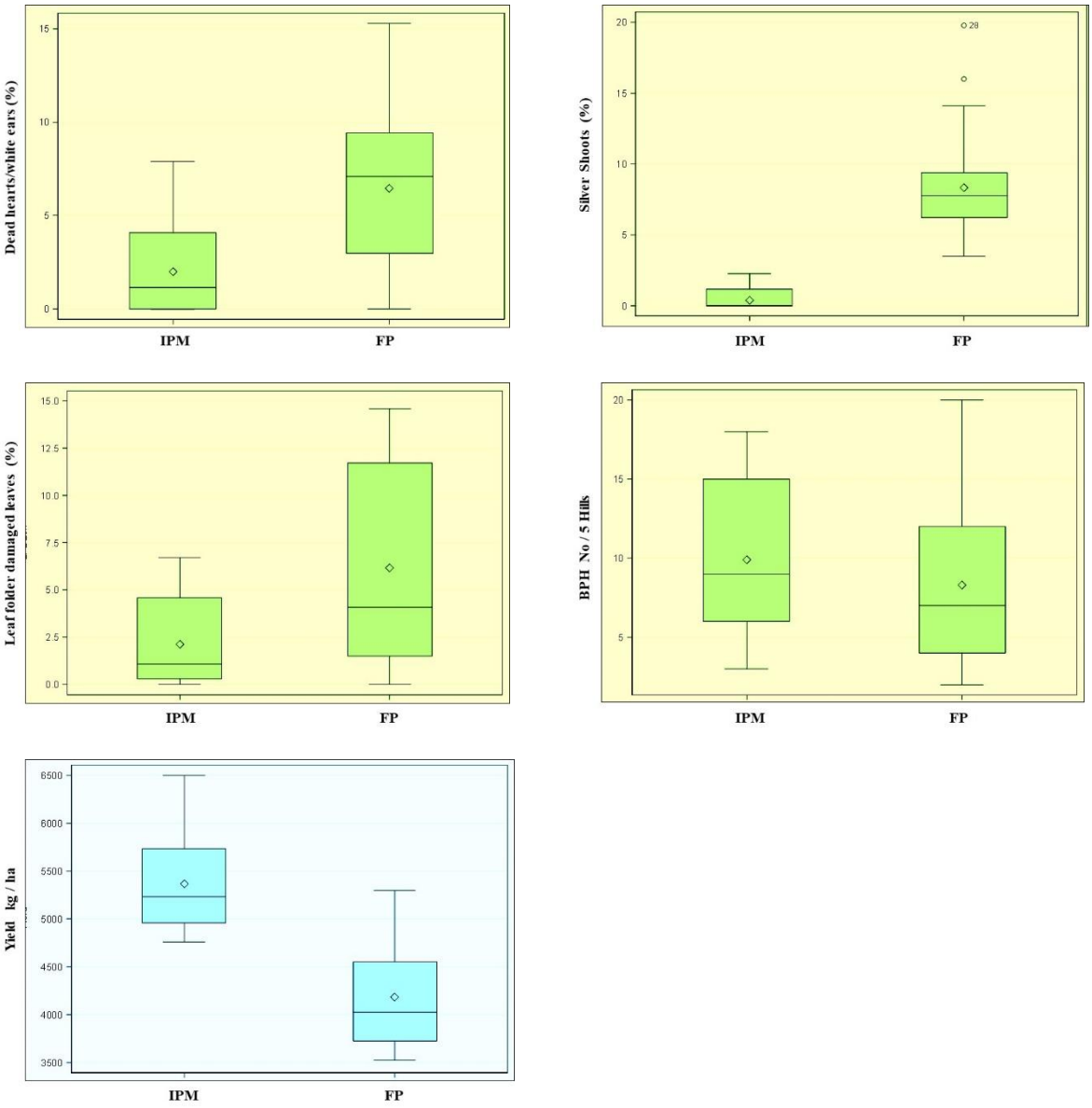


Fig 2.13: Incidence of dead hearts, gall midge, leaf folder, BPH, and grain yield in IPM and FP plots across locations in Zone III (Eastern)

The weed population at active vegetative stage and panicle initiation stage in IPM plots (21.69 & 32.02) was lower than farmers' practices (36.78 & 48.19), respectively. The dry weed biomass also was lower in IPM implemented fields at both the stages **(Table 2.76)**. In the Eastern zone, yield advantage of 24.87% was recorded in IPM implemented fields. The weed population was reduced by 41.02% at active vegetative stage and 33.55% at panicle initiation stage respectively in IPM

fields. The reduction in weed biomass was 31.55% at active vegetative stage and 25.29% at panicle initiation stage.

Grain yield was significantly high in IPM plots than in FP plots across the locations. High gross returns and lower cost of cultivation resulted in superior BC ratio in IPM fields as compared to farmers' practices at all the locations (**Table 2.77**).

Table 2.76: AUDPC values based on disease severity (%) and weed parameters in Zone III (Eastern), *Kharif* 2021

Treatments	Chiplima		Masodha			Weed population (No./m2)		Weed biomass (g/m2)	
	Leaf Blast – Disease severity (%)		AUDPC Values						
	45 DAT	60 DAT	Neck blast	BLB	Sheath blight	Veg stage	PI stage	Veg stage	PI stage
IPM	15.56	10.67	35	53	65	21.69	32.02	8.09	10.63
FP	31.11	37.33	172	246	239	36.78	48.19	11.82	14.23

Table 2.77: Returns and BC ratio in IPMs trial in Zone III (Eastern), *Kharif* 2021

Location	Treatments	Yield (q/ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs)	Net Returns (Rs.)	BC Ratio
CHP	IPM	51.30	99522	48820	50702	2.04
CHP	FP	44.50	86330	46718	39612	1.85
CHN	IPM	49.38	86415	55738	30677	1.55
CHN	FP	36.58	64015	53025	10990	1.21
MSD	IPM	56.80	110192	53200	56992	2.07
MSD	FP	39.40	76436	50310	26126	1.52
PSA	IPM	57.29	111143	39840	71303	2.79
PSA	FP	46.62	90443	35100	55343	2.58

Price of paddy: CHP, MSD & PSA = 1940 Rs/ q; CHN = 1750 Rs/ 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.

Practices followed in IPMs trial at Titabar in Zone IV (North Esatern), *Kharif* 2021

	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 • Placed tricho cards for stem borer and leaffolder management • Sprayed fresh cowdung solution @250g/L water at mid tillering stage against BLB	• Fertilizer application @ 60,20,40 kg NPK/ha • Manual weeding done two times

Low incidence of stem borer, gall midge, leaf folder, whorl maggot and GLH was observed in both IPM and FP plots **(Table 2.78 & Fig 2.14)**. Significant reduction in weed population (42.60%) and weed biomass (38.6%) at panicle initiation stage in IPM fields with variety Ranjit Sub1 was reported in this zone. Bacterial blight disease severity was reduced to 20.22 % in case of IPM adopted practices while it was 33.27% in farmer practices. Similar trend was observed in case of sheath blight also, where in 18.44% of disease severity was recorded in the IPM practices adopted field as against 30.59% in the Famers practices adopted field **(Table 2.79)**. However, grain yield was relatively high in IPM plot resulting in high net returns and better BC ratio (1.82) as against FP plot (1.62) **(Table 2.80)**.

Table 2.78: Insect pest incidence in IPMs trial at Titabar in Zone IV (North Eastern), *Kharif* 2021

Treatments	% DH		% WE	% SS	%LFDL	% WMDL	GLH (No. / 5 hills)
	22 DAT	50 DAT	Preharvest	50 DAT	22 DAT	57 DAT	71 DAT
IPM	7.8 ± 3.3	3.4 ± 0.6	1.8 ± 0.5	2.4 ± 0.8	8.2 ± 2.4	1.9 ± 0.6	7.0 ± 0.2
FP	11.9 ± 2.1	7.4 ± 0.8	8.7 ± 1.1	4.7 ± 0.8	7.4 ± 1.1	6.0 ± 0.6	13.0 ± 0.2

Table 2.79: Weed population and disease severity in Zone IV (North Eastern), *Kharif* 2021

Treatments	Weed population (No./m2)	Weed biomass (g/m2)	Disease severity (%)	
			BLB	Sheath blight
IPM	38.8	18.42	20.22	18.44
FP	67.6	30.00	33.27	30.59

Table 2.80: Gross returns and BC ratio in IPMs trial at Titabar, *Kharif* 2021

Treatments	Yield (Q/Ha)	Gross Returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC ratio
IPM	44.01	83619	46000	37619	1.82
FP	35.02	66538	41000	25538	1.62

Price of paddy = Rs. 1900/q

Zone V – Central areas

In this zone, IPMs trial was conducted at three farmer's fields each in two locations 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

Incidence of stem borer, leaf folder, whorl maggot, hispa, caseworm, thrips BPH, WBPH, GLH, leaf blast, neck blast and sheath blight was reported from all the locations **(Table 2.82)**. Thrips incidence was significantly high in farmer practices plots (12.9% RTDL) compared to IPM plots (8.9% RTHDL) across locations **(Fig 2.14).** BPH population was also found significantly higher in FP plots (30.1 hoppers/5 hills) than in IPM plots (4.7 hoppers/ 5hills). In general, the disease

progress was significantly lower in the experimental plots where IPM practices were followed compared to the farmers' practices. The AUDPC values for leaf blast were significantly low in IPM plots (256) compared to FP plots (1220). Similar trend was observed with respect to neck blast and sheath blight with low values in IPM practices **(Table 2.83).**

Table 2.81 Practices followed in IPMs trial at Zone V (Central), *Kharif* 2021

Practices followed by three farmers at Jagdalpur		
	IPM Practices	**Farmers Practices**
Area	1 acre each farmer	1 acre each farmer
Variety	Bamleswari/Safri	Bamleswari/Safri
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 80:50:30 kg NPK per hectare • 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 80 kg N, 50 kg P & 30 Kg K/ acre • 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	• Mahamaya	• Mahamaya
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 2.82: Insect Pest incidence in IPMs trial in Zone V (Central), *Kharif* 2021

Treatments			**%DH/WE**	**% LFDL**	**BPH (No./5hills)**	**%RTDL**	**Yield kg/ha**
T1 = IPM			4.1(3.3)a	1.5(1.5)b	4.7(5.6)b	8.9(2.6)b	4624.8(20.6)a
T2 = FP			8.5(4.6)a	2.7(2.8)a	30.1(36.6)a	12.9(3.7)a	3916.0(17.2)b
LSD (0.05,168)			**1.4**	**0.61**	**5.29**	**0.37**	**128.6**
DAT							
D1 = 45 DAT			4.7(3.4)a	1.7(2.3)a	24.8(30.0)a	10.5(3.1)a	
D2 = 75 DAT			6.0(3.2)a	1.9(2.2)a	18.1(21.8)b	11.2(3.2)a	
D3 = 95 DAT			7.8(4.9)a	2.6(1.9)a	17.0(20.6)b		
D4 = 105 DAT			6.7(4.1)a		9.8(11.9)c		
LSD (0.05,168)			**1.99**	**0.75**	**7.48**	**0.37**	
Location	**Farmer**						
JDP	F1 = Sri Sonu Kashyap	IPM	3.5(1.2)	1.7(2.4)		8.9(3.2)	4673.6(35.3)
		FP	8.2(2.9)	4.1(5.6)		13.0(4.6)	3844.0(29.1)
JDP	F2 = Sri Lachin Kashyap	IPM	4.2(0.9)	2.5(1.6)		9.3(2.0)	4155.2(16.6)
		FP	18.3(4.0)	4.4(2.8)		13.7(3.0)	3436.0(13.7)
JDP	F3 = Sri Sonsingh Nisad	IPM	4.6(1.3)	2.4(1.0)		8.5(2.5)	4102.4(20.2)
		FP	9.8(2.9)	3.7(1.6)		11.8(3.5)	3516.0(17.3)
RPR	F4 = Sri Bhagwat Prasad	IPM	4.1(5.7)	0.4(0.6)	4.5(6.2)		5568.0(10.1)
		FP	4.8(6.7)	1.3(1.7)	30.2(41.7)		4868.0(8.8)
RPR	F5 = Sri Yogendra Yadav	IPM	4.7(9.7)	0.8(1.7)	4.8(9.7)		
		FP	4.8(9.9)	1.3(2.6)	30.2(61.8)		
RPR	F6 = Sri Vedprakash Yadav	IPM	3.4(0.7)	0.8(1.5)	5.0(1.0)		
		FP	4.8(1.0)	1.3(2.3)	30.2(6.2)		

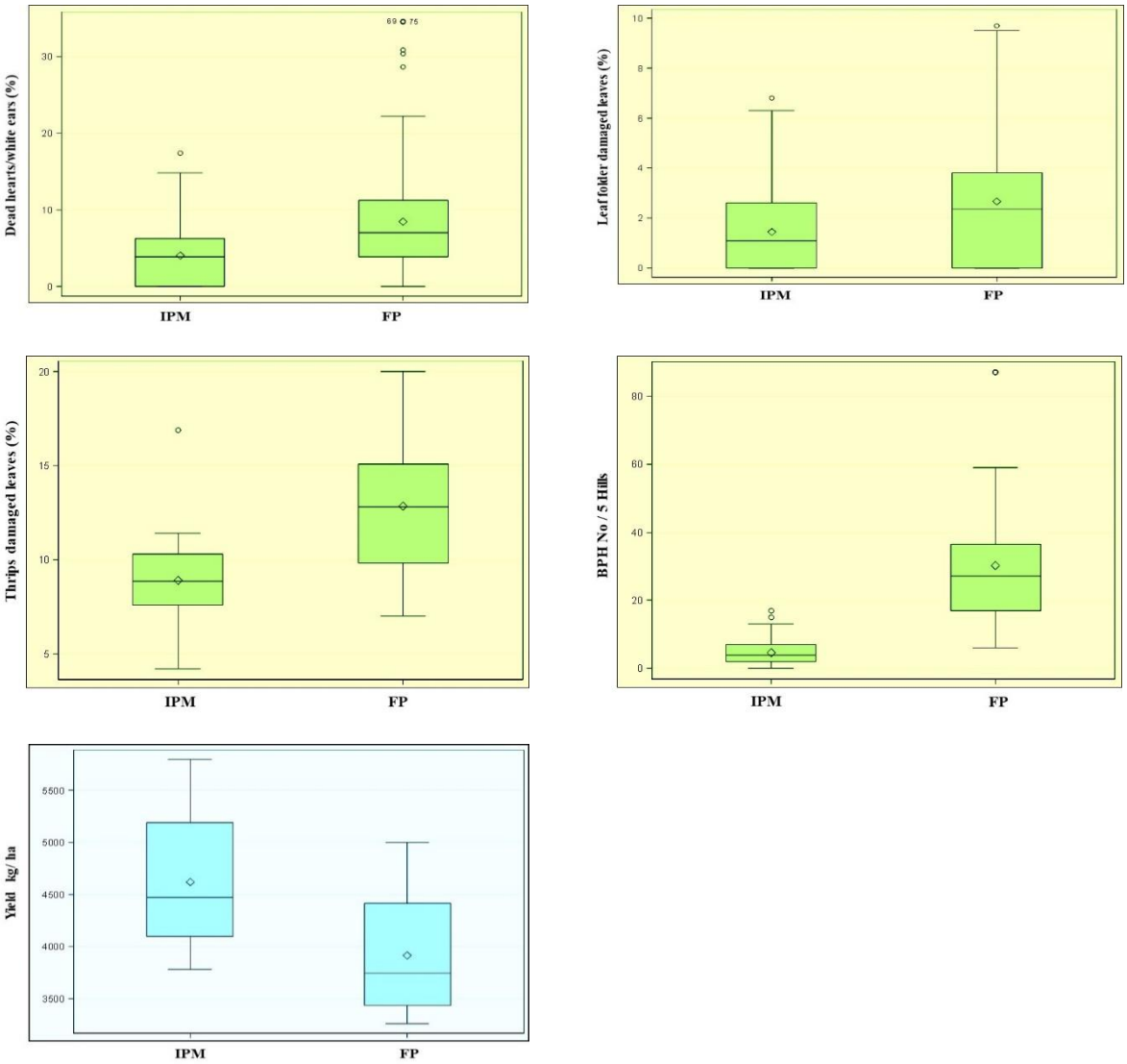


Fig 2.14: Incidence of stem borer, gall midge, leaf folder, thrips, BPH, and grain yield in IPM and FP plots across locations in Zone V (Central)

Table 2.83: AUDPC values based on disease severity (%) in Zone V (Central), *Kharif* – 2021

Farmer	Treatment	AUDPC Values		
		Leaf Blast	Neck blast	Sheath blight
F 1	IPM	264	147	273
	FP	1245	710	807
F2	IPM	273	164	279
	FP	1326	695	894
F3	IPM	231	152	246
	FP	1089	729	1011
IPM		**256**	**154**	**266**
FP		**1220**	**711**	**904**

The weed population was recorded at active vegetative stage only. In this zone, in IPM plots, the weed population was lower than farmers practice by 56.91%. Grain

yield was significantly high in IPM plots resulting in higher gross returns and better BC ratio **(Table 2.84)**.

Table 2.84: Returns and BC ratio in IPMs trial at Zone V (Central), *kharif* 2021

Name of the Farmer	Treatments	Yield (q/ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC ratio
F1 = Sri Sonu Kashyap	IPM	46.74	98154	20750	77404	4.73
	FP	38.44	80724	26750	53974	3.02
F2 = Sri Lachhin Kashyap	IPM	41.55	87255	20750	66505	4.21
	FP	34.36	72156	27500	44656	2.62
F3 = Sri Sonsingh Nisad	IPM	41.02	86142	20750	65392	4.15
	FP	35.16	73836	27500	46336	2.68
F4 = Sri Bhagwat Prasad	IPM	55.68	108019	39700	68319	2.72
	FP	48.68	94439	43375	51064	2.18

Price of Paddy = F1, F2 & F3 = Rs. 2100/q; F4 = Rs. 1940/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	Halivali/raigad	F1- Sri Tukaram Raghunath Shinde
2	Maharashtra	Karjat	Kiravli/Raigad	F2 - Sri Govind Badekar
3	Maharashtra	Karjat	Kiravli/Raigad	F3- Sri Shantaram Bhoir
4	Maharashtra	Sakoli	Dharmapuri/Sakoli tahsil/ Bhandara	F4- Sri Damunath Thakare
5	Maharashtra	Sakoli	Dharmapuri/Sakoli tahsil/ Bhandara	F5 - Sri Lukaram Fattu Karkate
6	Maharashtra	Sakoli	Dharmapuri/Sakoli tahsil/ Bhandara	F6 - Sri Nitaram Bhendarkar
7	Gujarat	Nawagam	Nawagam/ Kheda	F7 - Sri Shaileshbhai Bhulabhai Patel
8	Gujarat	Nawagam	Kathwada/ Kheda	F8 - Sri Vipulbhai Jayantibhai Bharwad
9	Gujarat	Nawagam	Kathwada/ Kheda	F9 - Sri Chandra-kantbhai Patel

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

Table 2.85: Package of practices followed in IPMs trial in Zone VI (Western), *Kharif* 2021

Practices followed by three farmers in IPMs trial at Karjat, *Kharif* 2021		
	IPM practices	**Farmers practices**
Area	1 acre	1 acre
Varieties	F1- Sri Tukaram Raghunath Shinde – Karjat 3 F2 - Sri Govind Badekar - Karjat 4 F3- Sri Shantaram Bhoir – Karjat 3	
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 in IPMs trial at Sakoli, *Kharif* 2021		
F4) Sri Damunath Thakare, Village: Dharmapuri, Tahsil: Sakoli; Bhandara district, Maharashtra		
Variety	PDKV Tilak	PDKV Tilak
Nursery	• Seed treatment with Trichoderma @ 10 g/kg seed	• Seed treatment with Thirum @ 3g/kg seed

	• Applied 20:20:0:13 complex @ 12.5 kg • Applied fipronil 0.3G @ 25 kg/ha, 5 days before pulling seedlings	• Applied urea – 5 kg
Main field	• Seedlings planted at spacing of 20 x 15 cm • Left alleyways of 30 cm after every 2 m or 10 rows. • Application of 187.5 kg DAP and 62.5 kg urea • Applied Butachlor @ 3 liter/ ha on 5th day after transplanting + 1 manual weeding • Mid-season drainage for BPH management • Applied Chlorantraniliprole (Ferterra) 0.4 G @ 10 kg/ha at 40 DAT • Installation of pheromone traps with 5 mg lure @ 8 traps/ ha for stem borer monitoring • Released Tricho cards @ 40,000/ acre at 36 DAT • Application of Cannon (Chlorpyriphos 50 % + Cypermethrin 5 % @ 1250ml/ ha at 70 DAT	• Seedlings were planted randomly at a spacing of 20 x15 cm • Application of 187.5 kg DAP and 62.5 kg urea • Applied Saathi (Pyrazosulfuron ethyl 10 % WP) @200g/ha at 5th day after transplanting+ 1 manual weeding • Applied Chlorantraniliprole (Ferterra) 0.4 G @ 10 kg/ha at 40 DAT • Application of Cannon (Chlorpyriphos 50 % + Cypermethrin 5 % @ 1250ml/ ha at 70 DAT
F5) Sri Lukaram Fattu Karkate; Village:Dharmapuri,Tahsil: Sakoli; Bhandara district		
Variety	IR 64	IR 64
Nursery	• Seed treatment with Trichoderma @ 10 g/kg seed • Application of fipronil 0.3 G @ 25 kg/ha, 5 days before pulling seedlings	Applied urea @ 10 kg/ ha
Main field	• Seedlings transplanted at spacing of 20 x 15 cm • Alleyways of 30 cm after every 2 m or 10 rows. • Application of 20:20:0:13 @ 125 kg/ ha and Urea 10 kg/ha • Application of Butachlor @ 3 liter. / ha on 5th day after transplanting + 1 manual weeding • Installation of pheromone traps with 5 mg lure @ 3 traps/ acre for stem borer monitoring • Released Tricho cards @ 40,000/ acre at 36 DAT • Mid-season drainage for BPH management	• Seedlings were transplanted randomly • Application of 20:20:0:13 @ 125 kg/ ha and Urea 10 Kg/ha • Applied Eraze (Pretilachlor 50 % EC)@ 1 litre/ha at 5th day after transplanting+ 1 manual weeding
F6) Sri Nitaram Bhendarkar; Village:Dharmapuri,Tahsil: Sakoli; Bhandara district		
Variety	P - 4444	P - 4444
Nursery	• Seed treatment with Trichoderma @ 10 g/kg seed • Applied 18:18:10 complex @ 25 kg/ ha • Applied fipronil 0.3 G @ 25 kg/ha, 5 days before pulling seedlings from nursery	• Seed treatment with Thirum @ 3g/kg seed • Applied 18:18:10 complex @ 25 kg/ha
Main field	• Seedlings transplanted at spacing of 20 x 15 cm • Alleyways of 30 cm after every 2 m or 10 rows. • Application of 20:20:0:13 @ 125 kg/ ha and Urea 10 kg/ha • Application of Butachlor @ 3 liter. / ha on 5th day after transplanting + 1 manual weeding • Installation of pheromone traps with 5 mg lure @ 3 traps/ acre for stem borer monitoring • Released Tricho cards @ 40,000/ acre at 36 DAT • Mid-season drainage for BPH management • Applied fipronil 0.3 G @ 25 kg/ha at 45 DAT • Application of Triflumezopyrium 10 % SC @ 94 ml/ acre	• Seedlings were transplanted randomly • Application DAP @ 125 kg/ ha • One manual weeding • Applied Chlorantraniliprole (Ferterra) 0.4 G @ 10 kg/ha at 45 DAT • Sprayed Flonicamid 50 %WG @150 g/ha at 95 DAT
Practices followed by three farmers in IPMs trial at Nawagam, *Kharif* 2021		
Area	1250 sq.m	1250 sq.m
Variety	Gurjari	Gurjari
Farmers	F7 - Sri Shaileshbhai Bhulabhai Patel F8 - Sri Vipulbhai Jayantibhai Bharwad F9 - Sri Chandra-kantbhai Patel	•
Nursery	• Seed treatment with Trichoderma @ 10 g/kg seed	• Application of Chlorantraniliprole 0.4 GR @ 10

	• Applied fipronil 0.3 G @ 25 kg/ha, 5 days before pulling seedlings from nursery	kg/ha
Main field	• Application of 220 kg urea, 54 kg DAP and 5 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 • Released *Trichogramma japonicum* @ 6 tricho card/ha • 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 220 kg urea, and 5 kg Zinc sulphate • 4-5 seedlings transplanted randomly • Applied Pendimethalin 30% EC @ 50 ml/ 10-liter water + One Hand weeding • Applied Chlorantraniliprole 0.4 GR @ 20 kg/ha

Table 2.86:Insect Pest incidence in IPMs trial in Zone VI (Western), *Kharif* 2021

Treatments			**%DH/WE**	**% LFDL**	**BPH (No. /5 hills)**	**WBPH (No. /5 hills)**	**Yield kg/ha**
T1 = IPM			4.6(2.8)b	1.1(1.6)b	9.1(14.8)b	6.4(10.8)b	3896.0(13.1)a
T2 = FP			5.8(3.4)a	1.4(1.9)a	13.4(21.8)a	11.7(20.3)a	3386.0(11.2)b
LSD (0.05,252)			**0.2**	**0.3**	**1.7**	**1.2**	**99.8**
D1 = 29/30 DAT			3.4(1.8)d	0.9(1.4)b	12.8(21.6)a	6.1(9.3)c	
D2 = 50 DAT			4.5(2.4)c	1.6(2.1)a	9.6(15.0)b	9.3(16.0)b	
D3 = 64 DAT			5.3(3.3)b			11.8(21.3)a	
D4 = 92 DAT			7.7(5.0)a				
LSD (0.05,252)			**0.3**	**0.3**	**1.7**	**1.5**	
Location	**Farmer**						
KJT	F1- Sri Tukaram Raghunath Shinde	IPM	2.8(2.0)	1.2(2.2)			3448.0(26.1)
		FP	3.8(2.7)	1.8(3.2)			2816.8(21.3)
KJT	F2 - Sri Govind Badekar	IPM	3.2(1.0)	2.1(1.6)			3553.6(14.2)
		FP	8.1(2.4)	2.7(2.1)			2833.6(11.3)
KJT	F3- Sri Shantaram Bhoir	IPM	4.4(1.8)	2.0(3.2)			3373.6(16.6)
		FP	4.4(1.8)	1.7(2.7)			2709.6(13.3)
SKL	F4- Sri Damunath Thakare	IPM	3.6(2.1)	0.3(0.6)	2.2(5.5)	0.9(0.4)	5399.2(9.8)
		FP	0.9(0.5)	0.3(0.7)	2.9(7.2)	0.7(0.3)	4919.2(8.9)
SKL	F5 - Sri Lukaram Karkate	IPM	3.0(1.1)	0.4(0.1)	0.0(0.0)	0.6(0.2)	4240.8(6.9)
		FP	5.3(1.9)	1.8(0.6)	0.0(0.0)	1.1(0.3)	4000.0(6.5)
SKL	F6 - Sri Nitaram Bhendarkar	IPM	1.9(1.1)	0.4(0.7)	25.0(39.0)	1.5(0.4)	4441.6(8.4)
		FP	3.3(1.9)	0.6(0.9)	37.3(58.2)	1.1(0.3)	3679.2(6.9)
NWG	F7 - Sri Shaileshbhai Bhulabhai Patel	IPM	7.5(6.0)	1.1(1.9)		7.8(13.6)	3008.0(14.0)
		FP	8.9(7.2)	1.3(2.3)		17.9(31.3)	2752.0(12.8)
NWG	F8 - Sri Vipulbhai Jayantibhai Bharwad	IPM	7.4(4.9)	1.1(2.3)		10.6(23.1)	3600.0(16.7)
		FP	8.5(5.6)	1.2(2.7)		19.8(43.1)	3216.0(15.0)
NWG	F9 - Sri Chandra-kantbhai Patel	IPM	7.8(5.5)	1.1(1.8)		17.3(27.0)	4000.0(5.4)
		FP	9.6(6.7)	1.4(2.2)		29.8(46.6)	3548.0(4.8)

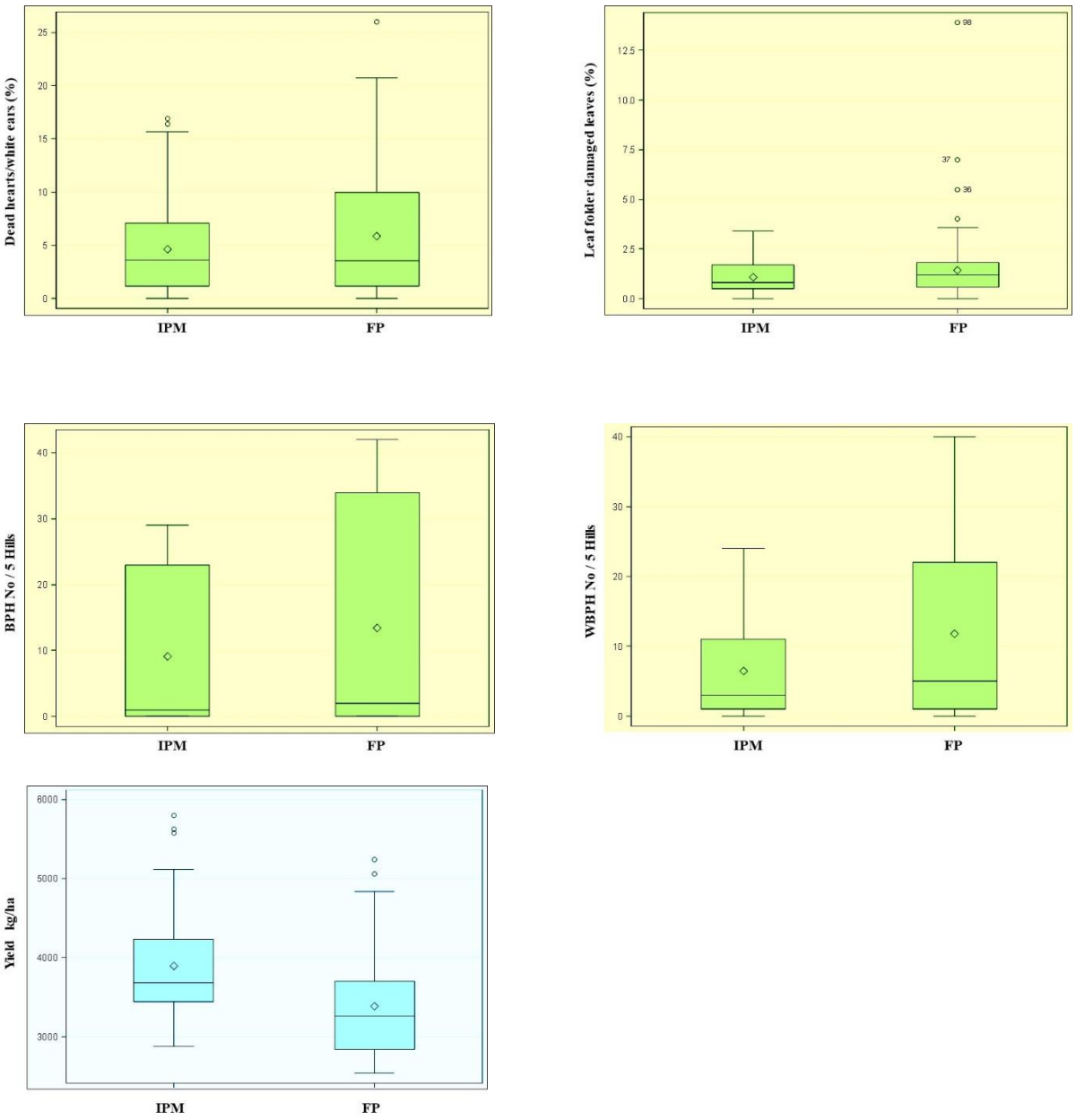


Fig 2.15: Incidence of stem borer, leaf folder, BPH, WBPH and grain yield in IPM and FP plots across locations in Zone VI (Western)

Incidence of stem borer, leaf folder, BPH, WBPH, leaf blast, neck blast, BLB, sheath blight, sheath rot, stem rot, and grain discolouration was observed in this zone. The overall pest incidence was not high in both the treatments across locations in this zone. However, the damage was significantly lower in IPM compared to FP plots **(Table 2.86 & Fig 2.15)**. Adoption of IPM practices resulted in low neck blast, sheath blight, sheath rot and grain discolouration. However, the disease severity was at par in IPM and FP plots with respect to leaf blast, BLB, brown spot, and disease score in case of BLB at Karjat **(Table 2.87)**. The weed population in IPM implemented fields was lower by 53.64% at active vegetative stage and 48.04% at

panicle initiation stage. The reduction in weed dry biomass was 64.84% at active vegetative stage and 55.28% at panicle initiation stages, respectively **(Table 2.88)**. Grain yield was significantly high in IPM plots resulting in high gross returns and high BC ratio across the locations **(Table 2.89)**. The high BC ratio of 2.72 and 2.53 was obtained in the IPM plot and FP plot of farmer 4 at Sakoli (2.72).

Table 2.87: Disease severity (%) and disease score in Zone VI (Western), *Kharif* 2021

Farmer	Treat-ment	Sakoli							Nawagam		Karjat
		AUDPC Values							AUDPC Values		Disease Score
		LB	NB	BLB	BS	SHB	SHR	SR	SHR	GD	BLB
F 1	IPM	47	173	3781	19	418	277	337	106	48	4.6
	FP	93	287	3732	7	215	274	154	131	58	5.0
F2	IPM	22		579	107	337	121	93	113	50	4.6
	FP	0		548	92	379	72	42	125	61	5.0
F2	IPM	197		966	474	835	158	1439	111	51	3.0
	FP	200		1087	532	730	131	1458	127	67	4.6
IPM		**89**	**173**	**1775**	**200**	**530**	**185**	**623**	**110**	**50**	**4.1**
FP		**98**	**287**	**1789**	**210**	**441**	**159**	**551**	**128**	**62**	**4.9**

Table2.88: Weed population and weed biomass in Zone VI (Western), *Kharif* – 2021

Treatments	Weed population (No./m2)		Weed biomass (g/m2)	
	Veg stage	PI stgae	Veg stage	PI stgae
IPM	10.06	13.28	9.71	14.85
FP	21.70	25.56	27.62	33.21

Table 2.89: Returns and BC ratio in IPMs trial at Zone VI (Western), *Kharif* 2021

Loc	Farmers	Treatments	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
KJT	F1- Sri. Tukaram Raghunath Shinde	IPM	34.48	72408	46183	26225	1.57
		FP	28.19	59199	47700	11499	1.24
KJT	F2 - Sri Govind Badekar	IPM	35.54	74634	45437	29197	1.64
		FP	28.34	59514	45250	14264	1.32
KJT	F3 -Shri. Shantaram Bhoir	IPM	33.74	70854	43883	26971	1.61
		FP	27.10	56910	46650	10260	1.22
SKL	F4- Sri. Damunath Thakare	IPM	53.99	118778	43617	75161	2.72
		FP	49.19	108218	42709	65509	2.53
SKL	F5 - Sri. Lakaram Kharkate	IPM	42.41	83124	43243	39881	1.92
		FP	40.00	78400	38698	39702	2.03
SKL	F6 - Nitaram Bhendarkar	IPM	44.42	87952	50100	37852	1.76
		FP	36.79	72844	45719	27125	1.59
NWG	F7 - Sri Shaileshbhai Bhulabhai Patel	IPM	30.08	49030	37440	11590	1.31
		FP	27.52	44858	35346	9512	1.27
NWG	F8 - Sri Vipulbhai Jayantibhai Bharwad	IPM	36.00	58680	37436	21244	1.57
		FP	32.16	52421	34433	17988	1.52
NWG	F9 - Sri Chandra-kantbhai Patel	IPM	40.00	65200	37476	27724	1.74
		FP	35.52	57897	34022	23875	1.70

Price of Paddy = F1, F2, F3 = Rs. 2100/q; F4 = Rs. 2200/q; F5 = Rs. 1960/q; F6 = Rs. 1980/q; F7, F8 & F9 = Rs. 1630/q

Zone VII – Southern areas

IPMs trial was conducted at 12 farmers' fields in 6 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	Tamil Nadu	Aduthurai	Komal East/Nagapattinam	F1- Sri S Shanmugam
2	Tamil Nadu	Aduthurai	Nallavur/ Nagapattinam	F2 - Sri N Mathiyazhagan
3	Tamil Nadu	Aduthurai	Narikudi/Thanjavure	F3- Sri Vilwanathan
4	Karnataka	Gangavathi	Sharanabasaveshwar camp/ Koppal	F4- Sri Suryarao
5	Karnataka	Mandya	Ganadalu/ Mandya	F5 - Sri Mahadevu
6	Karnataka	Mandya	Ganadalu/ Mandya	F6 - Sri Jayaramu
7	Andhra Pradesh	Maruteru	Penumanchili/ Achanta	F7 - Sri Illa Babji
8	Andhra Pradesh	Maruteru	Gummuluru/Poduru	F8 - Sri G China Durga Rao
9	Kerala	Pattambi	Kondurkara/ Palakkad	F9 - Sri Ummer
10	Telangana	Rajendranagar	SB Pally/ Kottur/ Ranga Reddy	F10 – Sri Yemme Sekhar
11	Telangana	Rajendranagar	SB Pally/ Kottur/ Ranga Reddy	F11 – Sri Ambati Prabhakar
12	Telangana	Rajendranagar	SB Pally/ Kottur/ Ranga Reddy	F12 – Sri Ambati Krishna

Practices followed in IPMs trial at Aduthurai, *Kharif* 2021

	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. • 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 50 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* 2021		
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* 2021		
Sri Mahadevu, Ganadalu village, Mandya district, Karnataka		
Area	1 acre	1 acre
Variety	MTU 1001	MTU 1001
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	• Urea 50 kg/ acre, 10:26:26 complex fertilizer 100 kg/ ac, MOP 25 kg/ acre • Random transplanting

	• 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 Cartap hydrochloride 50 WP @ 240 g/ acre at 60 DAT • Zinc sulphate @ 8 kg/ acre Tricyclazole 75WP @ 0.6g/lit	• Applied Pretilachlor 50 EC @ 400 ml/ acre (Refit) + two hand weedings • Carbofuran 4G application @ 8 kg/ acre • Chlorantraniliprole @ 60 ml/ acre • 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 • Fipronil 0.3G @ 10 kg/ acre • Flubendiamide 48 SC @ 0.1 ml/ liter And Hexaconazole @ 2 ml/l • Buprofezin 25 EC @ 104 ml/ liter • Continuous irrigation
Practices followed in IPMs trial at Maruteru, *Kharif* 2021		
Area	2000 sq	2000 sq
Variety	PLA 1100	MTU 1121
Nursery	Seed treatment with Trichoderma @ 10 g/ 10 kg seeds Application of Fipronil 0.3G/ 5cents nursery 5 days before pulling seedlings from nursery for transplantation	Application of Carbofuran 3G @ 800g/ 5 cents
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 • Application of metasulfuron ethyl+chlorimuronethyl (Almix) @ 20g/ha mixed with fine sand (50 kg sand/ha) • Installed pheromone traps @ 8 traps/ ha for stem borer management • Spraying of neemazal @ 3ml/liter of water at 45 DAT • Spraying of chlorantraniliprole 18.5 SC @ 60 ml/acre against stem borer and leaf folder at 65 DAT. • Spraying of triflumezopyrim 10 SC @ 94 ml/acre at 60 DAT • Mid-season drainage • Spraying of hexaconazole 5 EC @ 2 ml/acre • Spraying of propiconazole @ 1ml/liter against false smut.	• Formation of alleyways of 30 cm after every 2m • Bengal method of planting (28 x 28 cm spacing) • NPK @ 225-80-90 kg/ha • Applied Londax power @10kg/ha within one week after transplantation+one manual weeding • Application of dinotefuran, pymetrozine and acephate 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 hexaconazole and azoxystrobin +difenconazole (amistar top) against sheath blight • Spraying of blitox against false smut.
Practices followed in IPMs trial at Pattambi, *Rabi* 2020-2021		
Area	4000 sq.m	4000 sq m
Variety	Jyothi	Jyothi
Fertilizers	Application of NPK @ 70:35:35	Application of 100 kg Factomphos, 60 kg urea and 25 kg Potash
Nursery	• Seed treatment with Pseudomonas @ 10g/kg seed • Seedling dip with Pseudomonas @ 20 g / litre of water	
Main field	• Application of Sathy + Pretilachlor @ 40 g + 400 ml/ acre • Installation of pheromone traps	• Spraying of Quinalphos, Chlorantraniliprole, lamda cyhalothrin and malathion at 30, 60, 75

	• 5 sprays with Eco neem 1% at 15, 25, 45, 65 & 80 DAT • Six releases of *Trichogramma japonicum* for stem borer and T chilonis for leaf folder at weekly interval	and 95 DAT
Practices followed in IPMs trial at Rajendranagar, *Kharif* 2021		
Variety	JGL 24423	JGL 24423
Nursery	• Applied of 4 kg urea, 6 kg SSP and 2 kg MOP • Applied Carbofuran 3 G	• Application of 4 kg urea, 6 kg SSP and 2 kg MOP
Main field	• Applied 100 kg N,80 kg P and 30 kg K • Applied Chlorantraniliprole @ 0.3 ml/ liter water (60ml/ acre) at panicle initiation stage • Adopted alleyways • Applied weedicide Topstar @ 36 g/ acre at 3-5 DAT + one hand weeding • Applied Propiconazole @ 1 ml/litre water (200 ml/ acre)	• Application of 120 kg N,120 kg P and 20 kg K. • Sprayed Chlorpyriphos @ 2.5 ml/ liter water • Hand weeding • Sprayed Cartap hydrochloride 50SP @ 2g/l (400g/ acre) • Sprayed Trifloxystrobin + Tebuconazole @ 0.4g/litre (80g/ acre)

Incidence of stem borer, leaf folder, whorl maggot, hispa, caseworm, thrips, BPH, WBPH, GLH were observed in most of the locations **(Table 2.90)**. At Aduthurai, stem borer incidence was high in all the three farmers' fields with significantly higher damage in IPM plots. Similarly, gall midge incidence was also initially high in IPM plots but got reduced after the IPM interventions. At all other locations, the incidence of these two pests was low. At Maruteru, BPH incidence was higher in IPM plots while at Gangavathi, IPM strategy resulted in significantly lower WBPH infestation compared to farmer practices. Incidence of other pests was low in both IPM and FP plots to discern any trends across locations.

Overall, in this zone, IPM plots showed more stem borer damage whereas leaf folder incidence was more in FP plots **(Fig 2.16).** BPH numbers were similar in both IPM and FP plots while WBPH population was higher in farmer practices.

Application of IPM practices reduced the AUDPC value of leaf blast from 161 to 125 (L1) and 771 to 394 (L2) at Mandya. At Rajendranagar, disease severity of grain discolouration was significantly reduced compared to farmers' practices (L1 = IPM-3.3; FP-9.6; L2 = IPM – 4.5; FP – 14.4; L3 = IPM – 4.5; FP – 10.5) in all the three locations **(Table 2.91)**.

Weed population and weed biomass were significantly lower in IPM adopted plots as compared to FP plots at both the stages of crop growth **(Table 2.92)**. The weed population reduction in IPM fields was 41.37% at active vegetative stage and 45.06% at panicle initiation stage. The % reduction in weed biomass in IPM implemented fields was 49.67% at active vegetative stage and 51.76% at panicle initiation stage.

Table 2.90: Insect pest incidence in IPMs trial in Zone VII (Southern), *Kharif* 2021

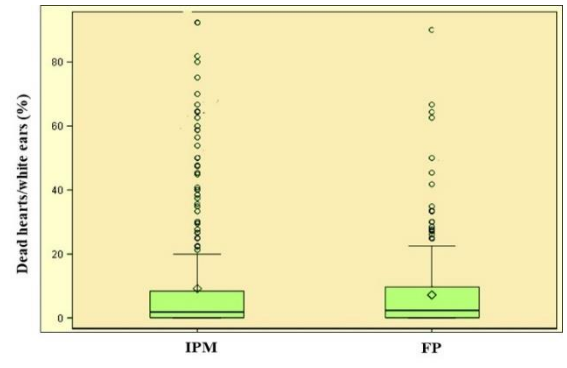
Treatments	%DH/WE	% SS	% LFDL	BPH (No./5 hills)	WBPH (No./5 hills)	Yield kg/ha
T1 = IPM	9.1(4.8)a	16.1(1.9)a	2.6(1.6)b	16.3(2.6)b	10.8(2.2)a	6130.8(17.0)a
T2 = FP	7.3(3.7)b	13.2(1.6)a	2.6(2.2)a	16.8(3.4)a	11.7(2.5)a	5962.6(16.8)a
LSD (0.05,324)	**0.76**	**0.42**	**0.42**	**0.22**	**0.25**	**236.97**

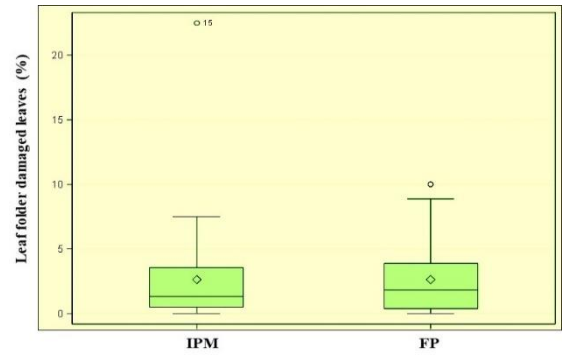
DAT						
D1 = 29 DAT	6.9(4.4)a	14.3(1.8)a	2.5(2.0)a	6.8(1.9)c	14.7(2.7)a	
D2 = 43 DAT	8.7(4.5)a	15.0(1.7)a	2.9(1.8)a	18.7(3.4)b	14.3(2.7)a	
D3 = 57 DAT	8.6(4.0)a			36.0(5.2)a	4.8(1.6)b	
D4 = 64/75 DAT	7.8(4.0)a			3.5(1.4)d		
D5 = Pre har	9.0(4.6)a					
LSD (0.05,324)	**1.21**	**0.42**	**43.2**	**0.31**	**0.3**	

Loca-tion	Name of the Farmer	Treatments						
ADT	F1 - Sri S Shanmugam	IPM	44.2(1.8)	34.3(1.6)	4.4(1.4)	3.5(1.4)	2.2(1.8)	5820.0(44.0)
		FP	24.8(1.0)	10.8(0.5)	5.5(1.8)	2.4(1.0)	2.3(1.9)	4920.0(37.2)
ADT	F2 - Sri N Mathiyazhagan	IPM	29.2(23.5)	41.3(1.6)	9.1(1.8)	1.3(0.9)	1.5(1.5)	5200.0(20.8)
		FP	15.6(12.5)	22.2(0.9)	3.6(0.7)	2.7(1.9)	2.0(1.9)	4300.0(17.2)
ADT	F3 - Sri Vilwanathan	IPM	19.2(11.7)	10.0(0.6)	4.4(1.4)	1.5(0.9)	2.1(1.5)	5950.0(29.3)
		FP	22.0(13.4)	36.0(2.2)	5.5(1.8)	5.1(3.2)	2.2(1.5)	6200.0(30.5)
GNV	F4 - Sri Surya rao	IPM	1.4(0.7)		0.5(3.2)	15.7(3.4)	40.0(6.9)	5685.6(10.3)
		FP	1.2(0.6)		0.5(3.2)	20.2(4.4)	44.5(7.6)	5911.2(10.7)
MND	F5 - Sri Maha devu	IPM	2.1(0.2)		1.0(1.3)	3.3(2.1)		6292.0(10.2)
		FP	3.2(0.3)		2.2(2.7)	8.0(5.0)		5650.4(9.2)
MND	F6 - Sri Jayaramu	IPM	2.4(0.2)		0.6(1.3)	3.7(2.0)		5136.0(9.7)
		FP	3.2(0.3)		3.2(6.9)	7.1(3.8)		4612.0(8.7)
MTU	F7 - Sri Illa Babji	IPM	2.2(2.9)	3.4(4.6)	0.4(1.5)	47.7(3.8)	9.6(0.8)	5250.0(24.4)
		FP	1.7(2.3)	1.7(2.3)	0.4(1.4)	39.9(3.2)	9.5(0.8)	6200.0(28.8)
MTU	F8 - Sri.G. China Durga Rao	IPM	2.1(1.0)	2.9(1.3)	0.9(1.2)	53.8(5.9)	9.6(1.1)	5250.0(24.4)
		FP	2.5(1.1)	2.4(1.1)	0.7(0.9)	44.2(4.8)	9.5(1.0)	6200.0(28.8)
PTB	F9 - Sri Ummer	IPM	3.7(1.5)	4.5(1.9)	2.4(1.0)			7187.8(9.6)
		FP	5.1(2.1)	6.2(2.5)	2.1(0.8)			7423.0(9.9)
RNR	F10-Sri Yemme Sekhar	IPM	0.7 (0.9)					7418.4(8.1)
		FP	2.9 (1.9)					6732.0(7.3)
RNR	F11 - Sri Ambati Prabhakar	IPM	1.5 (1.5)					7145.6(5.7)
		FP	2.7 (1.9)					6688.0(5.3)
RNR	F12 - Sri Ambati Krishna	IPM	1.1 (1.3)					7233.6(7.9)
		FP	2.4 (1.1)					6714.4(7.3)

Table 2.91: Disease severity and disease progress in Zone VII (Southern), *Kharif* – 2021

RNR				MND		
Grain discolouration/Disease severity (%)				AUDPC Values		
	L1	L2	L3	Leaf Blast	L1	L2
IPM	3.3	4.5	4.5	IPM	394	125
FP	9.7	14.5	10.5	FP	771	161





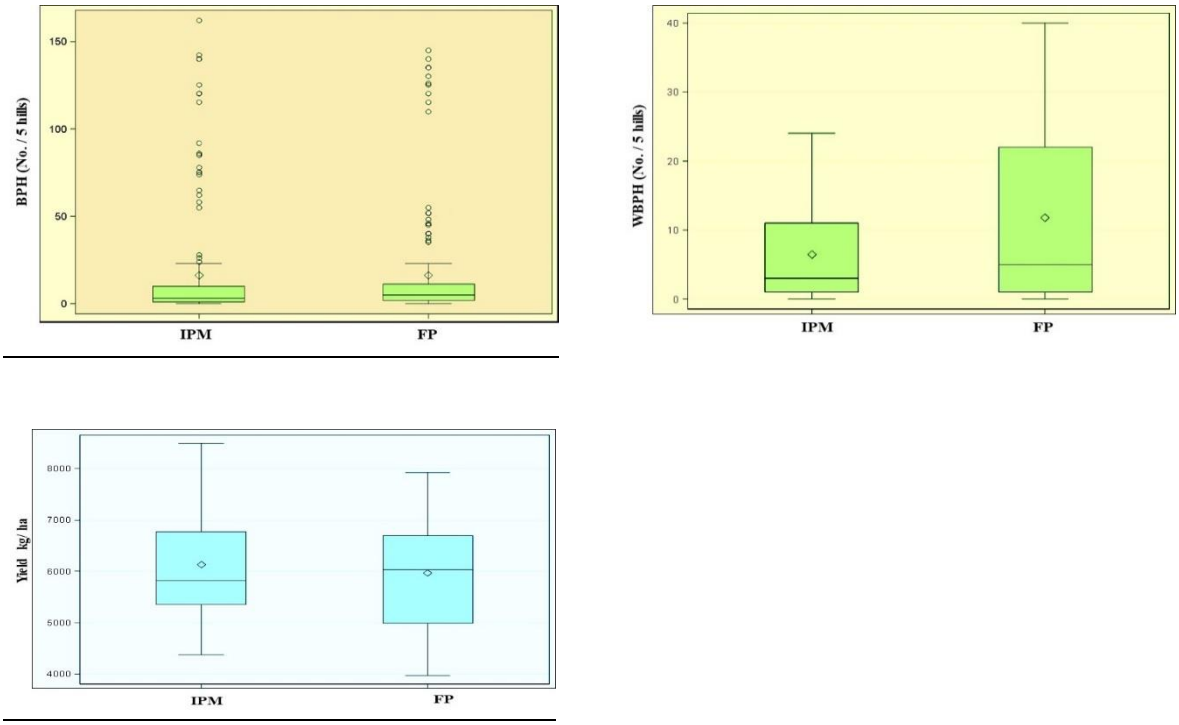


Fig 2.16: Incidence of stem borer, leaf folder, BPH, WBPH and grain yield in IPM and FP plots across locations in Zone VII (Southern)

Table 2.92: Weed population and weed biomass in Zone VII (Southern), *Kharif* – 2021

Treatments	Weed population (No./m2)		Weed biomass (g/m2)	
	Veg stage	PI stgae	Veg stage	PI stgae
IPM	20.40	15.13	12.47	13.43
FP	34.80	27.54	24.78	27.84

Grain yield in IPM plot was relatively high as compared to FP plots. However, high gross returns along with low cost of cultivation in IPM practices resulted in superior BC ratio compared to FP plots, at all the locations except at Maruteru. At this location, FP plots out yielded IPM plots resulting in higher gross returns and BC ratio (**Table 2.93**).

Table 2.93: Returns and BC ratio in IPMs trial at Zone VII (Southern), *Kharif* 2021

Location	Name of the Farmer	Treat ments	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
ADT	F1 - Sri S Shanmugam	IPM	58.20	108252	29205	79047	3.71
		FP	49.20	91512	36960	54552	2.48
ADT	F2 - Sri N Mathiyazhagan	IPM	52.00	96720	28955	67765	3.34
		FP	43.00	79980	36180	43800	2.21
ADT	F3 - Sri Vilwanathan	IPM	59.50	110670	29105	81565	3.80
		FP	62.00	115320	38030	77290	3.03
GNV	F4 - Sri Suryarao	IPM	56.86	113720	71180	42540	1.60
		FP	59.11	118220	78105	40115	1.51
MND	F5 - Sri Mahadevu	IPM	62.92	122065	55125	66940	2.21
		FP	56.50	109610	60750	48860	1.80
MND	F6 - Sri Jayaramu	IPM	51.36	99638	55250	44388	1.80
		FP	46.12	89473	61500	27973	1.45
MTU	F7 - Sri Illa Babji	IPM	52.50	95813	52000	43813	1.84
		FP	62.00	113150	58500	54650	1.93

MTU	F8 - Sri.G. China Durga Rao	IPM	53.50	97638	52000	45638	1.88
		FP	65.50	119538	56700	62838	2.11
PTB	F9 - Sri Ummer	IPM	71.87	196924	60875	136049	3.23
		FP	74.23	203390	83000	120390	2.45
RNR	F10 - Sri Yemme Sekhar	IPM	74.18	145393	59000	86393	2.46
		FP	67.32	131947	62138	69809	2.12
RNR	F11 - Sri Ambati Prabhakar	IPM	71.46	140062	59000	81062	2.37
		FP	66.88	131085	62138	68947	2.11
RNR	F12 - Sri Ambati Krishna	IPM	72.34	141786	59000	82786	2.40
		FP	67.14	131594	62138	69456	2.12
	IPM		**61.39**	**122390**	**50891**	**71499**	**2.56**
	FP		**59.92**	**119568**	**58012**	**61557**	**2.11**

Price of Paddy: F1, F2, F3 Rs. 1860/q; F4 = Rs. 2000/q; F5, F6= Rs. 1940/q; F7, F8 = Rs. 1825/q; F9 = Rs. 2740/q; F10, F11, F12 = Rs. 1960/q

IPMs trial was conducted with Zone-wise practices at 19 locations in 40 farmers' fields during Kharif 2021. In Zone I (Hilly areas), hispa was the predominant pest causing increasing damage up to 29.17% damage at 71 DAT in FP plot as against 15.45% in IPM plot. In Zone II (Northern areas), incidence of stem borer, leaf folder, BPH and WBPH was observed. Leaf folder incidence (> 20% LFDL) was higher in FP plots at Kaul in all the three farmer's fields. In Zone III (Eastern areas) and Zone IV (North Eastern areas), stem borer, gall midge, leaf folder, BPH and other pests were observed but the incidence was low. In Zone V (Central areas), high incidence of thrips was reported in FP plots (> 10% THDL) compared to IPM plots. However, the incidence of stem borer, leaf folder and BPH was low. In Zone VI (Western areas), incidence of steam borer, leaf folder, BPH and WBPH was low in both IPM and FP plots across locations. In Zone VII (Southern areas), stem borer and BPH incidence was high in both IPM and FP plots at Aduthurai and Maruteru, respectively, whereas WBPH populations were higher in FP plots, at Gangavathi.

Adoption of IPM practices effectively reduced the disease progression of leaf blast, BLB, sheath blight, brown spot in Zone II (Northern areas), neck blast and sheath blight in Zone III (Eastern areas), bacterial blight and sheath blight in Zone IV (North Eastern areas), leaf blast in Zone V (central areas), neck blast, sheath blight, sheath rot and grain discolouration in Zone VI (Western areas), leaf blast and grain discolouration in Zone VII (Southern areas).

In IPM adopted fields, the mean weed population reduction over the zones ranged from 41.02% in Zone III (Eastern areas) to 100 % in Zone II (Northern areas) at active vegetative stage. At panicle initiation stage, weed population reduction varied from 33.55% in Zone III (Eastern areas) to 69.79% in Zone I (Hilly areas). The dry weed biomass reported at 12 locations showed significant reduction by 5.67% in Zone I (Hilly areas), 64.84% in Zone VI (Western areas), 25.29% in Zone III (Eastern areas) to 51.76 in Zone VII (Southern areas).

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.

2.7. 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 2021, insect populations in rice ecosystems were recorded daily, throughout the year using light traps (Chinsurah/Robinson type) in 30 locations. 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 2021 are presented zone-wise hereunder:

Zone I- Hills

1. Himachal Pradesh-Malan (22-44 SW): WSB, CW, LF, BPH, WBPH, GLH, WM, and black beetle were recorded at this location. LF activity was conspicuously low, being found only in the 26th SW (1 moth) as compared to the previous year in which it was active throughout the year (highest of 189 moths in 39th SW). WSB made its first appearance in 26th SW and continued up to 42rd SW with a peak population of 19135 moths in 36th SW. CW was found from 27th SW to 43rd SW. During 32nd to 39th SW it was most active with a peak population of 418 moths in 38th SW. Black beetle was also recorded throughout the observation period except 31st and 32nd SWs and was most active in 41st SW (61 beetles). BPH was found during 26th to 43rd SWs with a maximum catch in the 40th SW (38 hoppers). GLH population was found up to 40th SW with a maximum activity in the 27th SW (36 hoppers). Among the natural enemies, rove beetle was reported.

2. Jammu & Kashmir-Khudwani (13-44 SW): BPH, WBPH, SB, LF, and scarabaeids were recorded at this centre. White grub is the major species. It

occurred in between 18th to 34th SWs on continuous basis. Peak activity was observed in the 33rd SW with 33 beetles.

Zone II- Northern

3. Haryana-Kaul (13-52 SW): YSB, PSB, LF, BPH and WBPH were recorded at this location. PSB was dominant among the stem borers and occurred late in the season (37th SW) as compared to YSB (21st SW). PSB was continuous from 37th SW to 52nd SW with a peak activity in the 42nd SW (36 moths). On the other hand, YSB was most active during 29th SW (26 moths). LF was recorded from 20th to 44th SWs with a highest catch of 146 moths in 39th SW. BPH was found during 34th to 45th SWs and highest population was recorded 38th SW (1872). WBPH was found during 34th to 40th SWs, and highest population was observed in the 36th SW (303).

4. Jammu & Kashmir-Chatha (1-52 SW): White grub, GSB, GH, WSB, YSB, LF, and GLH were recorded. White grub appeared continuously from 13th to 44th SWs with peak activity during 37th SW (101). GSB incidence scattered up to 49th SW. GH was found active from 15th SW onwards. Maximum incidence was in 17th SW (39 hoppers). LF activity started late in the season, from 32th SW and was at peak in 44th SW (88). GLH was observed continuously from 23rd to 45th SW with heightened activity in the 37rd SW (53 hoppers).

5. Punjab-Ludhiana (1-52 SW): Three species of stem borers; YSB, PSB and WSB were recorded at this location. YSB and WSB catches were confined to the rainy season from 31st to 40th SWs (high of 16 in 39th SW and 5 in 37th SW respectively). PSB showed two distinct periods of activity 9th to 22nd and 33rd to 48th SWs and the highest catch of 41 moths was found in 10th SW. LF, BPH, and WBPH were also found but only in the rainy season. LF catches appeared from 32nd SW till 48th SW, gradually increasing in numbers to a maximum of 220 moths in 42nd SW followed by a decline. BPH was found during 31st to 45th SWs with a peak population of 7155 in 40th SW. WBPH catches were small, highest being 139 in 39th SW.

6. Uttarakhand-Pantnagar (22-48 SW): YSB, LF, GLH, BPH, WBPH, RH and RGB were recorded at this location. YSB appeared with much activity up to 47th SW. YSB population increased gradually, and reached maximum level during 37th SW followed by a gradual decline and catches consisted, mostly of females. Highest catch was recorded in 37th SW (2755 females and 195 males). LF was recorded from 23rd to 46th SWs and showed maximum activity in 41st SW (240). BPH and WBPH were most active (17860 and 1560 respectively) in 43th SW.

RGB was found active during 36th to 48th SWs with a peak catch of 274 in 41st SW.

Zone III-Eastern

7. Odisha-Chiplima (26-52 SW): SB, GM, LF, GLH, BPH, WBPH and CW were reported from this centre. During the rainy season, YSB activity started from 39th SW, increased gradually to reach the high in 44th SW (28 female and 36 male moths). GM was active during 30th to 46th SWs with a peak activity in 40th SW (166). Both the species of GLH; *N. virescens* and *N. nigropictus* were recorded, though the former was the dominant one. *N. virescens* catch was largest (2074) in 39th SW. BPH and WBPH populations showed a gradual build up from the first appearance in 36th and 38th SWs attaining maximum level during 47th SW (934) and 44th SW (43) respectively followed by a decline. LF also showed a similar trend in their population build up with a maximum catch of 20 in 47th SW. CW was found in small numbers reaching up to 17 in 40th SW.

8. Assam-Titabar (1-52 SW): YSB, WSB, WM, CW, Blue beetle, GM, LF, GLH, BPH, WBPH, WLH, Black bug, Mole cricket, GH and RGB were recorded from this location. Except stem borers, remaining pests were predominantly found in the rainy season. YSB and WSB made first appearance in 5th SW and both the borers showed cyclical fluctuations in the population with highs followed by lows. Maximum number of YSB moths (343 females and 339 males) was in 35th SW. WSB numbers also peaked in the same week with 338 moths. GM was active from 19th to 37th SWs and highest activity was in 35th SW (350). LF was active from 14th to 51st SWs and was most active in 40th SW (262). BPH and WBPH were negligible and were recorded only in 32st SW. Other pests namely, WM, CW, blue beetle, black bug, GH, mole cricket, and RGB also were recorded in significant numbers during the rainy season. Among the natural enemies, general predators namely, dragonfly, damselfly and ground beetles were recorded in moderate numbers during the rainy season.

9. West Bengal-Chinsurah (1-52 SW): SBs, LF, GLH, BPH, WBPH, WLH, and RGB were found active throughout the year. However, temporal distribution of the insect populations revealed two distinct peaks coinciding with *Kharif* and *Rabi* seasons. Also, insect catches in *Kharif* were larger as compared to *Rabi*, particularly that of YSB and hoppers. In case of YSB, males were more abundant at this location. Maximum number of moths (171 females and 563 males) were trapped in 14th SW. BPH and WBPH were most active in 43rd (1042) and 44th (157) SWs respectively. Moderate numbers of WLH and RGB also were most active during this period.

Zone V- Central

10. Chhattisgarh-Raipur (1-52 SW): YSB, PSB, LF, GLH, BPH, ZZLH, CW, RGB and blue beetle and *Spodoptera* sp. were recorded at this location. Both the stem borers were found throughout the year. YSB catches were highest (368 females and 191 males) in 44th SW. BPH and ZZLH showed distinct seasonal pattern that was corresponding to crop growth period. BPH was most active during 13thto 23th SWs *Rabi* and 39th to 49th SWs in *Kharif* and the catch was highest (50406) in 47th SW. Significant catches of ZZLH were also observed, with a maximum catch (105) in 47th SW. CW occurred throughout the year and high activity was in the 41st SW (303 moths). Generalist predators like coccinellids, ground beetles, and rove beetles also were recorded round the year though were more abundant in the rain season. Rove beetles were in abundance with a catch size of 2690in 27th SW.

11. Chhattisgarh-Jagdalpur (1-12, 26-52 SW): YSB, GM, CW, LF, GLH, BPH, WBPH, ZZLH, RGB, and GH were recorded at this location. From 13th SW to 25th SW data was not recorded due to lockdown. YSB occurred throughout the year and incidence was more during the crop growth period. Maximum population was recorded in 44th SW (34 females and 41 males). GM was found during 33rd to 48th SWs with a maximum catch of 62 in 42nd SW. LF occurrence was highest (61) in 46th SW. GLH was more active during the *Kharif* season and the combined catch of *N. virescens* and *N. nigropictus* reached up to 10726 in 45th SW. BPH and WBPH populations were not considerable. ZZLH population was recorded up to 203 hoppers in 41st SW. Grasshopper activity picked up in the rainy season and was highest in 43rd SW (26). Among the natural enemies, coccinellids and ground beetles were recorded round the year with a maximum of 344 and 145 respectively in 45 SW.

12. Maharashtra-Sakoli (1-52 SW): YSB, GM, LF, GLH, BPH, WBPH and rice moth were recorded at this location. YSB was found active throughout the year. At this location YSB was more active in *rabi* (329 females and 116 males) in 18th SW. GM occurred during 31st to 46th SWs and the highest catch was recorded in 39th SW (538). LF was found continuously from 31st SW onwards with a peak activity in 38th SW (48). Hoppers showed a distinct seasonal activity corresponding to the crop growth period. GLH population was highest (499) in 14th SW. BPH population reached maximum (1052) in 43rd SW. Whereas, WBPH was highest in 15th SW (364). Among the natural enemies, coccinellids were recorded during the crop growth season.

13. UttarPradesh-Mashoda (22-52 SW): YSB, LF, GLH, CW, RGB and GH were recorded from this location, throughout the recording period. YSB population gradually increased to attain peak activity during the 42nd SW (1118 females + 307 males). LF catch was maximum during 41st SW (3753). GLH also most abundant (5012) in the same week. CW also occurred in big numbers with a high of 2484 moths in 43rd SW.

Zone VI- Western

14. Gujarat-Navsari (1-52 SW): SBs, LF, GLH, BPH, WBPH, RGB, and paddy skipper were recorded in this location. No catches were recorded during the *rabi* season. YSB appeared from 22nd SW and increased gradually along with other SBs reaching peak population (267 females and 64 males) in 40th SW followed by a steady decline. LF started from 23rd SW and reached peak in 37th SW (178). Sucking pests appeared late in the season, after 33rd SW and increased gradually by 44th SW attained maximum activity. Paddy skipper, the pest specific to this area was first recorded in 22nd SW and increased up to 204 in 43rd SW followed by a gradual decline.

15. Gujarat-Nawagam (1-52 SW): YSB, LF, GLH, WBPH and natural enemies were recorded at this location in moderate numbers and incidence was relatively higher in the rainy season. Highest levels of YSB and LF were recorded in 37th SW (62 and 43 respectively). WBPH incidence was throughout, with a highest population of 126 in the 40th SW. Among the natural enemies, earwigs and rove beetles were reported.

16. Maharashtra-Karjat (1-52 SW): YSB, GLH, and RGB were recorded at this centre. YSB catches coincided with crop growth period. In 41st SW, YSB was most active (74 females and 35 males). GLH picked up activity after 31st SW and reached peak in 43rd SW (1258).

VII-Southern

17. Andhra Pradesh-Ragolu (30-52 SW): SBs, GM, LF, GLH, BPH, WBPH and mirid bug were reported from this centre. YSB incidence was moderate and dominated by males. Highest catch was in the 48th SW (20 females and 26 males). GM appeared in 40th and gradually population increased to a maximum of 500 in 45th SW. BPH and WBPH were nearly in equal proportion. BPH started appearing in the 32nd SW and gradually increased to a maximum level of 328 hoppers per week. Whereas, WBPH reached highest level (332) in the 45th SW. Mirids closely followed hoppers population and reached maximum level in 4th SW (398).

18. Andhra Pradesh-Nellore (26-52): YSB, GM, LF, GLH, BPH, WBPH and mirid bug were reported from this centre. Insects were active throughout the observation period. Highest catch of YSB was in the 37th SW (2635). GM appeared in 30th and gradually population increased to a maximum of 138 the 42nd SW. WBPH is the dominant plant hopper at this location with a maximum population of 715 in 40th SW. Mirid bug was maximum in the 42nd SW (535).

19. Andhra Pradesh-Bapatla (31-52): YSB, CW, LF, GLH, BPH, WBPH, ZZLH, mirid bug, coccinellids and mole cricket were reported from this centre. Catches were of moderate size. YSB appeared from 35th SW onwards, and reached a peak of 63 moths in the 43rd SW. Leaf folder was most active in the 47th SW (98). BPH and WBPH existed in similar proportion and both showed maximum activity in the 41st SW. Mirid bug was active throughout the period and reached maximum in the 48th SW (819).

20. Andhra Pradesh-Maruteru (22-52 SW): YSB, GM, LF, GLH, BPH, WBPH, ZZLH, black bug, coccinellids and mirid bug were reported from this centre. YSB was active through the season and catches were highest (886 females and 683 males) in 45th SW. GM was found consistently from 36th SW onwards. In 44th SW it showed peak activity (500). Among the plant hoppers, BPH was predominant and the largest catch was of 17133 in the 45th SW. WBPH also was most active in the 45th SW (5119). Black bug was found throughout the recording period and was most active (1184) in 51st SW. Among the natural enemies, mirid bugs were recorded and the largest catch (2591) was in 44th SW.

21. Telangana-Jagityal (1-52 SW): YSB, GM, BPH and GLH were recorded at this centre. All the pests were found throughout the year at a moderate level. GM was more active between 37th to 46th SWs. BPH was highest in 17th SW (120). GLH also exhibited a similar pattern and reached peak population level in 17th SW (118).

22. Telangana-Rajendra Nagar (1-52 SW): YSB, PSB, CW, LF, GLH, BPH, blue beetle, GLH, GSB, coccinellids and mirid bug were recorded at this centre. YSB activity was spread across the *rabi* season and late in the *kharif* season. In 18th SW its activity was at peak (524 females and 108 males).LF showed heightened activity during 15th to 18th SWs with a maximum weekly catch in the 16th SW (962). BPH was found during 12th to 18th SW and 41st to 48th SW and maximum

activity was in the 45th SW (817). Blue beetle was active during the *Rabi* season and in the 8th SW maximum numbers were recorded (27).

23. Telangana-Warangal (1-52 SW): YSB, WSB, GM, LF, BPH, WBPH, GLH, and GSB were recorded at this location. In general pest population synchronized with the cropping season. Except GLH, others were more abundant in the rainy season. YSB and GM were most active during 43rd SW (255 females: 11 males and 680 respectively). Highest BPH and WBPH populations were in 47th SW (5156 and 403 respectively). Among the natural enemies; coccinellids, mirid bug and rove beetle were recorded. Mirid bug closely followed hopper population and was most active during 44thSW (3795).

24. Tamil Nadu-Aduthurai (1-52 SW): YSB, WSB, GM, LF, GLH, BPH, WBPH, GSB, coccinellids, mirid bug, and rove beetle were recorded at this location. Insect incidence showed close synchrony with the crop growth period. YSB started appearing from 36th SW and reached highest level b the 45th SW (255 males + 11 females). GM also followed similar trend and was highest in the 45th SW (680). Hoppers activity picked up in the April and October-November months. BPH and WBPH were most abundant in the 47th SW (403 and 5156 respectively). Mirid bug closely followed plant hoppers and peaked in the same SW (3795).

25. Tamil Nadu-Coimbatore (1-52 SW): YSB, CW, LF, GLH, BPH, WBPH, WLH, RGB, GSB, black bug, blue beetle, rove beetle, ground beetle and mirid bug were recorded at this location round the year except black bug and blue beetle which were found from 24th SW onwards. Ground beetle appeared from 26th SW onwards. Overall, the insect catches were small with and occurred uniformly without any seasonal spikes.

26. Kerala-Moncompu (1-52 SW): SBs, GM, LF, GLH, BPH, WBPH, black bug, and natural enemies were recorded. Generally, insect incidence was low and occurred during the cropping season. Water bug was found almost throughout the year, with a peak population of 163 in 34th SW. During 17th to 26th SWs there were no catches.

27. Kerala-Pattambi (1-52 SW): YSB, WSB, GM, LF, GLH, BPH, WLH, CW, coccinellids, ground beetle, rover beetle, and mirid bug were recorded in light trap catches. High incidence of YSB was recorded at this location and was active from 1st to 19th and 31st to 52nd SWs. Its activity peaked in 52nd SW (1199). BPH population also similar trend and reached maximum level in 10th SW (928). WSB catches were comparatively smaller and maximum (59) was in

2nd SW. GM was active during 1st to 8th and 25th to 52ndSWs with a maximum catch of 150 in 38th SW. GLH was found throughout the year and was more active early in the year. Both the species, *N. nigropictus* (5414) and *N. virescens* (5102) reached their peak population levels in the 2ndSW. WLH also occurred throughout the year and was maximum in 1st SW (382). Among the natural enemies, ground beetles, rove beetles and mirid bugs were recorded in good numbers throughout the year. Mirid bugs were abundant showing clear trend in density dependent population dynamics. Maximum mirid bug catch (59726) was recorded in 10th SW.

28. Karnataka-Mandya (1-52 SW): YSB, LF, CW, GLH, and BPH were recorded at this centre. YSB was found throughout the year with fluctuations in population corresponding to the crop growth seasons. The pest was more active in *kharif* with a maximum population (196 females and 141 males) in 39th SW. LF showed two favorable periods of activity with a high population in 13th SW (113) in *rabi* and in 42nd SW (183) in the *kharif* season. CW occurred from 4th SW onwards, with a maximum population (73) in 41st SW. BPH was consistent during the rainy season and high activity was in 44th SW (356).

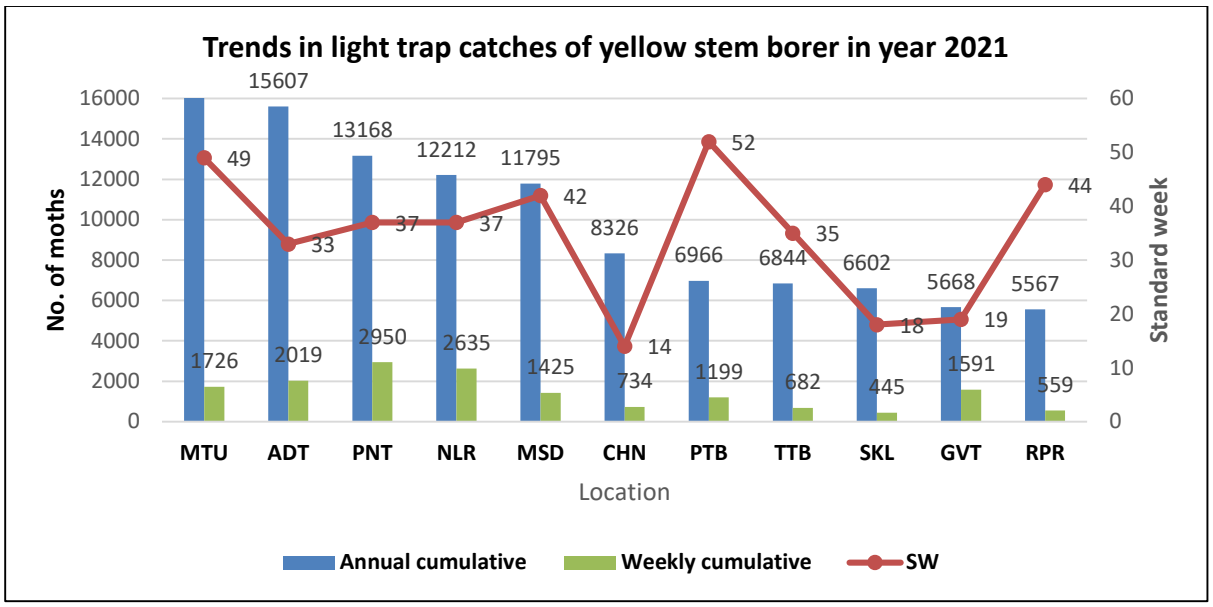
29. Karnataka-Gangavati (1-52 SW): YSB and other stem borers, GM, LF, GLH, and BPH. WBPH, ZZLH, mirid bug, and coccinellids were recorded at this location. YSB population was highest in 19th SW (743 females and 848 males). Except SBs other insects were not found during the summer months. GM appeared from 1st to 20th SW and 38th to 52 SWs. And peak activity was in 15th SW (643). LF was found during 1st to 8th SW and 40th to 52nd SWs. Planthoppers were more active during 1st to 10th and 37th to 52nd SWs. Highest weekly catches of BPH (1054) and WBPH (2163) in 45th and 46th SWs respectively. Stem borers, other than YSB were also reported in significant numbers, with a highest weekly catch of 3467 in the 44th SW.

30. Puducherry-Karaikal (1-52 SW): SBs, LF, GLH, BPH, WBPH, WLH, ZZLH, RGB, coccinellids and ground beetles were recorded in small numbers.

Pest-wise analysis of light trap catches:

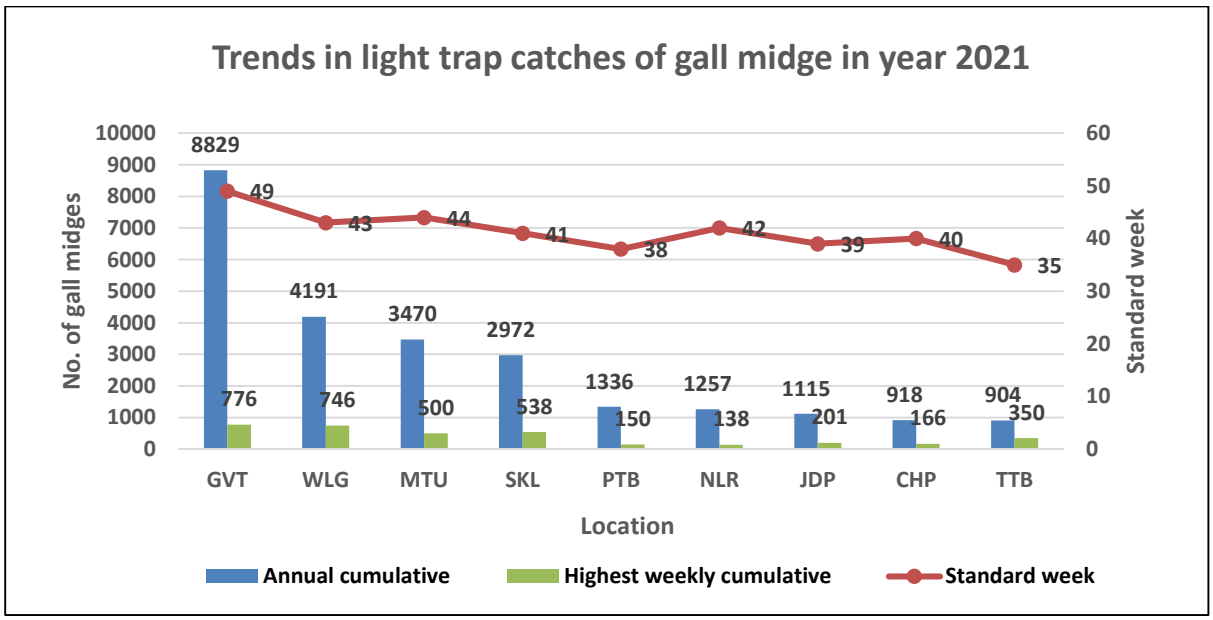
Stem borer

Yellow stem borer was recorded in 28 locations, except in KHD and CHT. Annual cumulative catches were highest at MTU (16755) followed by ADT (15607) and PNT (13168). Weekly highest catch was in PNT (2950) in 37th SW followed by NLR (2635) in 37th and ADT (2019) in 33rd SW. In the previous year annual cumulative catches were highest at ADT (11038) followed by PNT (9785) and MND (7566).



Gall midge

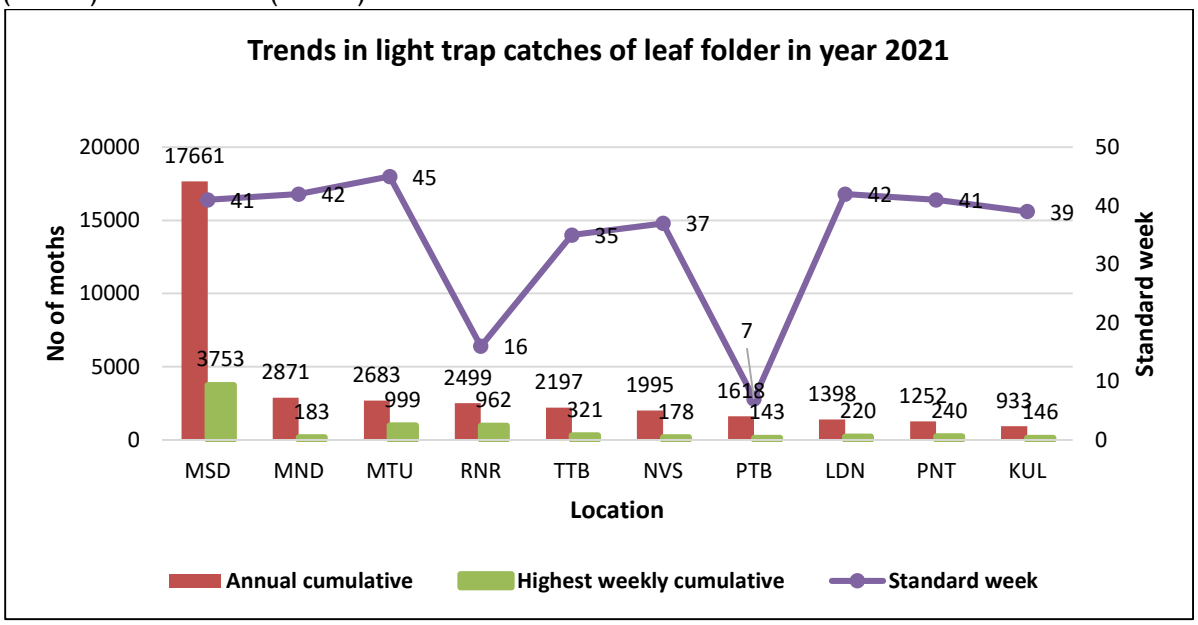
Gall midge occurrence was observed at 12 locations. It was not recorded from Hills, Northern and Western Zone. Annual cumulative catches were highest in GNV (8829) followed by WGL (4129) and MTU (3470). In terms of weekly cumulative catch, it was most active in GNV (774) in 49th SW, followed by WGL (746) in 43rd SW and SKL (538) in 41st SW (Fig. 2.16). In the previous year on the basis of yearly cumulative catch, it was most active in GNV (14005) followed by WGL (4273) and SKL (3072).



Leaf folder

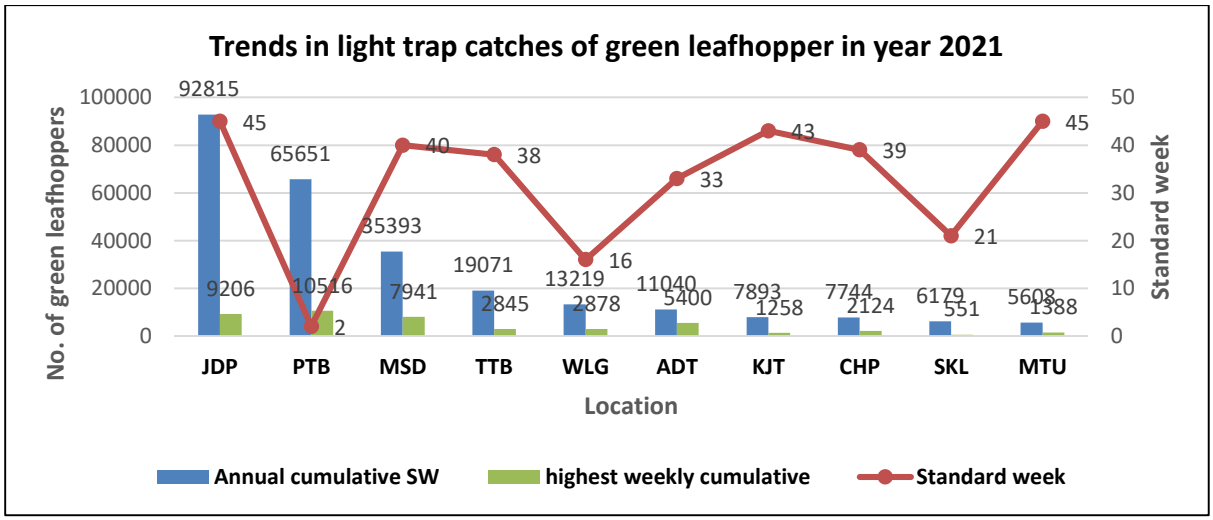
Leaf folder also was recorded at 28 centres across the zones except JGL and KRK from. It was most active in MSD (17661), MND (2871), MTU (2683) in terms of

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 (Fig.2.17). In the previous year it was most active in NVS (5402), followed by MSD (4467) and MND (2686) in terms of annual cumulative catches.



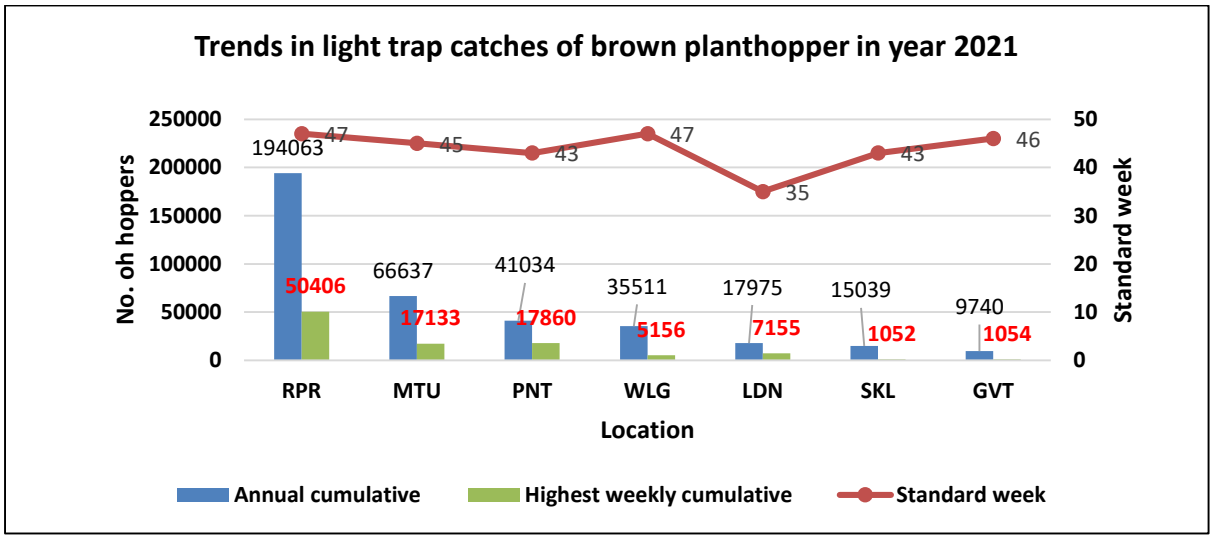
Green leafhopper

Green leaf hopper was recorded from 28 locations except KHD and KUL. In 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 (Fig. 2.18). In the previous year, GLH was reported from 24 locations spread over all the zones with a large population at TTB (295769) followed by JDP (140788), and MSD (42439).



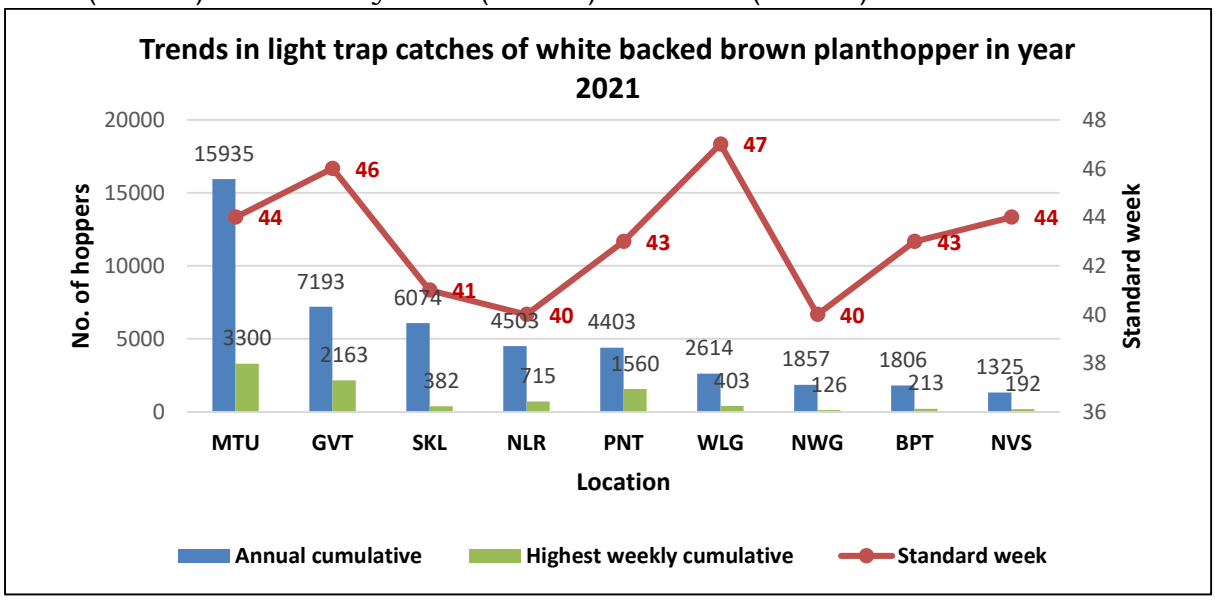
Brown planthopper

Brown plant hopper was recorded in 25 locations BPH was most abundant in RPR (194063), followed by MTU (66637) and PNT (41034) on yearly cumulative basis. Weekly cumulative catches were also highest in RPR (50406) in 47th SW, followed by PNT (17860) in 43rd SW and MTU (17133) in 45th SW. In the previous year 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.



White- backed planthopper

White backed plant hopper was recorded in 14 locations. 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. (Fig. 2.20). In the preceding year it was recorded at 18 locations with an annual cumulative catches were highest in GNV (24120) followed by CHP (28862) and PNT (13671).



Among the insect pests of minor importance, case worm was recorded in 14 locations: MSD, MLN, PTB, TTB, RPR, MND, GNV, JDP, BPT, CHP, RNR, KHD, CBT, and KJT. It was most active in MSD (22191), followed by MLN (2566) and TTB (2324). Rice gundhi bug was recorded at 11 locations: PTB, MSD, TTB, NVS, PNT, KJT, JDP, RPR, CBT, CHN, and KRK. Its activity was high in PTB (7100), followed by MSD (1890), and TTB (1604).

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, white stem borer, pink stem borer, black bug, gundhi bug, and zigzag leaf hopper showed an increase in the spread and intensity of incidence posing concern for future. Patterns in seasonal incidence and population build up on the basis of 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 2020-2021

Summary

1. Stem borer screening trial (SBST): Evaluation of 60 entries in 13 valid field tests from 4 locations in Rabi 2021 identified, 11 entries, CRCPT 7, KAUPTB 0627-2-15, HWR 17, RP 5587-B-B-B-274-6, HWR 20, RP 5588-B-B-B-B-177, RP 5588-B-B-B-B-223, RP 5588-B-B-B-B-226, RP 5588-B-B-B-B-238, Chandra- hasini and W1263 as promising in 7-9 tests in terms of low dead hearts (2-3 tests), white ear damage (2-3 tests) and high grain yield (3-4 tests) 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 25 entries at Maruteru for stem borer white ear damage identified, PTB33, RP 5690-20-6-3-2-1, Suraksha, KAUPTB 0627-2-11 and Sinnasivappu with ≤5% WE (DS 1.0).

3. National Screening Nursery (Boro): Evaluation of NSN boro entries in 2 greenhouse and one field tests identified IET 29618 as promising against BPH with a damage score of 2.5.

Insecticide-Botanicals Evaluation Trial (IBET) was carried out at 8 locations to to evaluate the efficacy of four combination modules/treatments against major insect pests of rice and consequent impact on natural enemies and grain yield during Rabi, 2019-20. 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. Neemazal, eucalyptus oil and cartap hydrochloride treatment was found effective against pests and its efficacy was superior to control. Highest grain yield of 7134-5 kg/ha was recorded in all insecticide treatment with 37.1% increase over control.

Effect of planting dates on insect pest incidence (EPDP) trial was conducted only at Maruteru during Rabi 2020-21. Incidence of white ear heads was high in normal planting (30.73 %) than the other two plantings (<10 %) across the locations. Incidence of gall midge (14.21% SS) and leaf folder (16.62% LFDL) was high only in late planting. BPH population crossed ETL in both normal and late plantings with mean numbers of 94.68 – 97.93/hills. Incidence of whorl maggot, hispa and WBPH was low in all the three plantings.

Ecological engineering for planthopper management (EEPM) was taken up in Maruteru with a combination of interventions such as organic manuring and growing of flowering plants on bunds. The population of natural was significantly higher in ecological engineering as compared to farmer's practices but pest incidence

was higher than that of farmers practice indicating a need for a minimal insecticidal intervention along with ecological engineering practices.

Bio intensive pest management trial (BIPM) was taken up at Aduthurai and Pattambi during Rabi 2020 -21. The natural enemy population was significantly higher in BIPM plots at Aduthurai and the egg parasitisation of stem borers was also high as compared to Farmers practices.

Integrated Pest Management special (IPMs) trial was conducted at Chinsurah, Karjat and Rajendranagar during Rabi 2020-21. Incidence of stem borer, leaf folder and whorl maggot was observed in both IPM and FP plots across locations. Dead heart incidence crossed ETL at Chinsurah (10.36% DH) and Karjat (11.78% DH) while white ear incidence crossed ETL at Rajendranagar (17.63% WE) in farmers' practices. Incidence of leaf folder and whorl maggot was low in both the treatments. Across the locations, gross returns were high in IPM plots due to the high grain yield and low cost of cultivation resulting in high BC ratio.

Rabi 2020-2021

1. Stem borer screening trial (SBST)

The trial was initiated in 2015 was continued during Rabi 2020-21 with 60 entries, including nominations from IIRR, Jagtial, Pattambi, Warangal and NRRI Cuttack which were specifically bred for stem borer tolerance. The entries were evaluated at 5 locations *viz.*, IIRR, Pattambi, Chinsurah, Maruteru and Rajendranagar. 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 0.0 to 59.76% with an average damage of 16.18% DH across 3 locations in 4 valid tests. Evaluation of entries for dead heart damage in two staggered sowings helped in identification of CRCPT 7, KAUPTB 0627-2-15, HWR17, RP 5587-B-B-B-274-6, HWR 20, RP 5588-B-B-B-B-177, RP 5588-B-B-B-B-223, RP 5588-B-B-B-B- 226, RP 5588-B-B-B-B-238, RP Bio4919-385, IET 27540, NND6, Chandrahasini and W1263 as promising in 3 tests with ≤10% DH (DS of 3.0). All these entries were under retesting.

White ear damage: The white ear damage across 4 locations in 5 valid tests varied from 0.0 to 76.92% with a mean of 14.14% WE. Evaluation of entries identified CRCPT 7, JGL 32994, HWR 20, RP 5588-B-B-B-B-177 and RP 5588-B-B-B-B-223 as promising in 3 of the 5 valid tests with a promising level of ≤5% WE (DS of 1.0). PSB was reported in RP5587 at Rajendranagar.

The larval survival per entry across two locations in three tests varied from 0.56 to 5.7 larvae/hill in the stubbles with a mean of 2.24 larvae/hill.

Grain yield: RNR 28361, CRCPT 7, KAUPTB 0627-2-15, HWR 17, RP 5587-B-B-B-274-6, HWR 20, RP 5588-B-B-B-B-177, RP 5588-B-B-B-B-223, RP 5588-B-B-B-B-238, Chandrahasini and W1263 were promising in three valid tests with ≥15g grain yield/hill despite stem borer damage of the four valid tests in three locations. All the entries were under retesting.

Overall reaction: Evaluation of 60 entries in 13 valid field tests (4 tests for dead heart damage and 5 tests for white ear damage and 4 tests for grain yield) identified 11 entries *viz.*, CRCPT 7, KAUPTB 0627-2-15, HWR 17, RP 5587-B-B-B-274-6, HWR 20, RP 5588-B-B-B-B-177, RP 5588-B-B-B-B-223, RP 5588-B-

B-B-B-226, RP5588-B-B-B-B-238, Chandrahasini and W1263 as promising in 7-9 tests in terms of low dead hearts (2-3 tests), white ear damage (2-3 tests) and high grain yield (3-4 tests) suggesting that recovery resistance and tolerance could be the mechanism in these entries as they recorded good grain yield despite damage **(Table 2.94)**.

Table: 2.94 Reaction of most promising cultures to stem borer in SBST, Rabi 2020-21

SBST No.	Designation	SBDH	SBWE	SBDH+SBWE	GY/hill	SBDH+SBWE+GY/hill	Larvae / hill
		NPT	NPT	NPT	NPT	NPT	
		4	5	9	4	13	
21	CRCPT 7*	3	3	6	3	9.0	0.78
37	HWR 20*	2	3	5	3	8.0	0.78
38	RP 5588-B-B-B-B-177*	2	3	5	3	8.0	1.33
41	RP 5588-B-B-B-B-223*	2	3	5	3	8.0	1.13
42	RP 5588-B-B-B-B- 226*	2	2	4	3	7.0	0.98
43	RP 5588-B-B-B-B-238*	2	2	4	3	7.0	1.33
26	KAUPTB 0627-2-15*	2	2	4	3	7.0	1.00
27	HWR 17*	2	2	4	3	7.0	0.56
32	RP 5587-B-B-B-274-6*	2	2	4	3	7.0	0.69
57	Chandrahasini*	2	2	4	3	7.0	1.11
59	W1263*	2	2	4	3	7.0	1.33

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

2. Multiple resistance screening trial (MRST): The trial was constituted with 20 entries and five checks and conducted at Khudwani, Maruteru and Rajendranagar. At Maruteru incidence of stem borer, planthoppers and leaf folder was observed. Whorl maggot, stem borer and leaffolder incidence was observed at RRS, Rajendranagar. Grasshopper incidence was recorded at Khudwani. Valid data on white ear damage from Maruteru was considered for analysis. Five entries *viz.*, PTB33, RP 5690-20-6-3-2-1, Suraksha, KAUPTB 0627-2-11 and Sinnasivappu recorded ≤5%WE (DS 1.0) at Maruteru.

3. **NSN-Boro:** This trial was constituted with 61 boro entries and 10 insect checks and evaluated at 3 locations *viz.*, Coimbatore, Pattambi and Gerua against 6 insect pests. Valid data for 3 insect pests from two locations identified IET 29618 as promising against BPH (DS 2.5) in greenhouse test at Coimbatore. Data on dead heart damage from Pattambi identified NPH 8899 (Check), IR 64 (Check) and IET Nos. 29593 and 29632 with ≤5 % DH.

Chemical Control Studies

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, 2019-20. The details of number and time of applications are given below:

Sl. No.	Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
1	Aduthurai	20-09-2021	22-10-2021	02-02-2022	2	30 & 50
2	Chinsurah	11-12-2020	27-01-2021	13-06-2021	3	15,30 &55
3	Cuttack	05-01-2021	12-02-2021	25-05-2021	3	25,50 & 65
4	Chiplima	02-01-2021	08-02-2021	24-05-2021	2	25 & 45
5	Karjat	10-01-2021	04-02-2021	16-05-2021	2	30 & 46
6	Maruteru	31-12-2020	04-02-2021	25-05-2021	3	30,52 & 60
7	Pattambi	30-11-2020	26-12-2020	02-04-2021	-	-
8	Raipur	04-12-2020	15-01-2021	17-05-2021	3	30, 50 & 70

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 (2.95)

Stem borer incidence was recorded in seven locations and high dead hearts damage was recorded at Raipur (18.7-20.1%) followed by chinsura with highest of 16.8% in control plots. There were significant differences in damage among the treatments at most of the locations. Mean dead heart damage in botanical combination treatments ranged between 7.1 and 7.9% compared to11.8% in control, while all insecticide treatment was the most effective treatment showing 5.7% DH.

Highest white ear damage was reported from Chinsura with22.1% WE followed by Aduthurai (17.3%) in untreated control. All treatments significantly reduced white ear damage (6.5-11.6%) when compared to 15.6% in control. All insecticide combination was the most effective treatment against stem borer with 6.5% mean white ear damage. Among botanical combinations, neemazal, eucalyptus oil and cartap hydrochloride combination was found effective with 8.5% WE.

Gall midge incidence was reported only from Aduthurai and Maruteru. The silver shoot damage varied from 1.2-10.7% in treatments as compared to 5.9-15.5% in control. The lowest mean damage was recorded in all insecticides treatment (5.2%).

Brown planthopper incidence was recorded from 4 locations. There were significant differences in the efficacy among the treatments at all three locations, except Maruteru. Botanical treatment was the most effective treatment with lowest mean population of 24.7 BPH/10 hills compared to 67.0 per 10 hills in control. However, there was no significant difference in efficacy of among all treatments against hoppers.

Leaf folder damage was reported from 3 locations and highest leaf damage was recorded in Chinsura (11.3%). There were significant differences in leaf damage among the treatments at2 locations except Maruteru. All insecticides combination was the most effective treatment showing mean leaf damage of 26.54% in comparison to 67.0% in control.

Whorl maggot damage was recorded in 3 locations. Lowest mean damage of 5.8 % was noticed in all insecticides treatment followed by neemazal, eucalyptus oil and cartap hydrochloride combination with 8.0% when compared to control (11.5%).

Grain Yield **(Table:2.96)**

There were significant differences in grain yield among the treatments at all 8 locations except Raipur and Pattambi. Based on mean yield of these locations, Neemazal, Neem oil and triflumezopyrim combination recorded the highest grain yield of 7134.3 kg/ha with 37.1% increase over control (IOC). All the treatments recorded higher yields than Control (3311.7kg/ha).

Insecticides and Botanical Evaluation Trial (IBET) was carried out at 8 locations to to evaluate the efficacy of four combination modules/treatments against major insect pests of rice and consequent impact on natural enemies and grain yield during Rabi, 2019-20. 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. Neemazal, eucalyptus oil and cartap hydrochloride treatment was found effective against pests and its efficacy was superior to control. Highest grain yield of 7134-5 kg/ha was recorded in all insecticide treatment with 37.1% increase over control.

Table: 2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Stem borer Damage (Dead hearts)															Mean
		ADT		CHN	CTC		KJT		MTU	PTB		RPR					
		30DT	50DT	30DT	30DT	60DT	30DT	50DT	40DT	30DT	50DT	30DT	50DT				
1	Botanical-Insecticide 1	7.8b	8.2ab	12.7a	4.9c	2.9c	6.5a	4.9b	3.6ab	8.7ab	10.4a	14.3a	9.9bc				**7.9b**
2	Botanical-Insecticide 2	5.2b	6.4b	5.4b	4.5c	3.4c	7.1a	3.4bc	3.0b	6.8b	10.2a	15.3a	14.8ab				**7.1b**
3	All Botanical	6.4b	9.0ab	14.7a	6.3b	5.7b	7.4a	4.1b	2.6b	6.1b	7.5a	14.6a	6.3c				**7.5b**
4	All Insecticide	1.9b	5.1b	3.7b	2.9d	2.1d	7.0a	2.2c	5.2a	7.1b	8.5a	12.1a	11.2ab				**5.7b**
5	Control (Water Spray)	14.5a	13.7a	16.8a	8.4a	6.7a	6.8a	7.5a	4.2ab	11.7a	12.5a	20.1a	18.7a				**11.8a**

Table: 2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Stem borer Damage (% White Ears)							Mean
		ADT	CHN	CTC	KJT	MTU	RPR	PTB	
1	Botanical-Insecticide 1	1.9b	12.3bc	5.1c	3.8b	12.5a	15.7a	8.2a	**8.5b**
2	Botanical-Insecticide 2	4.6b	4.3c	6.6c	2.6bc	15.8a	21.1a	12.6a	**9.6ab**
3	All Botanical	6.4b	17.1ab	10.9b	3.7b	11.2a	15.9a	16.5a	**11.6ab**
4	All Insecticide	3.5b	3.9c	3.4d	1.4c	10.4a	15.5a	7.5a	**6.5b**
5	Control (Water Spray)	17.3a	22.6a	15.9a	6.9a	14.2a	18.8a	13.3a	**15.5a**

Table:2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

S. No.	Treatment Details	Brown Planthopper (No./10hills)								Mean
		ADT		CHP	MTU			RPR		
		30DT	50DT	55DT	40DT	50DT	70DT	DT		
1	Botanical-Insecticide 1	6.6b	8.3a	7.6c	13.0a	75.0a	223.8a	42.5b		**53.82a**
2	Botanical-Insecticide 2	7.3b	6.0a	14.6bc	13.7a	60.0a	32.5a	40.0b		**24.87a**
3	All Botanical	8.3ab	8.6a	11.3c	21.0a	53.2a	336.5a	40.0b		**68.41a**
4	All Insecticide	7.6ab	5.3a	20.3b	11.7a	66.5a	32.0a	42.5b		**26.55a**
5	Control (Water Spray)	13.0a	9.6a	32.0a	9.5a	82.2a	259.0a	64.0a		**67.04a**

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 (60-65 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: 2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Gall midge Damage (% Silver Shoots)					Mean
		ADT			MTU		
		30DT	50DT		40DT	50DT	
1	Botanical-Insecticide 1	8.2b	6.9ab		4.7ab	7.2a	**6.7ab**
2	Botanical-Insecticide 2	8.2b	4.5b		3.3b	9.2a	**6.3ab**
3	All Botanical	9.2b	6.3ab		5.8a	8.1a	**7.3ab**
4	All Insecticide	1.2b	3.6b		5.2ab	10.7a	**5.1b**
5	Control (Water Spray)	15.5a	9.7a		5.9a	9.4a	**10.1a**

Table:2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Leaf folder (% Damaged leaves)						
		ADT			CHN		MTU	Mean
		30DT	50DT		DT 1	DT 2	70DT	
1	Botanical-Insecticide 1	2.8b	3.5b		5.0bc	2.4bc	7.4a	**4.2b**
2	Botanical-Insecticide 2	3.3b	3.0b		3.3dc	1.6cd	7.3a	**3.7b**
3	All Botanical	4.2b	3.5b		5.8b	3.2b	6.8a	**4.7b**
4	All Insecticide	1.5b	1.7b		2.5d	0.8d	5.7a	**2.4b**
5	Control (Water Spray)	9.2a	8.9a		10.3a	4.9a	7.9a	**8.2a**

Table:2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Green Leafhopper (No./10hills)		Mean
		ADT		
		30DT	50DT	
1	Botanical-Insecticide 1	7.6ab	8.0ab	**7.8b**
2	Botanical-Insecticide 2	9.3ab	7.6ab	**8.4b**
3	All Botanical	9.3ab	9.6ab	**9.4b**
4	All Insecticide	2.6b	3.0b	**2.8c**
5	Control (Water Spray)	12.6a	14.0a	**13.3a**

Table:2.95 Insect pests incidence in different treatments, IBET, Rabi 2020-21

S. No.	Treatment Details	Whorl Maggot (% Damaged leaves)								Mean
		ADT			CHN			PTB		
		30DT	50DT		DT	DT2		25DT	45DT	
1	Botanical-Insecticide 1	5.2bc	3.9b		4.7b	1.8b		12.8a	19.7a	**8.0a**
2	Botanical-Insecticide 2	5.7bc	3.3b		2.9b	0.8b		11.3a	17.7a	**6.9a**
3	All Botanical	6.6b	4.5b		5.8b	2.3b		15.4a	17.6a	**8.7a**
4	All Insecticide	3.2c	2.7b		1.9b	0.8b		12.2a	14.1a	**5.8a**
5	Control (Water Spray)	11.2a	8.3a		10.1a	5.2a		15.9a	18.6a	**11.5a**

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 (60-65 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:2.95 Incidence of natural enemies in different treatments, IBET, Rabi 2020-21

S. No.	Treatment Details	Spiders (No./10hills)					Mean
		ADT		MTU			
		10DT		40DT	50DT	70DT	
1	Botanical-Insecticide 1	5.0ab		16.7a	15.2a	36.7a	**18.4a**
2	Botanical-Insecticide 2	7.6ab		16.2a	20.0a	23.5bc	**16.8a**
3	All Botanical	7.3ab		17.2a	17.0a	34.2ab	**18.9a**
4	All Insecticide	2.6b		19.5a	18.7a	21.5a	**15.5a**
5	Control (Water Spray)	10.0a		15.0a	19.0a	34.2ab	**19.5a**

Table:2.95 Incidence of natural enemies in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Mirid Bugs (no. /10hills)		Mean
		MTU		
		50DT	70DT	
1	Botanical-Insecticide 1	9.2a	119.2a	**64.2a**
2	Botanical-Insecticide 2	8.0a	19.7b	**13.8a**
3	All Botanical	8.0a	119.0a	**63.5a**
4	All Insecticide	6.0a	11.2a	**8.6a**
5	Control (Water Spray)	12.0a	136.2a	**74.1a**

Table:2.96 Grain Yield in different treatments, IBET, Rabi 2020-21

Sl. No.	Treatment Details	Grain Yield (Kg/ha)								Mean
		ADT	CHN	CHP	CTC	KJT	MTU	RPR	PTB	
1	Botanical-Insecticide 1	2498.4a	6600.0bc	4161.8b	3950.0a	2420.0c	3430.0a	6220.0a	3354.2a	**4079.3a**
2	Botanical-Insecticide 2	2317.5bc	7275.0ab	422.05ab	3733.3b	31002.0ab	3200.5ab	6030.0a	30.93.8a	**7134.2a**
3	All Botanical	2100.0cd	5900.0cd	4087.3b	3366.6c	2520.0bc	3452.4a	5985.0a	2979.2a	**3798.8a**
4	All Insecticide	2893.7a	8175.0a	4498.6a	4116.6a	3220.0a	3375.3ab	6320.0a	3864.6a	**4557.9a**
5	Control (Water Spray)	1873.0d	4975.0d	3521.3c	2650.0d	1680.0d	2836.0b	5782.5a	3177.1a	**3311.8a**

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 (60-65 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)

ECOLOGICAL STUDIES & IPM

i) Effect of Planting Dates on Insect Pest Incidence (EPDP)

The trial was conducted during *Rabi* 2020-21 at only one location i.e., Maruteru.

At **Maruteru,** IR 64 was grown in all the three plantings during *Rabi* 2020-21 season. Incidence of stem borer, gall midge, leaf folder, whorl maggot, hispa, BPH and WBPH was recorded in all the three plantings. Incidence of white ears was very high in normal planting (30.73% WE) compared to early and late plantings **(Fig 2.17)**. Gall midge incidence was high in late planting at 45 DAT (14.21% SS). Leaf folder damage exceeded ETL in late planting at 66 DAT (16.62% LFDL). BPH incidence crossed ETL in early planting at 73 DAT and 84 DAT (71 – 269/5 hills) and in late planting at 66 DAT (243/5 hills). However, the incidence of whorl maggot and hispa was very low (< 3% DL) across the plantings.

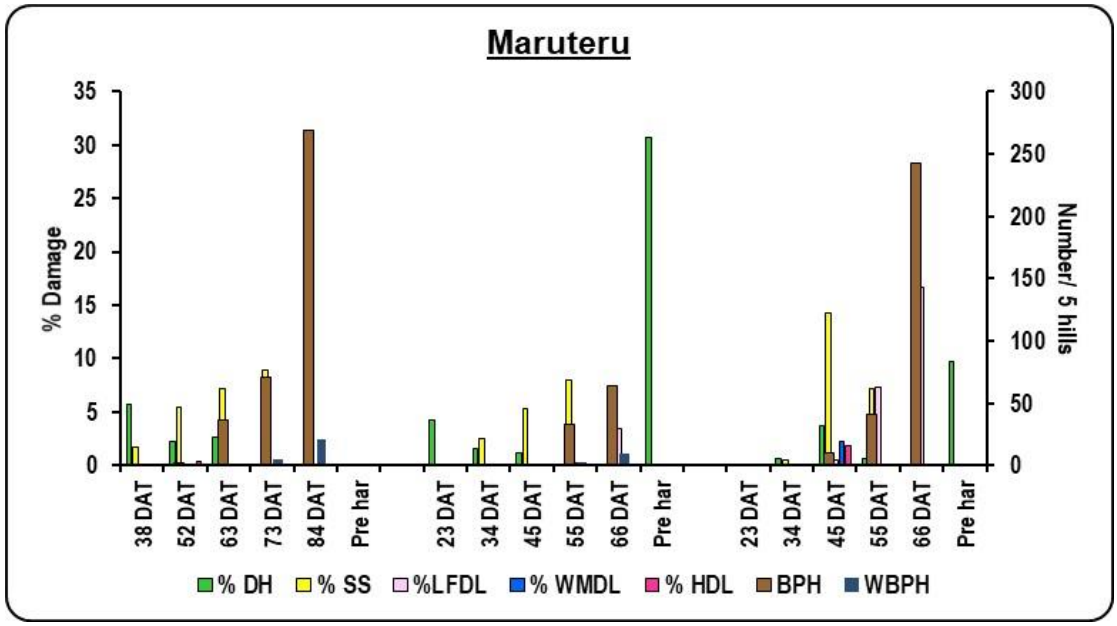


Fig 2.17 Effect of Planting dates on pest incidence at Maruteru, Rabi 2020-21.

Effect of planting dates on insect pest incidence (EPDP) trial was conducted only at Maruteru during Rabi 2020-21. Incidence of white ear heads was high in normal planting (30.73 %) than the other two plantings (<10 %) across the locations. Incidence of gall midge (14.21% SS) and leaf folder (16.62% LFDL) was high only in late planting. BPH population crossed ETL in both normal and late plantings with mean numbers of 94.68 – 97.93/hills. Incidence of whorl maggot, hispa and WBPH was low in all the three plantings.

2.3 BIOCONTROL AND BIODIVERSITY STUDIES

i) Ecological Engineering for Planthopper Management (EEPM)

This trial was carried out at Maruteru during Rabi, 2020-2021.The EE interventions tested at Maruteru were alleyways, flowering plants on bunds, wider spacing and proper water management. The observations on pests and their natural enemies were recorded six times over the crop growth period. The mean BPH population was significantly lower in FP treatment (2.74/hill) compared to EE (14.08 hoppers/hill) **(Table 2.97)**. Similarly, the white ear damage was higher in EE (8.08%). On the other hand, the population of green mirids, spiders and coccinellids was significantly higher in EE compared to FP treatment (11.19, 11.35 and 5.67/ 10 hills respectively). The yield was significantly higher in FP (7117 kg/ ha) as compared to EE treatment **(Table 2.98)**.

Table:2.97 Effect of ecological engineering on pests and its natural enemies at Maruteru, *Rabi 2020 -21*

Parameters	BPH (No./ hill)		WBPH (No./ hill)		WE (No./ hill)		LF (% damage)	
	EE	FP	EE	FP	EE	EE	EE	FP
Mean	14.08	2.74	3.35	0.04	8.08	6.35	3.71	2.76
t value	1.97*		8.31*		1.13**		1.97^{NS}	
df	18		8		18		8	
P - value	0.05		0.05		0.26		0.26	

Table:2.98 Effect of ecological engineering on natural enemies and yield at Maruteru, *Rabi 2020 -21*

Parameters	Mirids (No./ hill)		Spiders (No./10 hills)		Coccinellids (No./10 hills)		Yield* (kg/ ha)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	11.19	1.11	11.35	7.50	5.67	3.27	6474	7117
t value	8.90*		5.07**		3.01**		3.65*	
df	18		28		28		8	
P - value	0.01		0.01		0.01		0.01	

**projected yield*

Ecological engineering for planthopper management was taken up in Maruteru with a combination of interventions such as organic manuring and growing of flowering plants on bunds. The population of natural was significantly higher in ecological engineering as compared to farmer's practices but pest incidence was higher than that of farmers practice indicating a need for a minimal insecticidal intervention along with ecological engineering practices.

ii) Bio-intensive pest management trial (BIPM)

This trial was carried out at two locations, Aduthurai and Pattambi during Rabi 2020-2021

Aduthurai

Observations were recorded on the damage by whorl maggot, leaffolder, hoppers, stem borer and natural enemies like spiders, coccinellids and mirids. The percentage leaves damaged by leaffolder was significantly higher in BIPM plots (12.61 %) compared to the FP plots (4.27 %). The dead heart damage by stem borer was on par in FP and EE plots (17.17 and 13.89 % respectively) **(Table 2.99)**. Similar trend was observed for white ear damage, with 22.17 and 21.33 % in BIPM and FP plots respectively. The natural enemy population *viz.*, number of spiders (12.48/ 10 hills), coccinellids (11.17/ 10 hills) and mirids (10.81/10 hills) was significantly higher in BIPM plots than that of Farmers' practice plots (7.85, 8.28 and 7.98/10 hills respectively). The egg parasitisation of stem bores was significantly higher in BIPM practices (55.56%) when compared to 16.23 % in FP treatment. The yield was higher in FP plots (4232 kg/ha) than that of BIPM plots (4010 kg/ha) **(Table: 2.100)**.

Two species of egg parasitoids were recorded in both treatments – *Telenomus* sp and *Trichogramma* sp. The percent composition was similar with *Telenomus* being dominant accounting for 60.91% and *Trichogramma* accounting for 39.09 %.

Table 2.99 Pest incidence under Bio-intensive pest management trial at *Aduthurai*, *Rabi* 2020 -21

Parameters	LF(% damage)		WM (% damage)		DH (% damage)		WE (% damage)		BPH (No./ hill)	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	12.61	4.27	10.31	12.85	17.17	13.89	22.17	21.33	3.76	2.03
t value	7.45**		1.77 NS		1.41 NS		0.55 NS		7.05**	
df	10		34		22		34		34	
P - value	0.00		0.07		0.16		0.58		0.01	

Table 2.100 Population of natural enemies and yield under Bio-intensive pest management trial at *Aduthurai*, *Rabi* 2020 -21

Parameters	Spiders (No./10 hills)		Coccinellids (No./10 hills)		Mirids (No./10 hills)		% Parasitisation		Yield (Kg/ha)	
	BIPM	FP	BIPM	FP	BIPM	BIPM	BIPM	FP	BIPM	FP
Mean	12.48	7.85	11.17	8.28	10.81	7.98	55.56	16.23	4010	4232
t value	8.43**		8.55**		8.18**		9.79**		2.45*	
df	58		58		58		48		8	
P - value	0.01		0.01		0.01		0.01		0.03	

Pattambi

Observations were recorded on the damage by whorl maggot, stem borer and natural enemies like spiders, coccinellids and mirids. The percentage leaves damaged by

whorl maggot was significantly higher in BIPM plots (14.56 %) compared to the FP plots (12.91%). The dead heart damage by stem borer was on par in FP and BIPM plots (18.28 and 104.57 % respectively) **(Table 2.101)**. A similar trend was observed for white ear damage. The natural enemy population *viz.*, number of coccinellids (11.33/10 hills) and mirids (9.48/10 hills) was higher in FP plots than that of BIPM plots (8.00 and 8.73/ 10 hills respectively). The yield though higher in BIPM plots (2193.75 kg/ha) was on par with that of FP plots (1916.67 kg/ha)**(Table 2.102)**.

Table: 2.101 Pest incidence under Bio-intensive pest management trial at *Pattambi*, *Rabi* 2020 -21

Parameters	WM (% Damage)		DH (% Damage)		WE (% Damage)	
	BIPM	FP	BIPM	FP	BIPM	FP
Mean	14.56	12.91	18.28	14.57	10.83	14.70
t value	2.01 *		0.04^{NS}		1.25^{NS}	
df	22		10		10	
P - value	0.05		0.97		0.21	

***** WM – whorl maggot; DH- dead heart; WE- white ear

Table: 2.102 Natural enemies and yield parameters under Bio-intensive pest management trial at *Pattambi, Rabi* 2020 -21

Parameters	Spiders (No./10 hills)		Coccinellids (No./10 hills)		Mirids (No./10 hills)		Yield (Kg/ha)	
	BIPM	FP	BIPM	FP	BIPM	FP	BIPM	FP
Mean	8.75	9.58	8.00	11.33	8.73	9.48	2193.75	1916.67
t value	0.81^{NS}		2.26 *		2.26*		0.87 ^{NS}	
df	22		10		22		10	
P - value	0.42		0.03		0.03		0.40	

Bio intensive pest management trial was taken up at Aduthurai and Pattambi during Rabi 2020 -21. The natural enemy population was significantly higher in BIPM plots at Aduthurai and the egg parasitisation of stem borers was also high as compared to Farmers practices.

Integrated Pest Management Special Trial (IPMs)

During *Rabi* 2020-21, IPM special trial was conducted at three locations *viz.*, Chinsurah, Karjat and Rajendranagar. Location wise details are discussed below:

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

Practices followed in IPMs trial at Chinsurah, *Rabi (Boro)* 2020-21

	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 leveling 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 leveling 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

Incidence of stem borer, leaf folder, and whorl maggot was observed in both IPM and FP plots. Dead heart damage caused by stem borer crossed ETL at 57 DAT and was at par in both IPM and FP plots. However, incidence of white ears, leaf folder and whorl maggot was low in both the treatments. Grain yield was high in IPM resulting in higher gross returns and higher BC ratio (1.61) compared to farmers' practices **(Table 2.103).**

Table 2.103 Insect pest incidence in IPMs trial at Chinsurah, Boro 2020-21

Treatments	%DH	%WE	%LFDL	%WMDL	Yield	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC ratio
	57DAT	Pre har	50DAT	22DAT	kg/ ha				
IPM	10.03 ± 1.20	8.71 ± 1.26	0.28 ± 0.18	3.67 ± 0.72	5462 ± 82	95585	59350	36235	1.61
FP	10.36 ± 1.04	9.79 ± 1.60	0.34 ± 0.17	3.91 ± 0.69	4728 ± 89	82740	60395	22345	1.37

Price of Paddy = Rs. 1750/q

Karjat: IPMs trial was conducted in three farmer's fields, *viz.,* Sri Dehu Thakare's field of Varai village, Sri Ravindra Kadam's field and Sri Chandrakant Kadu's field of Salokh village. The package of practices followed by all the three farmers are given below:

Practices followed by three farmers in IPMs trial at Karjat, *Rabi* 2020-21

	IPM practices	Farmers practices
Area	1 acre	1 acre
Varieties	F1- Sri Dehu Thakare, Varai village– Karjat 186 F2 - Sri Ravindra Kadam, Salokh village - Karjat 3 F3- Sri Chandrakant Kadu, Salokh village – Karjat 184	
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 • 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)	• Seed broadcasted • 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)

Low incidence of stem borer and leaf folder was observed in all the three farmer's fields in both IPM and FP plots except in farmers' practices of Sri Ravindra Kadam's field (11.78% DH). Grain yield was significantly high in IPM practices than in farmer's practices in all the three fields resulting in higher gross returns and higher BC ratio **(Table 2.104)**.

Table: 2.104 Insect pest incidence in IPMs trial at Karjat, *Rabi* 2020-21

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 Dehu Thakare	IPM	5.60 ± 0.53	1.86 ± 0.42	3803 ± 12	79863	44383	35480	1.80
	FP	7.22 ± 0.67	2.53 ± 0.41	2985 ± 14	62685	44050	18635	1.42
F2 = Sri Ravindra Kadam	IPM	4.47 ± 1.20	2.20 ± 0.59	3699 ± 18	77679	41983	35696	1.85
	FP	11.78 ± 0.66	3.66 ± 0.79	2882 ± 9	60522	43400	17122	1.39
F3 = Sri Chandrakant kadu	IPM	6.60 ± 0.56	2.46 ± 0.28	3682 ± 34	77322	44083	33239	1.75
	FP	8.57 ± 0.94	2.43 ± 0.20	2916 ± 17	61236	45900	15336	1.33

Price of Paddy = Rs. 2100/q

Rajendranagar: IPMs trial was conducted in Sri G Krishna Reddy's field of Kotwalguda village, Shamshabad mandal, Ranga reddy district of Telangana State. Practices followed in both IPM and FP fields are given below:

Practices followed in IPMs trial at Rajendranagar, *Rabi 2020-21*

	IPM Practices	Farmers Practices
Variety	RNR 15048	RNR 15048
Nursery	• Applied of 4 kg urea, 6 kg SSP and 2 kg MOP • Applied Carbofuran 3 G	• Application of 4 kg urea, 6 kg SSP and 2 kg MOP
Main field	• Applied 100 kg N,80 kg P and 30 kg K • Applied Chlorantraniliprole @ 0.3 ml/liter water (60ml/ acre) at panicle initiation stage • Adopted alleyways • Applied weedicide Topstar @ 36 g/ acre at 3-5 DAT(except farmer 3) + one hand weeding • Applied Propiconazole @ 1ml/litre water (200 ml/ acre)	• Application of 120 kg N, 120 kg P and 20 kg K. • Sprayed Chlorpyriphos @ 2.5 ml/ liter water • Hand weeding • Sprayed Cartap hydrochloride 50SP @ 2g/l (400g/ acre) • Sprayed Trifloxystrobin + Tebuconazole @ 0.4g/litre (80g/ acre)

Incidence of white ears caused by stem borer was high in farmer practices at location 1 (17.63% WE) compared to IPM field (11.60% WE). However, white ear incidence was at par in both IPM and FP plots at location 2 (Table…). Incidence of dead hearts and whorl maggot was low in both the treatments across locations. Grain yield were high in IPM plots compared to FP plots at both the locations. High BC ratio was obtained in IPM plots (2.03-2.07) due to high gross returns and low cost of cultivation **(Table 2.105)**.

Table: 2.105 Insect pest incidence in IPMs trial at Rajendranagar, *Rabi* 2020-21

Location	Treatments	% DH	% WE	% WMDL	Yield	Gross Returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC Ratio
		53DAT	Preharvest	53DAT	Kg/ha				
Location 1	IPM	5.41 ± 1.10	11.60 ± 1.60	4.87 ± 0.42	6767 ± 720	123498	60900	62598	2.03
	FP	9.73 ± 2.62	17.63 ± 3.49	3.36 ± 0.26	5755 ± 399	105029	70000	35029	1.50
Location 2	IPM	2.65 ± 0.68	10.76 ± 2.15	4.63 ± 0.36	8474 ± 315	154651	60400	94251	2.56
	FP	3.29 ± 1.51	10.62 ± 2.20	6.81 ± 0.94	7982 ± 536	145672	70225	75447	2.07

Price of paddy = Rs. 1825/q

Integrated Pest Management special (IPMs) trial was conducted at Chinsurah, Karjat and Rajendranagar during Rabi 2020-21. Incidence of stem borer, leaf folder and whorl maggot was observed in both IPM and FP plots across locations. Dead heart incidence crossed ETL at Chinsurah (10.36% DH) and Karjat (11.78% DH) while white ear incidence crossed ETL at Rajendranagar (17.63% WE) in farmers' practices. Incidence of leaf folder and whorl maggot was low in both the treatments. Across the locations, gross returns were high in IPM plots due to the high grain yield and low cost of cultivation resulting in high BC ratio.

Appendix-I

ICAR-IIRR Headquarters, Hyderabad

Sl. No	Name of Scientist	Designation	Trials handled
1	Dr. B. Jhansi Rani	P.S & PI (AICRIP)	IBET
2	Dr. V.Jhansilakshmi	Pr. Scientist	PHS, PHSS & PHPM
3	Dr. A. P. Padmakumari	Pr. Scientist	GMS, SBST, MRST, GMBT, GMPM & NSN (4Trials)
4	Dr. Chitra Shanker	Pr. Scientist	EEPM & BIPM
5	Dr. Ch. Padmavathi	Pr. Scientist	IEMP, CSIP, EPBI & IPMs
6	Dr. Y. Sridhar	Pr. Scientist	PSR, EIGM & Light Trap collections

Cooperating Centres

Sl. No.	State	Location	Code	Name of the cooperator, Designation
1	Andhra Pradesh	Bapatla*	BPT	Dr. C. V. Rama Rao, Pr.Scientist (Ento.) & Head
2		Maruteru	MTU	Dr. M. Nandkishore, Scientist (Ento.)
3		Nellore*	NLR	Dr. I. Paramasiva Reddy, Scientist (Ento.)
4		Ragolu*	RGL	Dr. UdayaBabu, Scientist, Entomology
5	Assam	Titabar	TTB	Dr. Mayuri Baruah, Junior Scientist
6	Bihar	Pusa	PSA	Dr. Abbas Ahmed, Scientist(Ento.)
7		Ambikapur *	ABP	Dr. Kanhaiyalal Painkra, Scientist (Ento.)
8	Chattisgarh	Jagdalpur	JDP	Dr. N. C. Mandawi, Scientist
9		Raipur	RPR	Dr. Sanjay Sharma, Pr. Scientist (Ento.)
10	New Delhi	New Delhi*	IAR	Dr. S. Rajna, Scientist Ento), IARI
11	Jharkhand	Ranchi	RCI	Dr. Rabindra Prasad, Rice Entomologist
12	Gujarat	Nawagam	NWG	Dr. Sanju Thorat, Asst. Res. Scientist
13		Navsari	NVS	Dr. P. D. Ghoghari, Assoc. Res. Scientist (Ento.)
				Dr. Parth B. Patel, Asst. Prof.(Ento.)
14	Haryana	Kaul	KUL	Dr. Maha Singh Jaglan, Asst. Scientist (Ento.)
15	H.P	Malan	MLN	Dr. Ajai Srivastava, Principal Scientist
16	J & K	Chatha	CHT	Dr. Rajan Salalia, Jr. Scientist(Ento.)
17		Khudwani	KHD	Dr. Muneer Ahmad Sofi, Professor, (Ento.)
18	Karnataka	Brahmavar	BRM	**No Entomologist-No trials allotted**
19		Gangavathi	GNV	Dr. Sujay Hurali, Scientist (Ento.)
20		Mandya	MND	Dr. Kitturmath, Entomologist
21	Kerala	Moncompu	MNC	Dr. Jyoti Sara Jacob, Asst. Prof. (Ento.)
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	Dr. B. N.Chaudhari, Jr. Entomologist
26	Manipur	Wangbal	WBL	**No Entomologist-No trials allotted**
27	Odisha	Cuttack*	CTC	Dr. P. C. Rath, Principal Scientist (Ento.)
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 (Ento.)
32	Tripura	Arundhutinagar*	ARN	Mr. Srikanth Nath, Entomologist
33	Telangana	Jagtial*	JGT	Dr. S. Omprakash, Scientist (Ento.)
34		Rajendranagar	RNR	Dr. N. Ramagopala Varma, Pr. Scientist (Ento.)
35		Warangal	WGL	Dr.S.Malathi,P.S/Dr. Shravan, Scientist (Ento)
36	Puducherry - Union Territory	Karaikal*	KRK	Dr. K. Kumar, Prof. & Head (Agril. Ento.)
37		Kurumbapet	KBP	**No Entomologist-No Trials allotted**
38	Uttaranchal	Pantnagar	PNT	Dr. Ajay K. Pandey, Prof. (Dept. of Ento.)
39	Uttar Pradesh	Masodha	MSD	Dr. S.K.S. Rajpoot, Entomologist
40		Ghaghraghat	GGT	- do -
41	West Bengal	Chinsurah	CHN	Dr. Chirasree Ganguly, Entomologist

* - Voluntary Centre

Appendix II

State	Location	*Rabi* 2020-21		*Kharif* 2021	
		Allotted	Recd.	Allotted	Recd.
Andhra Pradesh	Bapatla *	0	0	6	6
	Maruteru	6	6	13	13
	Nellore *	0	0	7	7
	Ragolu *	1	0	8	8
Assam	Titabar	1	0	10	10
Bihar	Pusa	0	0	6	6
Chattisgarh	Ambikapur *	0	0	4	4
	Jagdalpur	0	0	13	13
	Raipur	2	1	10	10
Gujarat	Navsari	0	0	8	8
	Nawagam	0	0	10	10
Haryana	Kaul	0	0	5	5
Himachal Pradesh	Malan	0	0	10	9
Jammu & Kashmir	Chatha	0	0	5	5
	Khudwani	0	0	5	5
Jharkhand	Ranchi	0	0	5	5
Karnataka	Brahmavar	0	0	0	0
	Gangavathi	0	0	16	16
	Mandya	0	0	10	10
Kerala	Moncompu	1	0	11	11
	Pattambi	3	3	13	13
Madhya Pradesh	Rewa	0	0	0	0
Maharashtra	Karjat	2	2	7	7
	Sakoli	0	0	10	10
Manipur	Wangbal	0	0	0	0
New Delhi	New Delhi *	0	0	3	3
Odisha	Cuttack *	2	1	8	6
	Chiplima	1	1	8	8
Puducherry	Karaikal *	0	0	4	4
	Kurumbapet	0	0	0	0
Punjab	Ludhiana	0	0	14	14
Tamil Nadu	Aduthurai	2	2	11	11
	Coimbatore	1	0	12	12
Telangana State	Jagtial *	0	0	7	7
	Rajendranagar	3	3	13	12
	Warangal	0	0	12	12
Tripura	Arundhutinagar *	0	0	3	2
Uttar Pradesh	Ghaghraghat	0	0	5	4
	Masodha	0	0	7	7
Uttaranchal	Pantnagar	0	0	12	12
West Bengal	Chinsurah	4	3	9	9
Total trials in funded and voluntary centres		29	22	320	314
% Receipt of data for *kharif 2021* & *rabi 2020-21*		**75.9**		**98.1**	
Overall % Receipt of data		**87.0**			

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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