

## ENTOMOLOGY

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## 2. Entomology *Kharif* 2010

### SUMMARY

All India Coordinated Entomology Program was organized and conducted during *kharif* 2010 with eight major trials encompassing various aspects of rice entomology involving 313 experiments (82.6%) that were conducted at 47 locations (36 funded + 11 voluntary) in 24 states and one union territory. Details of scientists involved in the program at headquarters, cooperating centres and the performance of centres are provided in Appendices I and II.

**2.1 Host plant resistance studies** comprised of seven screening experiments involving 1368 entries which included 846 pre-breeding lines, 104 hybrids and 392 germplasm accessions. These entries were evaluated against 12 insect pests in 174 valid tests (46 greenhouse reactions + 128 field reactions). The results of these reactions identified 53 entries (3.9% of the tested) and 8 donors (2.0%) as promising against various insect pests. Of these promising materials, 18.9% were under retesting.

**Planthopper screening trial (PHS)** was constituted with 47 entries comprising of 14 breeding lines developed at TNAU, Coimbatore, 10 introgression lines derived from wild rices and developed at DRR and 23 lines promising against planthoppers during 2009 in various trials along with two resistant checks and one susceptible check. The entries were evaluated at 18 locations across the country against brown planthopper (BPH), whitebacked planthopper (WBPH), green leafhopper (GLH) and mixed populations of planthoppers under both field and greenhouse tests. Evaluation of all the entries against the three hopper pests in 10 greenhouse and 9 field tests revealed six entries as promising in 6 – 11 out of 19 tests. Of the promising cultures, five breeding lines were from Cuttack and another one was RP 4918 – 230S (Swarna/*O.nivara*) developed at DRR.

**Gall midge screening trial (GMS)** was constituted with 32 cultures derived from 22 crosses bred at 4 locations and evaluated at 14 locations. Evaluation of 32 entries at 12 locations in 12 valid tests (one greenhouse and 11 field tests) against 6 gall midge biotypes and 2 undefined populations revealed that 7 entries were promising in 3-4 tests out of 12 tests.

**Gall midge special screening trial (GMSS)** was constituted with 66 germplasm accessions and TN1 as susceptible check and evaluated at 8 locations against 6 biotypes and a population from Brahmavar. Evaluation of 66 germplasm accessions in one greenhouse and 7 field tests revealed that 6

accessions were promising against 6 biotypes and a population from Brahmavar in 2-4 tests. This included 3 new accessions *viz.*, KD-5-3-14, RCM-10, RCM-9 which were also found promising at Brahmavar.

Evaluation of 60 entries in **Leaf folder screening trial (LFST)** at 13 locations revealed that 6 entries were promising in 6 of the 9 tests. W 1263 and LF 293 (IR 36 / TNAU LFR 831311) were promising in 6 of 9 valid tests. These two lines were showing a consistent promising reaction since two years.

**Germplasm evaluation against major insect pests (GEMP)** trial was constituted with 317 germplasm accessions evaluated against 5 pests in 5 locations. The tests revealed that 2 accessions *viz.*, ACC 5345 and ACC 5403 as promising in 2 out of 10 tests (6 greenhouse and 4 field tests). All the entries were susceptible to gall midge at Brahmavar and Madurai.

**Multiple resistance screening trial (MRST)** was constituted with 55 entries comprising of 25 hybrids, 23 pre breeding lines and check varieties and evaluated at 32 locations. Evaluation of these entries against 12 insect pests in 50 valid tests (12 green house and 38 field tests ) revealed 7 entries as promising in 4-11 test against 2-6 pests with an MRI varying from 18-45. Of these, 4 are RP cultures from DRR and 2 are CB cultures and a hybrid, RTNRH-10. The PPR of these promising entries varied from 3.0-7.5

**National screening nurseries (NSN)** included four nurseries *viz.*, NSN1, NSN2, NSNH and NHSN. **NSN1** consisted of 171 entries (134 AVT entries+34 checks +3 checks from Entomology) evaluated at 19 locations against 9 insect pests. **NSN2** had 580 entries (534 pre breeding cultures from IVT trial, 46 yield checks + Suraksha and TN1 as pest evaluation checks) evaluated at 12 locations. **NSN hills** was constituted with 70 entries (61 cultures + 9 checks ) and conducted at 4 locations apart from DRR. **NHSN** was constituted with 82 hybrids nominated by both public and private sector agencies and tested at 6 locations against the prevalent pest damage. Evaluation of NSN1 cultures across locations in 33 tests against 9 pests identified 9 cultures as promising in 4-5 test against 2-4 pests. Testing of NSN 2 cultures across locations in 15 tests against 8 pests revealed 6 cultures as promising in 3 tests against 3 pests. IET Nos 21746, 21378 and 21764 were identified as promising in 2 tests against 1-2 pests when NSNH cultures were evaluated in 3 greenhouse and 3 field tests. In NHSN, IET-E-04 was the only culture promising in 4 tests against 3 pests.

**2.2 Insect biotype studies** included two trials 1. Gall midge biotype trial (GMBT) and 2. Gall midge population monitoring trial (GMPM).

This year, Gall **midge biotype trial (GMBT)** was constituted with 12 gene differentials whose genetics is well known and 6 potential donors of gall midge resistance and two susceptible check varieties (TN1 and B95-1). The trial was conducted at 13 locations in 4 greenhouse and 12 field tests. The entries

were evaluated against 6 different biotypes which were already characterized (GMB1, GMB3, GMB4, GMB4M, GMB5 and GMB6) and four undefined populations of gall midge. Jhitpiti and Aganni with *Gm8* were highly promising against 10 populations followed by INRC 1997 and INRC 3021 which were promising against 7-8 populations. INRC 1997 at Brahmavar, Dukong 1 at Titabar and six differentials were promising against Nellore population. *Gm7* was susceptible to all the populations tested and ARC 6605 was promising against Madurai population.

Virulence composition of gall midge was monitored in **Gall midge population monitoring trial (GMPM)** at Pattambi and Sakoli through single female tests. It was observed that 50 % of the populations at these locations displayed virulence against *Gm4* and *Gm11* genes.

**2.3 Chemical Control studies** were continued during *kharif* 2010 and included Insect evaluation trial (IET) and Pesticide compatibility trial (PCT).

**Insecticide evaluation trial (IET)** with an objective of evaluating efficacy of newer insecticide formulations against major insect pests of rice and consequent impact on grain yield, was carried out at 36 centres during *kharif* 2010. Based on the performance of the insecticide treatments for their efficacy in reducing pest infestation and their impact on grain yield, it was evident that the combination product containing Buprofezin 20% + Acephate 50% WP (RIL-049/F1) at the highest tested dose of 1000 g/ha was effective against stem borer, leaf folder, BPH, WBPH and army worm and registered the second highest grain yield among the treatments. The standard check, monocrotophos performed well against leaf folder and hispa and showed third highest yield. Though Acephate 95 SG treatment yielded the highest across the locations, its performance in terms of effectiveness in reducing pest populations was superior only against GLH and hispa.

**Pesticide compatibility trial (PCT)** with the objective of evaluating the compatibility of newer insecticide and fungicide formulations as tank mix against major insect pests and diseases of rice and consequent impact on grain yield, was carried out at 11 centres during *kharif* 2010. Based on the performance of the treatments when applied alone *vis a vis* their respective combinations in reducing pest infestation and their impact on grain yield, it was evident that rinaxypr when applied alone was the best treatment followed by its combination with tricyclazole both in terms of reducing pest and disease incidence as well as realizing higher yields and superiority in yield increase over control. The results also revealed that there was no adverse impact on the efficacy of either rinaxypr against stem borer or ethiprole+imidacloprid against plant and leafhoppers due to their combination with fungicides or *vice versa* confirming the compatibility of the chemicals when used as tank mix in the field.

**2.4 Ecological studies** consisted of three trials: i. Influence of rice cultivation systems on insect pest incidence (IRCP), ii. Effect of organic manures on pest incidence (EOMP) and iii. Trap crop for stem borer management (TCSB).

**Influence of rice cultivation systems on insect pest incidence (IRCP)** trial was carried out at 3 locations. Among the two cultivation systems, whorl maggot (1.17%) and hispa (0.19%) damage was low while white ear (15.25%) and leaf folder (14.14%) damage was high in direct seeded rice as compared to normal method. Hybrids registered higher whorl maggot (11.92%) and leaf folder (13.05%) damage and lower dead hearts as compared to the varieties. Across the locations, direct seeded rice recorded higher yield at two locations while normal method recorded higher yield at one location. Hybrids out yielded varieties except at Ludhiana.

In the **Effect of organic manures on pest incidence (EOMP)** trial carried out at 6 locations, stem borer, leaf folder, gall midge, GLH and hispa damage was high in recommended fertilizer dose treatment and low in untreated control except at Ranchi wherein neem cake and karanj cake applied plots recorded low pest incidence. Highest grain yield was obtained from recommended fertilizer dose treatment at four locations despite high pest pressure and damage. Vermicompost application resulted in variable performance across locations; lower planthopper populations with similar yield at Maruteru, lower pest damage and lower yield at Ranchi and Ludhiana, and no difference in pest incidence and yield at Mandya when compared with the recommended fertilizer dose.

The trial on **Trap crop for stem borer management (TCSB)** was in the second year of testing and was conducted at 6 locations for managing yellow stem borer damage by planting one row of susceptible variety (Pusa Basmati) for every 9 rows of main crop. The main crop varieties tested were Swarna (Chinsurah and Raipur), Jal Priya (Gaghraghat), Karjat 2 (Karjat), Rajendra Kasturi (Pusa) and BPT 5204 (Rajendranagar). Dead heart damage at Chinsurah and Pusa; white ear damage by stem borer at Chinsurah, Raipur, Pusa and Gaghraghat were significantly lower in the main treatment where trap crop (Pusa Basmati) was grown along with main crop. The total grain yield was also higher in this treatment (main crop +trap crop) as compared to main crop alone at these locations. The benefit cost ratio varied from 1.18-4.17 across locations and the monetary gain obtained by growing trap crop along with main crop was 3.27-8.25%. Need based application of insecticide had significantly reduced the damage and gave higher yields.

**2.5 Biocontrol and Biodiversity studies** covered Monitoring of pest species and their natural enemies (MPNE) and Ecological engineering for management of planthoppers (EEMP).

**Monitoring of pest species and their natural enemies (MPNE)** was carried out at 20 locations in *kharif 2010*. Stem borer composition and its natural enemies were reported from 11 centres. Four species in varying composition were reported from the centres and three parasitoids were reported on the egg masses viz., *Tetrastichus schoenobii*, *Telenomus dignus* and *Trichogramma japonicum*. Composition of three species of leaf folder viz., *Cnaphalocrocis medinalis*, *Marasmia patnalis* and *Brachmia* sp., were reported from 6 centres. *Apanteles* was the most prevalent parasitoid resulting in 16-76 % larval parasitisation. The planthopper ratios and population of its predator were reported from two centres. The extent of parasitisation of gall midge reported from four locations was 15.6 to 58.4 %.

**Ecological engineering for management of planthoppers (EEMP)** was proposed last year with the objective of managing hoppers through increased natural enemy fitness. An increase in mirids was observed in plots with alleyways at Kaul, while at Mandya no significant differences were observed between plots with and without enhanced floral diversity.

**2.6 Integrated Pest Management Studies** involved a new study, yield loss estimation trial and on-farm pest management trial.

A new trial, **Yield loss estimation trial (YLET)** was initiated this year for two insect pest's viz., leaf folder and stem borer. Damage levels were created by augmentation and protection at different crop growth stages. The trial was conducted at 6 locations. Step down regression analysis revealed that white ears had significant impact on yield at Chinsurah and Ludhiana ( $r^2 = 0.89$ ).

In the trial on **On-farm pest management (OIPM)**, validation of IPM modules at three locations revealed that BPH and gall midge populations could be managed effectively with one need based application of chemicals. At Pusa, stem borer damage was high and IPM I and IPM II modules were at par with farmers practices.

**2.7 Population dynamics of insect pests** assessed through light trap collections included reports on dynamics of populations of major insect pests of rice along with the corresponding meteorological factors from 28 centers during the year 2010.

**Yellow stem borer** was reported from 26 centers with the highest peak catch (5185 females + 503 males) occurring during first week of May at Maruteru. This pest appears to be maintaining its status as number one pest of rice in India.

**Gall midge** was reported from 14 centers, with the highest catch of 1900 insects per week during last week of October at Warangal. The pest continued to damage the crop at low levels in localized pockets.

**Brown planthoppers (BPH)** were reported from 22 centers, with maximum peak population (15190 insects / week) occurring during third week of March at Maruteru. The pest is spreading to new areas causing severe damage.

**Whitebacked planthopper (WBPH)** was present at 16 centers with the highest population of 4023 insects/week occurring during second week of October at Pantnagar. Thus, WBPH is also spreading to new areas and becoming important along with BPH.

**Green leafhoppers** were reported from 25 centers with the highest population of 172336 during third week of October at Jagdalpur. Thus, this pest was found to maintain its abundance, both in area and magnitude.

Although occurrence of **Leaf folder** was reported from 24 centers, populations were very low in many centers. The highest population of 426 per week recorded during fourth week of January at Moncompu.

Among **other insect pests**, case worm, gundhi bug, white leafhopper, pink stem borer, zigzag leafhopper, blue beetle, grasshopper, black bug were important to a lesser magnitude.

Among the **natural enemies**, mirid bugs and coccinellids were reported from many centers.

## **2. ENTOMOLOGY**

### INTRODUCTION

Rice production scenario during the *kharif* 2010 seemed to be bright with an early onset of monsoon, but subsequently many central and northern parts of the country received less than normal rainfall and the southern states had untimely floods. Hence, total rice production is predicted to be better than last year but not crossing the best recorded during 2009-10. Insect pest scenario, in tune with this, had occasional outbreaks of pests associated with floods and drought.

Real-time online Pest Surveys initiated last year were continued. During July, flash floods were reported from Haryana and incidence of stem borers in Uttarakhand. During August, black bug damage was seen in Kerala and incidence of WBPH reported from Himachal Pradesh and Kerala. During September, gall midge incidence was noticed in parts of Orissa and Jharkhand. During October, moderate to severe damage by BPH and WBPH were reported from Kerala, Chhattisgarh, Punjab, Uttarakhand and Delhi. Armyworm damage was also observed in Orissa following floods. However, overall pest situation was not alarming.

Entomology coordinated studies continued to focus on host-plant resistance, monitoring virulence in pest populations and identification of effective yet safe insecticides and their compatibility. Ecological studies covered influence of rice cultivation practices and organic manures on pest population dynamics and effectiveness of trap crop for stem borer management. Species composition of major pests and their natural enemies was also studied across the locations. A new study on estimation of yield losses due leaf folder and stem borer was initiated this year. On farm Integrated Pest Management studies were continued while a new initiative, IPM special trial was taken up integrating insect pests, pathogens and weeds. The long term pest surveillance through light trap catches continued to provide short term fluctuations and long term trends in pest abundance.

This report summarizes significant findings under each of the trials taking into account the performance across the locations.

## 2.1 HOST PLANT RESISTANCE STUDIES

Host plant resistance trials are 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 characterize insect pest populations from various hot spots. To achieve these objectives, seven trials viz., i) Planthopper screening trial (PHS), ii) Gall midge screening trial (GMS), iii) Gall midge special screening trial (GMSS), iv) Leaf folder screening trial (LFST), v) Germplasm evaluation against major insect pests (GEMP), vi) Multiple resistance screening trial (MRST), and vii) National screening nurseries (NSN) were constituted and conducted. The results are summarized and discussed trial wise. The pest reaction of the entries in each trial are tabulated in a separate volume “**Screening Nurseries: Vol. II - Pests & Diseases**”.

### i) Planthopper screening trial (PHS)

The trial was constituted with 47 entries comprising of 14 breeding lines developed at TNAU, Coimbatore, 10 breeding lines derived from wild rices and developed at DRR and 23 lines promising against planthoppers during 2009 in various trials along with two resistant checks PTB33 and MO1 and one susceptible check TN1. Of these, 23 entries were under retesting. The entries were evaluated at 18 locations across the country against brown planthopper (BPH), whitebacked planthopper (WBPH), green leafhopper (GLH) and mixed populations of planthoppers under both field and greenhouse tests. Data from Navsari, Nawagam, Maruteru and Karjat were not considered for analysis due to low pest pressure.

Evaluation of entries in 7 greenhouse tests against brown planthopper revealed that six breeding lines, viz., C R 2711-76, C R 2711-139, C R 2711-149, C R 2711-114, C R 2712-12 and RP Bio 4918 -230(S) (Swarna/*O.nivara*) as promising in 3-6 tests. Three cultures C R 2712-12, RP Bio 4918-230(S) and RP Bio 4919 (KMR3/*O.rufipogon*) were promising in 3 out of 6 field tests against BPH alone. Analysis of data across locations in all the 13 tests against BPH revealed that all the cultures promising in greenhouse evaluation were promising here also in 5-8 tests. But C R 2712-12 and RP Bio 4918-230(S) were promising in seedling evaluation test and field tests (6 out of 13 tests).

Two entries viz., IR 64 Sub1 and C R2502 had DS< 3.0 in two greenhouse tests (DRR and Coimbatore) against whitebacked planthopper. Four entries had DS 1.0 against GLH alone under greenhouse conditions at Coimbatore. Evaluation of cultures in 3 field tests identified OR 2109-2 as promising and 9 cultures (CB 05-022, CB 05-031, CB 06-135, CR 2711-76, CR 2711-114, CR 2711-149, NDR 2084, OR 2162-5, RP Bio 4919) had no hopper burn at Pantnagar.

**Planthopper population dynamics:** Fig 1. depicts the population dynamics of planthoppers reported from 5 locations. The data revealed that across locations the infestation started around 60 DAT except at Sambalpur where it was at 32 DAT. WBPH was observed at Raipur, Pantnagar and Sakoli but in low numbers. At Gangavathi, it was only BPH. At Pantnagar, Sambalpur and Sakoli mixed populations were observed, but BPH was consistently present through out the observation period.

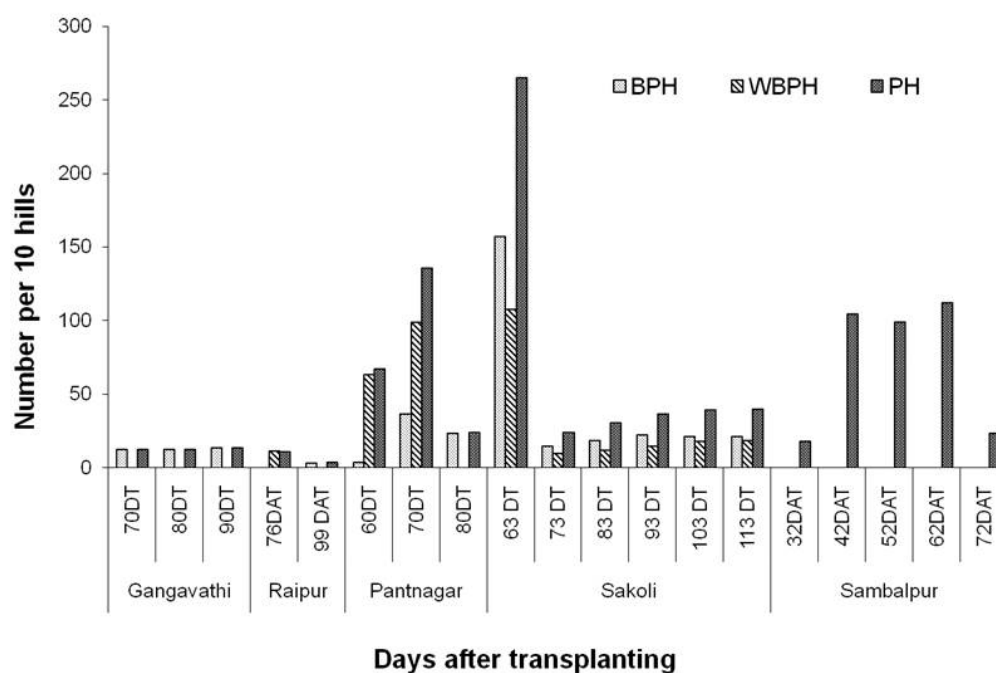


Fig 2.1: Population dynamics of planthoppers in PHS, kharif 2010.

Table 2.1: Reaction of most promising cultures against hopper pests in **PHS**, *kharif* 2010

Entry No.	Designation	BPH	BPH	WBPH	GLH	PH	Overall NPT
		GH NPT (7)	FR NPT (6)	GH NPT (2)	FR NPT (1)	FR NPT (3)	
23	CR 2711-76	6	2	1	1	1	<b>11</b>
26	CR 2711-149	4	2	0	0	1	<b>7</b>
44	RP Bio 4918	3	3	0	1	0	<b>7</b>
24	CR 2711-114	3	2	0	0	1	<b>6</b>
25	CR 2711-139	4	2	0	0	0	<b>6</b>
27	CR 2712-12	3	3	0	0	0	<b>6</b>
20	PTB 33	4	2	0	0	1	<b>7</b>

Valid data from following locations was considered for analysis of **PHS**, *Kharif* 2010

<b>BPH (GH)</b>	DRR	CBT	MND	RPR	CTC	MDR	LDN
<b>BPH (FR)</b>	MLN	KUL	MDR	REW	MND	GGV	
<b>PH (FR)</b>	SKL	SBP	PNR				
<b>WBPH</b>	DRR	CBT					
<b>GLH</b>	CBT						

*Evaluation of all the entries against the three hopper pests in 10 greenhouse and 9 field tests revealed six entries as promising in 6 – 11 out of 19 tests (Table 2.1). Of the promising cultures, fives breeding lines were from Cuttack and another introgression line derived from wild rice and developed at DRR.*

## **ii) Gall midge screening trial (GMS):**

The trial was constituted with 32 cultures derived from 22 crosses bred at 4 locations and evaluated at 14 locations. Data from Sakoli and Raipur were not considered for analysis due to low pest pressure. Valid data from 12 locations is analysed and discussed herewith. JGL 6266, JGL 17190 had nil damage at Sambalpur against gall midge biotype1 (GMB1). JGL 17782 and JGL17788 had nil damage at Ranchi against GMB3. RP4930-BA, RP4930-BA, RP 4929-BK, RP 2068-18-3-5, RGL 7001 had nil damage against GMB4 at Ragolu and GMB4M at DRR. JGL 17653 was the only entry which had nil damage at Warangal (GMB4M). JGL 17578, JGL 17974 recorded nil damage for GMB5. JGL 17974, JGL 6266, JGL 17653, JGL 17673 and RGL 7002 had nil damage against GMB6. JGL 17578 and RP 4929-BK had nil damage against undefined biotypes at Nellore.

*Evaluation of entries at 12 locations in 12 valid tests (one greenhouse and 11 field tests) against 6 gall midge biotypes and 2 populations revealed that 7 entries were promising in 3-4 tests out of 12 tests (Table 2.2 ). JGL 17190\* is the old entry under retesting. All the other 6 entries identified as promising are new nominations. Additional tests at DRR recorded resistance in RP4930BK against GMB1 and GMB4 also.*

**iii) Gall midge special screening trial (GMSS):**

The trial was constituted with 66 germplasm accessions and TN1 as susceptible check and evaluated at 8 locations against 6 biotypes and a population from Brahmavar. Pest pressure at Raipur was very low. INRC 6260, INRC 17459, INRC 17494 and ARC 15067 recorded nil damage at Sambalpur by gall midge biotype1 (GMB1). INRC 17534 is the only accession with nil damage against GMB3 at Ranchi apart from four donors viz., W1263, Jhitpiti, RP 2068-18-3-5 and Madhuri 9. IC 114788 and INRC 17494 were the two accessions promising against GMB4 and GMB4M at DRR but IC 114788 was susceptible at Warangal. At Warangal INRC 17468 and INRC 17470 recorded nil damage against GMB4M. KD-5-3-14, ARC 13516, WR-1-9-1-1 were identified as promising at Moncompu for GMB5. KD-5-3-14, RCM-10, RCM-9 had nil damage at Brahmavar. Eight accessions were promising against GMB6 at Iroisemba.

*The results identified 6 accessions viz., INRC 17494, IC 114788, INRC 17459, KD-5-3-14, RCM-10, RCM-9 as promising in 2-4 tests apart from the donors, Jhitpiti Phalguna Abhaya and RP 2068-18-3-5 (Table 2.3) against 6 biotypes and a population of gall midge.*

Table 2.2 : Promising cultures identified against gall midge in **GMS**, *kharif* 2010

Entry No.	Designation	Cross	GMB1	GMB3	GMB4	GMB5		GMB6		GMB4M		GMB?			GM NPT 12
			SBP	RNC	RGL	MNC	PTB	WGB	IRS	WGL	DRR	NLR	BMR	MDR	
			FR	FR	FR	FR	FR	FR	FR	FR	GH	FR	FR	FR	
			% DP	%SS	%DP	%DP	%DP	%DP	%DP	%DP	%DP	%DP	%DP		
6	JGL 17578	JGL 3844/NLR 34452	10	18.2	55.6	0	0	0	5	100	100	0	85	59.3	4
19	JGL 17974	MTU 1001/JGL 11470	15	9.3	20	0	0	0	0	100	100	10	75	47.4	4
1	JGL 6266	Erramallelu/Betangamblin	0	11.1	NT	10	23.8	0	0	90	100	40	NT	65.6	3
2	JGL 17190*	JGL 1798/MTU 1010	0	13	0	50	NT	0	80	90	NT	50	NT	NT	3
11	JGL 17653	JGL 3828/OR 1032-5-2	75	9.3	70	100	23.8	0	0	0	100	35	70	82.1	3
27	RP 4930-BA	B95-1/Kavya	30	14	0	50	38.1	0	15	90	0	25	100	100	3
17	JGL 17788	WGL 14377/JGL 3844	20	0	50	0	15	0	5	90	100	10	75	46.2	3
Average damage in TN1			55	33	68	100	32	5	30	55	100	48	90	100	
Promising level			0	36	0	0	0	0	0	0	0	0	10	10	
No. promising			2	2	8	3	7	20	7	1	5	3	0	0	

Table 2.3: Promising germplasm accessions against gall midge biotypes in **GMSS**, *kharif* 2010.

Entry No.	Designation	Per cent plant damage in field								GM NPT 8
		GMB1 SBP	GMB 3 RNC	GMB 4 RGL	GMB 5 MNC	GMB 6 IRS	GMB 4M		GMB? BMR	
							WGL	DRR <sup>\$</sup>		
36	INRC 17494*	0	55	0	50	10	10	0	20	4
19	IC 114788*	15	25	0	60	10	100	0	55	3
33	INRC 17459*	0	15	25	50	15	10	0	15	2
55	KD-5-3-14	45	20	25	5	15	60	NT	0	2
62	RCM-10	20	30	40	40	10	60	100	0	2
63	RCM-9	15	30	33.3	50	10	70	100	0	2
60	RP 2068-18-3-5	10	0	0	75	25	20	NT	20	2
51	Jhitpiti	35	0	0	10	15	10	NT	15	3
40	Phalguna	55	20	60	60	10	30	0	33.3	2
69	Abhaya	65	5	0	10	70	100	NT	30	2
Average damage in TN1		52	55	43	83	40	93	100	29	
Promising level		0	0	0	10	10	0	0	0	
No. promising		4	5	7	5	11	2	4	3	

\$ = Greenhouse reaction

#### iv) Leaf folder screening trial (LFST)

This trial was constituted during 2008 to identify donors for leaf folder resistance. The trial consisted of 60 entries evaluated in the field at 13 locations across the country. Data from Aduthurai, Chinsurah, DRR and Navsari were not considered for analysis due to low pest pressure and data from Arundhuthinagar was not considered for analysis due to late receipt. Though the pest was augmented, the damage was low in many locations due to heavy and continuous rainfall. Data analysis from 9 valid tests revealed that 6 entries were promising in 6 of the 9 tests (Table 2.4). W 1263 and LF 293 (IR 36 / TNAU LFR 831311) showed consistent promising reaction during three years of testing, recorded promising reaction in 6 of 9 tests this year. RP 4645 -688 (ARC 15831/ Aganni), GEB 24 and INRC3021 recorded promising reaction in 4 of 9 tests. The consistency in reaction of some of these entries suggests that these entries could be used for further studies on mechanisms and genetic basis of resistance of leaf folder.

Table 2.4: Promising cultures against leaf folder, **LFST**, *Kharif* 2010

S.No	Designation	Per cent damaged leaves									NPT (9)	ADN
		JDP 61 DAT	MLN 80 DAT	LDN 75 DAT	NWG 68 DAT	PDC 30 DAT	KRK 80 DAT	NLR 60 DAT	KUL 68 DAT	PTN -		
19	W 1263 (DRR)*	3.67	45.5	3.99	6.54	1.3	100	57.52	3.3	3.93	6	0.74
24	LF 293*	7.79	11.8	2.4	8.8	1.6	100	39.83	5	1.74	6	1.89
18	TKM 6*	6.06	13.4	6.26	7.22	1.7	100	31.7	2.8	4.77	5	0.23
11	GEB 24*	2.63	6.5	13.34	7.66	3.6	NT	23.75	6	5.05	4	1.14
12	INRC 3021*	4.14	13	14.93	7.66	2.9	NT	23.62	NT	5.97	4	4.07
15	RP 4645-688	6.57	13	29.06	8.98	1.7	100	58.33	4.8	10.32	4	0.98
Av.damage in TN1		6.72	45.44	26.7	12.53	14.35	99.98	40.61	7.7	12.44		3.41
Promising level		5	15	5	10	5	15	10	5	5		5
No. Promising		8	8	5	36	16	0	1	21	5		51

\* Entry under retesting

*Evaluation of 60 entries in Leaf folder screening trial (LFST) at 13 locations revealed that 6 entries were promising in 6 of the 9 tests. W 1263 and LF 293 (IR 36 / TNAU LFR 831311) are showing consistent promising reaction since two years and this year also, recorded promising reaction in 6 of 9 tests.*

#### v) Germplasm evaluation against major insect pests (GEMP)

The trial was constituted with 317 germplasm accessions nominated by NBPGR with TN1 as susceptible check and Suraksha as resistant check. The trial was conducted at 4 locations apart from DRR against 5 major pests viz., BPH, WBPH, GM, SB and leaf folder. Data from Mandya for rice thrips and leaf folder; Karjat and Mandya for stem borer dead heart damage; due to low pest pressure were not considered for analysis. Planthoppers data

from Maruteru due to severe rat damage was also not included. ACC Nos 5345, 4656, 4067, 3627, 3026, 3016, 2914, 2836, 2834, 2780, 2638, 2198 were promising against planthoppers in one test out of 5. ACC Nos 4067, 3016, 2638, 2684 and 5310 recorded nil damage against biotype 4M at DRR. Only one accession, ACC No 3405 recorded low damage at Karjat and nil damage at Ludhiana. At Ludhiana, against leaf folder 8 accessions viz., ACC Nos 2494, 3643, 4647, 4648, 4740, 4805, 3418 and entry no 193 recorded <10% DL. At DRR three accessions viz., 3503, 4294 and 5310 had ≤ 10% plant damage against stem borer dead hearts.

*Evaluation of germplasm accessions in 6 greenhouse and 5 field tests helped in identification of only two accessions viz., ACC 5345 and ACC 5403 promising in 2 tests out of 11 against 5 pests.*

#### **vi) Multiple resistant screening trial (MRST)**

The trial was constituted with 55 entries comprising of 25 hybrids , 8 lines from Coimbatore, 9 lines from DRR, 4 from Rajendranagar and 2 from Manipur and with TN1, PTB33, Abhaya, Kavya and Suraksha as checks. The entries were evaluated at 32 locations. Data from Jagdalpur and Maruteru for BPH; Jagdalpur for GLH; from Ragolu and Ranchi for gall midge ; from Jagdalpur, Karjat, Ludhiana, Faizabad, Madurai, Patna, Gangavathi , Mandya , Moncompu and Navsari for stem borer dead heart damage; Kaul, Gaghraghat, Bubaneswar and Bankura for stem borer white ear damage; Jagdalpur, Chinsurah, Faizabad, Khudwani, Gangavathi, Iroishemba, Raipur and Ranchi for leaf folder damage; Malan. Faizabad and Rajendranagar for whorl maggot damage ; Rice hispa from Malan were not considered for analysis due to low pest pressure. Data from Arundhuthinagar was not included due to late receipt. Valid data across locations is discussed pest wise.

**Hopper pests:** Indam 200-017 and US312 were promising against hopper pests in 2-3 tests of the 12 tests.

**Gall midge:** RP 4687-52-2-1192, RP 4687-52-2-1197, RP 4643-51-2-1037, RP 4683-32-1-684, and RP 4686-48-1-935 were promising in 5-6 tests of the 10 tests against gall midge. These were developed from either Aganni or INRC 3021 as one of the parents and are under retesting.

**Stem borer:** CB 06-563, RP 4683-32-1-684 and Indam-200-017 were promising in 2 tests of the 6 valid tests against dead heart damage. CB 06-563, RNR 898, RP 4683-32-1-684 and Suraksha were promising in 3 tests against white ear damage alone. CB 06-563, CB 06-535, CB 06-548, CB 06-803 and RNR 898 were promising in 2-3 tests against both dead heart and white ear damage of the 14 tests.

**Leaf folder:** RP 4687-52-2-1197, KD-6-18-7-1 and NK-5251 were promising against leaf folder in 2-3 tests out of 9 tests.

**Leaf damaging pests:** This includes damage by whorl maggot, hispa, grass hoppers in 5 tests. CB 06-535, RP 4683-29-2-645, RP 4683-32-1-684, RP 4684-35-2-746, RP 4687-52-2-1192, Sahyadri-4 and RTNRH-10 were promising against leaf damage in one test only.

Table 2.5 : Most promising cultures promising against insect pests in **MRST, kharif 2010**

S.No.	Designation	Cross combination	PH NPT 12	GM NPT 10	SBDH NPT 6	SBWE NPT 8	LF NPT 9	LDP NPT 5	Overall NPT 50	No. of pests 12	MRI 600	PPR 100
17	RP 4683-32-1-684*	Aganni/AC 169	0	5	2	1	0	1	9	5	45	7.5
22	RP 4687-52-2-1192*	INRC3021/TN1	0	6	0	1	1	1	9	4	36	6.0
53	RTNRH-10	-	1	0	1	1	1	1	5	6	30	5.0
1	CB 06-535	-	1	1	0	0	1	1	4	5	20	3.3
3	CB 06-563	-	0	3	2	1	0	0	6	3	18	3.0
19	RP 4686-48-1-935*	Aganni/AC 355	0	5	0	0	1	0	6	3	18	3.0
23	RP 4687-52-2-1197*	INRC3021/TN1	0	6	0	0	3	0	9	2	18	3.0
40	PTB 33	Check	5	4	2	0	0	0	11	3	33	5.5
20	Suraksha	Check	1	4	1	1	0	0	7	3	21	3.5

Valid data from the following centres was considered for analysis in MRST.

<b>BPH</b>	DRR	RPR	LDN	CTC	BBN	MND	CBT	KDW	KUL		
<b>WBPH</b>	DRR	CBT									
<b>GLH</b>	CBT										
<b>GM</b>	DRR GMB1	DRR GMB4	DRR GMB4M	MNC GMB5	RNC GMB3	WGL GMB4M	RGL GMB 4	CTC GMB2	JDP GMB?	MDR GMB?	
<b>SBDH</b>	PUSA	CHN	RNC	RNR	PNR	PDC					
<b>SBWE</b>	PNR	KJT	MNC	NVS	RNR	RGL	LDN	NWG			
<b>LF</b>	JDL	PUSA	MLN	LDN	NWG	RNC	MNC	PDC			
<b>Leaf damaging pests</b>											
<b>RT</b>	JDL										
<b>GRH</b>	REWA										
<b>WM</b>	JDL										
<b>GRH+LF</b>	CTA	PTN									

*Evaluation of 55 entries against 12 insect pests in 50 valid tests (12 greenhouse and 38 field tests) revealed 7 entries as promising in 4-9 tests against 2-6 pests with an MRI varying from 18-45 apart from PTB 33 and Suraksha. Of these, 4 are RP cultures from DRR and 2 are CB cultures and a hybrid. The PPR of these promising entries varied from 3.0-7.5 ( Table 2.5).*

## **vii) National Screening Nurseries (NSN)**

**NSN1:** The trial consisted of 171 entries (134 AVT entries+34 checks +3 checks from Entomology) and evaluated at 19 locations against 9 insect pests. **NSN2** had 580 entries (534 pre breeding cultures from IVT trial, 46 yield checks + Suraksha and TN1 as pest evaluation checks) and evaluated at 12 locations. **NSN hills** was constituted with 70 entries (61 cultures + 9 checks) and conducted at 4 locations apart from DRR. **NHSN** was constituted with 82 hybrids nominated by both public and private sector agencies and tested at 6 locations against the prevalent pest damage.

The NSN1 data from Ranchi, Raipur, Pattambi, Karjat, Faizabad, and Sambalpur for dead heart damage ; Ludhiana, Nawagam, Rajendranagar, Ranchi and Pattambi for white ear damage; Chatha for grasshopper; Pusa, Raipur, Ranchi, Chatha, Faizabad and Chinsurah for leaf folder damage and Pattambi for whorl maggot were not considered for analysis due to insufficient pest pressure. NSN 2 data from Jagdalpur and Ragolu for gall midge; Moncompu and Jagdalpur for stem borer dead hearts damage; Jagdalpur, Gaghraghat, Moncompu and Puducherry for stem borer white ear damage and from Navsari, Puducherry and Aduthurai for leaf folder damage were not considered for analysis due to low pest pressure. NSN hills data from Chatha for grasshoppers damage; leaf folder from Chatha and Malan; NHSN data from Raipur and Nawagam for leaf folder and Karjat for stem borer dead heart damage were not considered for analysis due to low pest pressure.

### **Hopper pests:**

**NSN1:** Evaluation of NSN1 cultures against BPH, WBPH and GLH in 6 greenhouse and 2 field tests revealed six cultures *viz.*, IET Nos 21510, 21625, 21627, 21633, MAS 26, MAS 946 and IR64 as promising in 3 tests.

**NSN2:** Evaluation of NSN2 cultures in 2 greenhouse and 2 field tests identified two cultures *viz.*, IET 21725 and 22129 as promising against both BPH and WBPH in 2 tests.

**NSN Hills:** IET 21378 was the only entry promising against planthoppers.

**NHSN:** Three nominations *viz.*, IHRT-E-04, IHRT-ME-31 and IHRT-MS-06 recorded promising reaction in one of the tests.

### **Gall midge:**

**NSN1:** Screening of entries in one greenhouse and 5 field tests helped in identification of 3 entries *viz.*, IET Nos 21193, 21119, 21278 as promising in 3 tests.

**NSN2:** IET Nos 22044, 22165, 22027, 21727 and 22252 were reported to have nil damage against gall midge in 2 tests.

**NSN hills:** None of the entries were promising against gall midge biotype 4M at DRR.

**NHSN:** Seven nominations *viz.*, IHRT-E-02, IHRT-E-04, IHRT-ME-03, IHRT-ME-04, IHRT E-12, IHRT-ME-20 and IHRT-ME-23 recorded nil damage against GMB4M in greenhouse test at DRR.

#### **Stem borer:**

**NSN1:** Field evaluation of cultures in 6 tests identified 2 cultures *viz.*, IET Nos 20925 and 21280 as promising for dead heart damage in 2 tests and Vandana in 3 tests. Of the 7 valid field tests conducted IET Nos 21425 and 21478 were promising for white ear damage in 3 tests. Vandana (in 4 tests) and 5 other cultures *viz.*, IET Nos 21425, 21475, 21478, Govind and HR12 were identified as promising in 3 tests against stem borer at both phases of crop growth. However the promising entries need to be evaluated under artificial conditions to confirm the reaction.

**NSN2:** At Aduthurai, 32 cultures had no white ear damage but this needs to be confirmed under greenhouse evaluations as the observations were taken from 90-125 DAT and the possibility of escapes are very high.

**NHSN:** Seven nominations, IHRT-E-02, IHRT-E-04, IHRT-E-06, IHRT-ME-09, IHRT-ME-15, IHRT-ME-25 and IHRT-M-13 recorded promising reaction in two of the five valid tests covering both vegetative and reproductive stage damage.

#### **Leaf folder:**

**NSN1:** Evaluation of NSN1 cultures in 3 tests revealed that IET Nos 21405, 21406, 21411, 21422, 21523, 21540, 21208, 21638 and Swarnadhan as promising in one test only.

**NSN2:** IET Nos, 21865, 21867, 21896, 21703, 21961, 22018, 21927, 21911, 22022, 22083 and 21284 had nil damage in one field test only.

**NSN hills:** IET No. 21764 and Vivekdhan 62 had <17% leaf damage at Malan.

**NHSN:** None of entries was promising.

#### **Whorl maggot:**

**NSN1:** IET Nos 21185, 20863, 21291, 21300, 20923, 20924, 20734, 21009, 21288, Jaldidhan 6(NC), and Aditya had nil damage at both Chinsurah and Faizabad.

**NSN2:** IET Nos **22030**, 21921, 21920, 21918, 21911, 21964, 21917, 21972, 21926, 21860, 21958 had  $\leq$  3% DL at Jagdalpur.

**NSN hills:** IET 21746 had no whorl maggot damage at Malan.

**Rice Thrips :**

**NSN2:** IET Nos 21937, 22036, 22074, 22131, 22049, 22050 had nil damage against thrips at Aduthurai.

**Blue beetle:**

**NSN1:** IET 19886, 21205 and Taroari basmati had < 5% DL.

**Grasshoppers:**

Twenty one cultures from NSN2 at Chatha but none of NHSN entries at Rewa recorded a damage score of 1.

**Overall reaction:**

**NSN1:** Evaluation of NSN1 cultures across location in 33 tests (7 greenhouse and 26 field tests) against 9 pests identified 9 cultures and two checks Vandana and Tulasi as promising in 4-5 test against 2-4 pests (Table 2.6).

**NSN2:** Evaluation of NSN 2 cultures across locations in 15 (3 greenhouse and 12 field) tests against 8 pests revealed that 6 cultures and HR12 were promising in 3 tests against 3 pests (Table 2.7).

**NSN hills:** Evaluation of cultures in 3 greenhouse and 3 field tests identified 4 cultures viz., IET Nos 21746, 21378, 21764 apart from Vivekdhan 62 as promising in 2 tests against 1-2 pests.

**NHSN:** Evaluation of cultures in 3 greenhouse and 8 field tests against 8 pests identified IET-E-04 culture as promising in 4 tests against 3 pests.

Table 2.6: Performance of most promising cultures against insect pests in **NSN1**, Kharif 2010.

Entry No.	IET No.	PH NPT 8	GM NPT 6	SBDH NPT 6	SBWE NPT 7	LF NPT 3	WM NPT 2	BB NPT 1	OVERALL NPT 33	NPP
53	20934	2	0	1	1	0	1	0	5	4
93	21528	2	1	0	1	0	1	0	5	4
152	Tulasi	1	1	2	0	0	1	0	5	4
89	21510	3	0	1	0	0	1	0	5	3
142	MAS 946	3	0	1	0	0	1	0	5	3
144	Vandana	1	0	3	1	0	0	0	5	3
108	21478	2	0	0	3	0	0	0	5	2
2	21190	1	1	1	0	0	1	0	4	4
26	21289	1	1	1	0	0	1	0	4	4
37	21106	1	0	1	1	0	1	0	4	4
52	20930	1	0	1	1	0	1	0	4	4

Valid reactions from following locations were considered for analysis of NSN 1.

<b>BPH</b>	DRR	CBT	LDN	MND	KUL	
<b>WBPH</b>	DRR	CBT				
<b>GLH</b>	CBT					
<b>GM</b>	DRR GMB4M	PTB GMB5	BRH GMB?	SBP GMB1	WGL GMB4M	WGB GMB4
<b>SBDH</b>	MND	RNR	PNR	SBP	PUS	LDN
<b>SBWE</b>	SBP	PNR	RPR	PNR	KJT	RNR
<b>LF</b>	LDN	NWG	PDC			
<b>WM</b>	CHN	FZB				
<b>BB</b>	PTB					

Table 2.7: Performance of most promising cultures against insect pests in NSN 2, *kharif* 2010

Entry No.	IET No.	BPH NPT 3	WBPH NPT 1	GM NPT 3	SBWE NPT 2	LF NPT 2	RT NPT 2	WM NPT 1	GRH NPT 1	Overall NPT 15	No. of pests 8
131	21961	0	0	1	1	1	0	NT	0	3	3
145	22018	0	0	1	0	1	0	0	1	3	3
159	21725	1	1	0	1	0	0	NT	0	3	3
192	21918	0	0	1	1	0	0	1	0	3	3
549	22044	0	1	2	0	0	0	0	0	3	2
555	22050	0	0	1	1	0	1	0	0	3	3
569	HR 12	0	0	1	1	0	1	0	0	3	3

Valid data from the following locations considered for analysis in NSN 2.

<b>BPH</b>	DRR	JDP	GGV
<b>WBPH</b>	DRR		
<b>GM</b>	DRR	SKL	MNC
<b>SBWE</b>	NVS	ADT	
<b>LF</b>	JDP	MNC	
<b>RT</b>	JDP	ADT	
<b>GrH</b>	CHT		
<b>WM</b>	JDP		

## 2.2 INSECT BIOTYPE STUDIES

Biotype variations in the gall midge population in endemic areas are monitored through two trials i) Gall midge biotype trial (GMBT) ii) Gall midge population monitoring trial (GMPM).

### i) Gall midge biotype trial (GMBT):

This year the trial was constituted with 12 gene differentials whose genetics is well known and 6 potential donors of gall midge resistance and two check varieties. (TN1 and B95-1). The trial was conducted across 13 locations in 4 greenhouse and 12 field tests. The entries were evaluated against 6 different biotypes which were already characterized (GMB1, 3, 4, 4M, 5, and 6) and four unidentified populations of gall midge. The valid data are summarized in Table 2.8 and discussed based on the performance/reaction of gene differentials to various gall midge populations as under:

**Group I** differentials with *Gm1* were promising against populations at both Sambalpur and Sakoli. But W 1263 was also promising against biotype 5 at Pattambi and DRR.

Among **group II** differentials, *Gm2* was promising against Nellore population; *Gm5* against Pattambi and Nellore populations; *Gm6* against Ranchi, Nellore and Titabar, *Gm9* against Sambalpur, Sakoli and Nellore populations; *Gm10* against Ranchi populations. *Gm7* was susceptible to all the populations tested.

**Group III** differentials, included 4 donors with designated genes and 4 potential donors (INRC 202, INRC 1997, INRC 3021, Aganni and ARC 15831) with unknown genes. *Gm11* was promising against GMB1, GMB3 and GMB4 at Ragolu and Nellore; *gm3* was promising against GMB1, GMB3, GMB4, GMB 5 and GMB4M at DRR. The gene from Abhaya (*Gm4*) was promising against GMB3, GMB4 at Ragolu and DRR and GMB 5. Jhitpiti with *Gm8* was promising against 10 populations except against populations at Pattambi, Warangal, Nellore, Brahmavar, Madurai and Titabar.

### Donors with unidentified genes:

**INRC 202** was promising against GMB1, 3, 4, 4M and 5 at DRR.

**INRC 1997:** The differential was promising against GMB1, GMB4, GMB4M, GMB5 at DRR, Nellore and Brahmavar population. It was susceptible at other locations.

**INRC 3021:** The differential was promising against GMB1, GMB4, GMB5 (Moncompu), GMB4M (DRR) and Nellore populations.

**Aganni:** This differential was promising against 10 populations but susceptible at Nellore, Madurai, Titabar, Brahmavar, Iroishemba (GMB6) and Pattambi (GMB5).

**ARC 15831:** Its promising against populations at Sambalpur (GMB1), GMB4, GMB4M and GMB5 (DRR) only.

*Jhitpiti with Gm8 and Aganni with Gm? are highly promising against 10 populations followed by INRC 1997 and INRC 3021. The two new donors were promising against 7-8 populations. INRC 1997 at Brahmavar, Dukong 1 at Titabar and six differentials were promising against Nellore population. Gm7 was susceptible to all the populations tested and ARC 6605 alone was promising against Madurai population.*

## ii) Gall midge population monitoring (GMPM)

This study has been designed to complement the information generated in the earlier trial on gall midge biotypes. Single female test involved in this trial will provide more accurate information on the virulence composition of the pest population at a given location. The trial was conducted only at Sakoli and Pattambi. Based on evaluation of 193 and 173 females, respectively, virulence against the new undeployed resistance genes was estimated (Fig. 2). Significantly, about 50% of the population at these locations displayed virulence against *Gm4* and *Gm11* genes. Though high level of virulence in Pattambi population was noted against *Gm8* in Aganni, these results need confirmation.

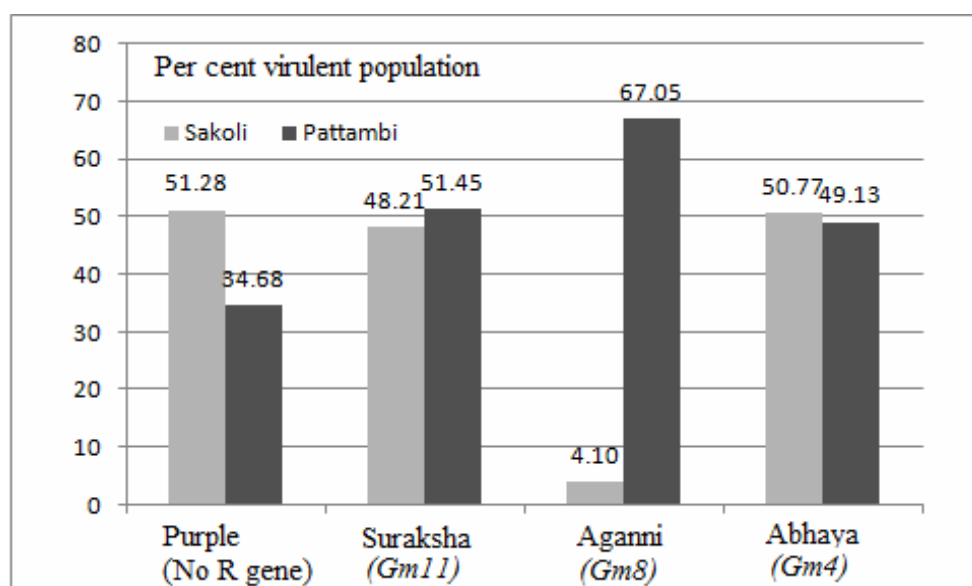


Fig. 2: Virulence against new gall midge resistance genes in two gall midge populations (GMPM, 2010).

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Table 2.8 : Reaction of gene differentials against Gall midge in **GBMT**, *Kharif* 2010.

Group	Entry No.	Differential	Gene	Per cent plant damage																Resi. against populations No. 16
				GMB 1		GMB 3	GMB 4			GMB 5			GMB 6	GMB 4M		GMB ?	GMB ?	GMB 1?	GMB ?	
				SBP	DRR	RNC	RGL	SKL	DRR	MNC	PTB	DRR	IRS	WGL	DRR	NLR	BMR	MDR	TTB	
				FR	GR	FR	FR	FR	GR	FR	FR	GR	FR	FR	GR	FR	FR	FR	FR	
50 DT	30 DT	50 DT	50 DT	50 DT	50 DT	50 DT	50 DT	50 DT	50 DT	50 DT	-	50 DT	50 DT	42 DT	50 DT					
I	1	Kavya	<i>Gm 1</i>	0.0	100	15.0	42.9	0.0	100	60.0	11.1	25	20.0	70.0	100	15.0	50.0	81.6	25.0	2
	2	W 1263	<i>Gm 1</i>	0.0	86	20.0	35.7	2.0	100	33.3	5.0	0	15.0	30.0	50	15.0	53.0	25.0	30.0	4
	3	ARC 6605	(?)	5.0	100	0.0	50.0	2.5	100	75.0	19.1	17	15.0	80.0	100	0.0	65.0	10.0	20.0	5
II	4	Phalguna	<i>Gm 2</i>	40.0	100	15.0	35.0	47.6	100	60.0	71.4	78	10.0	90.0	100	45.0	65.0	100.0	15.0	1
	5	ARC 5984	<i>Gm 5</i>	40.0	70	20.0	25.0	19.3	100	60.0	9.5	60	15.0	80.0	71	10.0	100.0	73.3	30.0	2
	6	DUKONG 1	<i>Gm 6</i>	20.0	36	10.0	40.0	19.5	100	25.0	31.6	22	20.0	100.0	100	0.0	25.0	72.7	5.0	3
	7	RP 2333-156-8	<i>Gm 7</i>	20.0	17	30.0	35.0	26.4	92	75.0	60.0	56	20.0	90.0	100	30.0	35.0	83.9	25.0	0
	8	Madhuri L 9	<i>Gm 9</i>	0.0	93	15.0	55.0	4.1	92	50.0	19.1	30	20.0	100.0	67	5.0	100.0	83.8	35.0	3
	9	BG 380-2	<i>Gm 10</i>	30.0	92	10.0	40.0	38.3	100	90.0	71.4	70	15.0	90.0	100	30.0	40.0	87.9	25.0	1
III	10	MR 1523	<i>Gm 11</i>	50.0	0	0.0	0.0	3.1	0	60.0	45.0	50	15.0	80.0	44	10.0	40.0	100.0	30.0	6
IV	11	RP 2068-18-3-5	<i>gm 3</i>	30.0	0	0.0	0.0	4.8	0	75.0	55.0	0	15.0	40.0	0	45.0	30.0	82.8	30.0	7
	12	Abhaya	<i>Gm 4</i>	60.0	18	0.0	5.0	22.1	10	50.0	90.5	0	15.0	50.0	60	35.0	90.0	100.0	35.0	4
	13	JHITPITI	<i>Gm 8</i>	0.0	8	0.0	0.0	0.0	0	5.0	15.0	0	10.0	30.0	0	25.0	25.0	100.0	25.0	10
	14	INRC 202	(?)	0.0	0	0.0	0.0	0.0	0	20.0	19.1	0	15.0	0.0	0	25.0	30.0	100.0	40.0	9
	15	INRC 1997	(?)	20.0	8	0.0	0.0	0.0	0	50.0	30.0	0	25.0	0.0	0	5.0	10.0	87.5	20.0	10
	16	INRC 3021	(?)	20.0	0	0.0	0.0	0.0	0	10.0	19.1	0	20.0	20.0	11	0.0	20.0	100.0	30.0	8
	17	Aganni	(?)	0.0	0	0.0	0.0	0.0	0	5.0	42.1	0	20.0	0.0	0	20.0	50.0	100.0	25.0	10
	18	ARC 15831	(?)	0.0	30	15.0	0.0	0.0	0	30.0	50.0	0	20.0	0.0	0	15.0	40.0	80.0	20.0	7
V	19	B 95-1	<i>none</i>	40.0	90	25.0	50.0	40.0	100	50.0	75.0	89	15.0	90.0	100	50.0	65.0	100.0	30.0	0
	20	TN1	<i>none</i>	50.0	100	55.0	60.0	35.4	100	100.0	84.2	100	25.0	90.0	100	35.0	80.0	87.1	45.0	0

## 2.3 CHEMICAL CONTROL STUDIES

Chemical control through insecticides continues to be an integral component of rice IPM, particularly in situations of pest outbreaks. Also, farmers find insecticide application simple, convenient and sometimes quite economical too. Despite this, the need for eco-friendly insecticides has never been felt so compelling as in the present situation mainly because of lack of understanding of the associated environmental concerns by the farmers. However, one positive sign of progress points out towards the pesticide industry striving for the development of newer insecticide formulations not only effective against more than one pest but also with no adverse impact on the beneficial and other non target organisms. In order to strengthen this component of IPM at the national level, continuous efforts are being made under the All India Coordinated Rice Improvement Project to thoroughly evaluate the effectiveness and performance of the newly developed formulations, through multi location trials before their recommendation for use by the farmers. Additionally, there is also a need to ensure that the newer insecticides are compatible with other chemicals, mainly fungicides because farmers resort to tank mixing of insecticides and fungicides for their simultaneous application to control both insect pests and diseases to save time and labour. So, evaluation of the compatibility of newer pesticides to confirm their efficacy even when applied as tank mix in the farmers fields, becomes essential. In view of these, insecticide trials consisting of Insecticide evaluation trial (IET) and Pesticide compatibility trial (PCT) were continued with inclusion of newer formulations, during *kharif* 2010.

### **i) Insecticide evaluation trial (IET)**

In this trial, field studies are carried out to evaluate the efficacy of newer insecticide formulations at specified dosages across multi locations to identify the promising ones for use in IPM programs. Insecticides found consistently effective across the locations will be considered for inclusion in the insecticide recommendations for the respective areas. The trial was carried out at 36 locations during *kharif* 2010.

#### **Treatments:**

Two newer insecticide formulations supplied by Rallis India Limited, 1) a combination product viz., an insecticide pre-mixture, Buprofezin 20% + Acephate 50% WP (RIL-049/F1) at three doses, 800 (160 g a.i.+ 400 g a.i./ha), 900 (180 g a.i.+ 450 g a.i./ha) and 1000g (200 g a.i.+ 500 g a.i./ha) and 2) a new formulation of acephate, Acephate 95% SG (RIL-059/F1 95% SG) @ 562 g a.i./ha, were evaluated. The combination product, Buprofezin 20% + Acephate 50% WP is claimed to have broad spectrum action against a range of rice insect pests from leaf and planthoppers to lepidopteran pests (leaf folder and stem borer). Acephate 95% SG is a newer formulation found effective in earlier trials. The performance of newer products was compared with that of individual components viz., Buprofezin (Applaud 25 SC) @ 200 g a.i./ha, acephate 75% SP @ 500 g a.i./ha, the standard check insecticide

monocrotophos (Monocrown 36 WSC) @ 500 g a.i./ha and an untreated control treatment without any insecticide application. The trial was laid out in Randomized Complete Block Design (RCBD) with eight treatments replicated thrice each. Initially, all the insecticide treatments were applied as blanket application at 15 DAT to assess the efficacy of the treatments around 25 to 30 DAT. Further applications were need based and differed in number across locations. The insecticides were applied as high volume sprays @ 500 litres of spray fluid/ha.

Location-wise time and frequency of insecticide application and dates of sowing, planting and harvest were as follows:

Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
Aduthurai	06-07-10	1-8-2010	01-11-10	3	15, 45 and 60
Bankura	07-07-10	20.08.10	07-12-10	1	25
Bhubaneswar	15-07-10	16-08-10	06-12-10	1	13
Brahmavar	12-07-10	08-08-10	19-11-10	1	15
Chinsurah	02-07-10	31-07-10	23-11-10	2	24 and 70
Coimbatore	08-08-10	02-09-10	18-01-11	1	59
Faizabad	03-07-10	03-08-10	15-11-10	2	12 and 36
Gangavathi	15-07-10	21-08-10	06-01-11	1	59
Ghaghrahat	23-06-10	2/8/2010	30-11-10	2	18 and 77
Jagdapur	08-07-10	4/8/2010	16-12-10	3	25, 50 and 70
Karjat	19-06-10	8/7/2010	22-11-10	2	39 and 53
Kaul	10-06-10	21-07-10	16-11-10	3	16, 54 and 78
Ludhiana	23-05-10	25-06-10	12-10-10	2	11 and 56
Malan	18-06-10	20-07-10	19-10-10	2	15 and 39
Mandya	3/8/2010	01-09-10	13-12-10	2	10 and 48
Maruteru	14-07-10	10-08-10	02-12-10	4	20,35,45 and 62
Moncompu	7/6/2010	29-06-10	07-10-10	2	30 and 65
Navsari	10-06-10	22-07-10	12-11-10	3	15, 35 and 50
Nawagam	06-07-10	12-08-10	27-11-10	2	48 and 63
Nellore	15-09-10	19-10-10	-	2	15 and 30
New Delhi	22-06-10	21-07-10	19-11-10	3	13, 55 and 82
Pantnagar	25-06-10	23-07-10	03-12-10	3	15, 38 and 72
Pattambi	26-06-10	20-07-10	01-11-10	3	25, 45 and 60
Puducherry	12-06-10	17-07-10	16-11-10	2	30 and 50
Pusa	09-06-10	04-07-10	27-10-10	2	10 and 42
Ragolu	17-07-10	29-08-10	16-12-10	-	-
Raipur	07-07-10	04-08-10	29-11-10	2	50 and 70
Rajendranagar	21-06-10	25-07-10	24-11-10	2	15 and 67
Ranchi	21-07-10	20-08-10	23-12-10	4	15, 45, 70 and 105
Rewa	10-07-10	27-07-10	09-11-10	1	53
Sakoli	13-07-10	30-07-10	26-12-10	1	11
Sambalpur	27-07-10	02-08-10	22-11-10	3	15, 54 and 74
Titabar	08-07-10	15-08-10	18-11-10	3	10, 35 and 45
Wangbal	02-07-10	28-07-10	12-11-10	2	15 and 53
Warangal	24-06-10	29-07-10	04-12-10	3	17, 43 and 77

Insect pest incidence was recorded at regular intervals through standard observation procedures throughout the crop growth period. Observations on total tillers (TT), dead hearts (DH) and silver shoots (SS) were recorded at 30 and 50 DAT to assess stem borer and gall midge damage, while stem borer damage at heading stage was worked out based on counts of panicle bearing tillers (PBT) and white ear heads (WE) and the damages were expressed as percentages. In case of brown planthopper (BPH), whitebacked planthopper (WBPH), green leafhopper (GLH), army worm and gundhi bug as well as natural enemies, number of insects /10 randomly selected hills were enumerated. The damage assessment of leaf folder, whorl maggot, hispa, case worm and thrips, was done 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. The comparative efficacy of the treatments was worked out based on efficacy at each DAT as well as their performance against pooled means of each pest damage, across observations and over locations. Yield obtained in each treatment was also pooled across the locations and included for assessment.

## **Results**

### **Pest Infestation (Table 2.9):**

**Stem borer** infestation during vegetative stage was recorded upto a maximum of 17.2% DH in the insecticide treatments and upto 23.6% DH in untreated control across different locations, during 30 to 50 DAT. However, at only 11 locations, minimum damage exceeding 5% DH was recorded and differences were significant among the treatments at 8 locations. The mean infestation data over these locations revealed that stem borer infestation varied between 6.2 and 7.7% DH in insecticide treatments, while the control plot showed 10.4% DH. At heading stage, 19 centres recorded more than 5% white ears (WE) and differences were significant at 15 sites. Across these locations, white ear incidence was recorded upto 21.9% WE in the insecticide treatments compared to a maximum of 23.8% WE in untreated control. The mean infestation ranged from 8.0 to 10.8 in insecticide treatments, while the untreated control showed a higher incidence of 14.7%. Overall, the performance of combination product at all the three doses was on par with that of acephate and monocrotophos treatments and superior to buprofezin alone and the untreated control.

**Gall midge** infestation was high at Brahmavar ranging from 22.4 to 39.0 % silver shoots (SS) at 30 DAT and 13.5 to 42.4% SS at 50 DAT, while at Warangal, the damage was high only at 50 DAT (26.2 to 35.3% SS). At Sakoli moderate damage varying between 15.7 and 25.5% SS, was recorded. The incidence was more than 5% SS across 8 centres and there were significant differences among the treatments except at Pattambi and at 30 and 50 DAT at Brahmavar and Warangal. Mean infestation over 8 locations also was at par in the insecticide treatments (11.3 to 14.1) and higher in control (19.2% SS). Overall, the insecticide treatments showed superior performance over untreated control.

**Leaf folder** damage was recorded at 15 centres, of which 7 centres (Chinsurah, Jagdalpur, Mandya, Pantnagar, Ragolu, Raipur and Kaul) showed less than 5% damaged leaves (DL). At the remaining locations, the insecticide treatments exhibited damage in a range of 1.4 to 18.7% DL compared to 4.0 to 24.8 % DL in control. The mean damage across locations was also lower in insecticide treatments (4.8 to 5.7% DL) than control (8.5% DL). At Puducherry, Ranchi and Sambalpur, leaf folder damage assessed based on average damage leaves (ADL) per 10 hills revealed a range of 12.0 to 73.3 DL/10 hills in insecticide treatments and 19.7 to 77.7 DL before treatment. However, after treatment the range of leaf folder damaged leaves was significantly lower in the insecticide treatments (5.3 to 51.0 DL/10 hills) compared to control (6.0 to 86.3 DL/10hills). There was maximum reduction of leaf folder damage (71%) in standard check treatment of monocrotophos followed by the three combination product treatments (68.5 to 70.0% reduction) and acephate treatments (56.3 and 64.1% in 75 WP and 95 SG, respectively). Buprofezin was the least effective treatment showing 34.8% reduction, while there was no reduction in leaf folder damage in control. The mean damage across the locations was also significantly lower in the insecticide treatments (18.1 to 26.8 DL/10 hills) compared to 31.2 DL/10 hills in control. Monocrotophos was the most effective treatment followed by acephate 75 WP and combination product at the highest dose (1000g/ha).

**Brown planthopper** populations were high at Kaul (maximum up to 430 hoppers/ 10 hills) moderate at Maruteru (131 hoppers/ 10 hills) and Warangal (up to 92 hoppers/10 hills) and low at Gangavathi, Pantnagar and Mandya. Buprofezin treatment resulted in the least mean infestation of 17.9 hoppers/10 hills followed by the three combination product treatments (19.8 to 21.7 hoppers/10 hills) and acephate treatments of 75 WP(34.3 hoppers/10 hills) and 95 SG(43.6 hoppers/10 hills). The check treatment of monocrotophos showed a population of 45.8 hoppers/10 hills, while the mean population was the highest in control plot (55.6 hoppers/10 hills).

The mean data from Kaul and Gangavathi centres with relatively higher BPH population revealed that after insecticidal application, there was significant control of hopper populations in Buprofezin (24.3 hoppers/10 hills) and combination product treatments (31.0 to 34.7 hoppers/ 10 hills), while it remained higher in acephate 75 WP (140.4 hoppers/10 hills), 95

SG(96.6 hoppers/10 hills), monocrotophos (153.1 hoppers/10 hills) and control (202.4 hoppers/10 hills). At Kaul, the impact of treatments was quite evident by the significant reduction in BPH population following application of respective treatments at 54 and 78 DAT. At 54 DAT, Buprofezin application resulted in BPH population reduction to the extent of 81.3 and 81.9% after 4 and 8 days, respectively while the combination product treatments reduced the populations in the range of 67.5 to 79.1%. These treatments were significantly superior to acephate 75 WP (47.0 and 50.0% reduction, respectively), monocrotophos (32.3 and 37.4% reduction, respectively) and acephate 95 SG (29.8 and 29.2% reduction, respectively). After second application at 78 DAT, the performance of combination product treatments was superior after 8 days (53.4 to 59.2% reduction of BPH population) to that of buprofezin (34.4% reduction), while the acephate and monocrotophos treatments were at par with untreated control. However, application of insecticides at later stages of crop growth (78 DAT) had less impact on reducing BPH population compared to application at earlier stage (54 DAT). Overall, buprofezin treatment and combination product treatments were significantly superior to acephate and standard check, monocrotophos treatments. At Gangavathi, the performance of acephate and monocrotophos treatments (86.3 to 92.1% reduction of BPH population) was superior to that of combination product treatments (68.1 to 88.2% reduction) and buprofezin (77.6% reduction). At Maruteru also, BPH population range was lower in buprofezin treatment (5.0 to 25.3 hoppers/10 hills) followed by combination product treatments (11.0 to 27.7 hoppers/10 hills), acephate 75 SP (12.0 to 39.3 hoppers/10 hills), monocrotophos (14.3 to 52.7 hoppers/10 hills) and acephate 95 SG(12.0 to 39.3 hoppers/ 10 hills), while control plot showed 42.3 to 131.0 hoppers/10 hills, during 45 to 60 DAT.

Overall, the performance of buprofezin and combination product treatments was better than the other treatments under conditions of higher BPH incidence.

**Whitebacked planthopper** infestation was noted at New Delhi during 37 to 57 DAT (14.3 to 151.8 hoppers/10 hills), Pantnagar during 30 to 90 DAT (2.3 to 42.3 hoppers/10 hills) and Kaul during 54 to 62 DAT(4.0 to 44.0 hoppers/10 hills). The mean infestation ranged from 32.3 to 35.9 hoppers/10 hills in the insecticide treatments as against 44.6 hoppers/10 hills in control. There were no significant differences among the insecticide treatments at Pantnagar, while at New Delhi, buprofezin treatment showed superiority over other treatments and all were superior to control, at 57 DAT. At Kaul, there was significant reduction in WBPH population following application of respective treatments at 54 DAT. Combination product at the highest dose of 1000 g/ha resulted in maximum population reduction upto 74.7 and 87.9%, 4 and 8 days after application. The other two doses of the combination product also reduced the WBPH population in the range of 50.0 to 77.5%. In contrast, Buprofezin application resulted in WBPH population reduction to the extent of 63.1 and 70.9% after 4 and 8 days, respectively, while the two treatments of acephate reduced the populations by 37.9 to

79.0%. Standard check monocrotophos also significantly reduced the hopper population upto 51.0 and 75.5% at 4 and 8 days after application, respectively. The natural reduction in hopper populations in control plot (14.0 and 56.1%) showed that the impact of insecticide treatments was superior to that of control only at initial stage (4 days after application), while after 8 days, there was natural decline in WBPH population.

**Green leafhopper** populations were observed at 3 centres and ranged from 1.7 to 62.7 hoppers/10 hills in insecticide treatments, while control treatment showed 11.8 to 66.7 hoppers/10 hills. Monocrotophos treatment showed the lowest GLH populations (10.2 hoppers/10 hills) followed by the combination product treatments (11.4 to 13.8 hoppers/10 hills), acephate 95 SG (13.1 hoppers/10 hills), 75 WP (14.1 hoppers/10 hills) and buprofezin (14.6 hoppers/10 hills). The insecticide treatments were significantly superior to the untreated control (25.6 hoppers/10 hills). At Ranchi, the superiority of insecticide treatments was evident, particularly of acephate 95 SG treatment which resulted reduction of GLH population upto 80.4% within four days after application followed by acephate 75 WP (78.2%) and monocrotophos (77.0%) was evident. The GLH population reduction was in the range of 65.1 to 75.0% in the three combination product treatments, while buprofezin treatment reduced the hopper population upto 54.4%.

In case of other foliage feeders, low **whorl maggot** damage (upto 13.7% DL) was recorded at 10 centres, of which 6 centres showed more than 5% damage. There were no discernible differences among the insecticide treatments (4.3 to 5.1% DL) and control (6.2% DL). **Rice hispa** damage was recorded to the extent of 75.7% at Ranchi in control plot, however, the insecticide treatments showed significantly less damage (10.0 to 48.0% DL). Monocrotophos application resulted in significant reduction (67.7%) of hispa damage followed by acephate 95 SG (48.6% reduction in damage). There was no reduction in buprofezin treatment. At Rewa, high populations of **armyworm caterpillars** were observed ranging from 20.7 to 45.7 per 10 hills at 53 DAT. There was significant impact of the insecticide treatments and combination product application at 1000g/ha resulted in 95.0% and 99.2% reduction of larval population within 3 and 10 days after application, respectively. Monocrotophos was the next best treatment resulting in 91.6 and 97.4% reduction of larval population, respectively. The other treatments also significantly reduced the larval population (64.9 to 90.7% reduction) compared to control. Thrips and blue beetle damage were observed at Mandya and Pattambi, respectively but the infestation remained low and treatment differences were not significant.

**Gundhi bug** population was observed only at Ranchi and the populations were significantly lower in monocrotophos (1.3 bugs/10 hills), combination product treatments (2.0 to 3.3 bugs/10 hills) as well as acephate treatments (4.0 to 5.7 bugs/10 hills) compared to buprofezin (11.7 bugs/10 hills) and control(15.3 bugs/10 hills), which were at par.

Data on populations of **natural enemies** viz., spiders and mirid bugs recorded at Kaul, showed that the insecticide treatments did not have adverse impact on spider numbers as their population increased to the extent of 26.7 to 57.9% in the combination product treatments compared to 35.0 increase in monocrotophos, 8.9 to 11.3% in acephate treatments and 37.1% increase in untreated control, four days after application. After eight days of application also, there were no significant differences among the treatments including untreated control. In case of mirid bugs also, there was no adverse impact after 4 days after application though the treatments differed significantly as the bug population increased to the extent of 29.1 to 61.5% across the treatments. Eight days after application, monocrotophos and acephate 95 SG treatments were the best among the insecticide treatments (28.3 and 20.7 bugs/10 hills), but the control plot showed significantly higher population of 45.7 bugs/10 hills. At Maruteru, there were no significant differences in spider populations across the treatments but mirid bugs were significantly lower in combination product treatment @ 900g/ha(13.7 bugs/20 hills) and buprofezin treatment (18.3 bugs/20 hills) compared to the remaining treatments including untreated control, which were at par (22.7 to 41.7 bugs/20 hills).

#### **Grain Yield (Table 2.10):**

There were significant differences in grain yield among the treatments at 26 locations. Based on mean yield of these locations acephate 95 SG recorded the highest yield (4138 kg/ha) which was 21.6% increase over control (IOC) (3402 kg/ha). The combination product application at 1000 g/ha yielded the next highest (4055 kg/ha) with 19.2% IOC closely followed by monocrotophos treatment showing 4036 kg/ha with 18.6% IOC. The remaining treatments showed a yield range of 3854 to 3984 kg/ha registering 13.3 to 17.1% IOC.

*Insecticide evaluation trial with an objective of evaluating efficacy of newer insecticide formulations against major insect pests of rice and consequent impact on grain yield was carried out at 36 centres during kharif 2010. Based on the performance of the insecticide treatments for their efficacy in reducing pest infestation and their impact on grain yield, it was evident that the combination product containing Buprofezin 20% + Acephate 50% WP (RIL-049/F1) at the highest tested dose of 1000 g/ha was effective against stem borer, leaf folder, BPH, WBPH and army worm and registered the second highest grain yield among the treatments. The standard check, monocrotophos performed well against leaf folder and hispa and showed third highest yield. Though Acephate 95 SG treatment yielded the highest across the locations, its performance in terms of effectiveness in reducing pest populations was superior only against GLH and hispa.*

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Table 2.9: Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					STEM BORER											
Common Name	Trade Name	% Formulation	Rate		% dead hearts											
			g a.i. /ha	g or ml of formulation/ha	ADT		FZB		MNC		PNR		PUS		RGL	
					30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	30 DAT	50 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT
Buprofezin + Acephate	RIL-049/F1	20+50 WP	160 + 400	800 g	2.3a	2.1a	6.4ab	7.4bc	8.9a	0.3a	1.7a	6.7a	4.2a	8.3a	7.0a	15.7a
Buprofezin + Acephate	RIL-049/F1	20+50 WP	180 + 450	900 g	3.3a	4.2a	5.2a	6.2b	8.4a	0.4a	1.2a	5.9a	4.7a	14.2a	9.7a	12.5a
Buprofezin + Acephate	RIL-049/F1	20+50 WP	200 + 500	1000 g	2.1a	5.9a	3.7a	4.1a	7.4a	0.3a	1.3a	5.8a	8.6b	13.4a	15.1a	14.7a
Buprofezin	Applaud	25 SC	200	800 ml	4.6b	1.7a	4.3a	5.0a	9.3a	0.2a	2.1b	5.2a	3.8a	13.5a	14.4a	15.4a
Acephate	Acephate	75 SP	500	667 g	5.6b	4.9a	5.6ab	7.0bc	6.2a	0.8a	3.0b	5.8a	3.8a	15.8a	11.8a	10.6a
Acephate	RIL-059/F1	95 SG	562.5	592 g	4.7a	1.9a	8.3c	9.2c	8.5a	0.5a	0.9a	6.7a	3.8a	10.2a	12.6a	14.7a
Monocrotophos	Monocrown	36 SL	500	1390 ml	1.1a	2.9a	7.4bc	8.3c	8.1a	0.1a	1.2a	6.2a	5.5a	12.2a	12.4a	16.0a
Untreated control					4.5a	9.8b	12.1d	16.3d	12.6b	0.6a	1.5a	15.1b	8.9b	23.6b	13.3a	14.9a

Table 2.9 (Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					STEM BORER							
Common Name	Trade Name	% Formulation	Rate		% dead hearts							
			g a.i. /ha	g or ml of formulation/ha	RPR		RNR	RNC	SBP		WGB	Mean
					50 DAT	70 DAT	65 DAT	50 DAT	64 DAT	84 DAT	30 DAT	
Buprofezin + Acephate	RIL-049/F1	20+50 WP	160 + 400	800 g	3.8a	7.2ab	5.4a	9.3c	5.7a	4.3b	1.2a	6.2
Buprofezin + Acephate	RIL-049/F1	20+50 WP	180 + 450	900 g	3.7a	6.4a	8.7a	5.5b	5.2a	4.4b	0.8a	6.4
Buprofezin + Acephate	RIL-049/F1	20+50 WP	200 + 500	1000 g	2.7a	7.4a	7.7a	2.1a	4.0a	4.0b	0.7a	6.4
Buprofezin	Applaud	25 SC	200	800 ml	3.4a	5.2a	12.7a	17.2e	7.7a	5.7c	1.2a	7.7
Acephate	Acephate	75 SP	500	667 g	2.9a	6.2a	5.3a	12.4d	6.1a	5.1bc	2.8a	6.9
Acephate	RIL-059/F1	95 SG	562.5	592 g	4.5a	7.6a	7.3a	8.9c	4.5a	4.1b	1.6a	7.0
Monocrotophos	Monocrown	36 SL	500	1390 ml	4.8a	5.8a	9.4a	4.8b	3.9a	2.7a	1.8a	6.7
Untreated control					5.8a	9.6b	10.7a	20.6f	5.8a	6.2c	5.5a	10.4

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

Table 2.9(contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					STEM BORER													
Common Name	Trade Name	% Formulation	Rate		% white ears													
			g a.i. /ha	g or ml of formulation/ha	ADT	BBN	FZB	GGT	JDP	KJT	MND	MNC	NWG	PNR	PTB	PUS	RGL	RPR
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800 g	1.7a	4.9a	7.1bc	4.9a	11.0ab	9.6a	6.1a	7.1a	3.5ab	14.0ab	27.6a	6.3ab	12.5ab	19.5b
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900 g	1.8a	4.0a	5.7a	5.1a	8.2a	7.9a	5.3a	9.6a	2.7a	10.4a	29.6a	5.8ab	11.1ab	19.5b
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	1.8a	4.1a	3.9a	4.6a	9.9a	8.1a	5.5a	11.1ab	3.5ab	15.1b	15.7a	5.5ab	15.3b	19.8b
Buprofezin	Applaud	25 SC	200	800 ml	8.3b	4.3a	4.5a	5.0a	10.1a	12.3a	9.7ab	14.4b	4.1b	18.0b	35.6a	4.7ab	11.4ab	15.8a
Acephate	Acephate	75 SP	500	667 g	7.9b	3.7a	6.0ab	4.7a	10.0a	9.5a	6.4a	7.3a	3.3a	18.2b	17.7a	6.0ab	8.6a	19.4b
Acephate	RIL-059/F1	95 SG	562.5	592 g	6.7b	3.8a	6.9b	5.1a	10.0a	7.7a	8.6ab	10.5ab	4.0b	10.8a	26.7a	7.1b	8.6a	17.1ab
Monocrotophos	Monocrown	36 SL	500	1390 ml	3.0a	6.0a	5.9ab	5.2a	10.7ab	9.2a	12.9b	9.6a	3.7ab	8.7a	26.7a	4.0a	9.8a	21.9bc
Untreated control					19.0c	6.2a	9.2c	9.4b	14.7b	12.5a	14.5b	18.9b	6.3c	21.6c	34.8a	20.4c	18.1b	23.8c

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					STEM BORER					
Common Name	Trade Name	% Formulation	Rate		% white ears					
			g a.i. /ha	g or ml of formulation/ha	RNC	SKL	SBP	BNK	WGB	Mean
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800 g	3.7b	16.2a	4.5b	4.4a	1.6a	8.8
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900 g	2.7b	15.5a	4.7b	4.9a	2.8a	8.0
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	1.9a	15.2a	4.3b	5.6a	6.1a	8.3
Buprofezin	Applaud	25 SC	200	800 ml	8.7c	18.9a	6.9c	5.6a	7.0ab	10.8
Acephate	Acephate	75 SP	500	667 g	4.6b	16.3a	3.2a	7.0a	4.4ab	9.0
Acephate	RIL-059/F1	95 SG	562.5	592 g	3.6b	15.9a	5.3b	5.2a	8.1b	9.0
Monocrotophos	Monocrown	36 SL	500	1390 ml	3.5b	16.7a	3.0a	4.9a	3.5ab	8.7
Untreated control					11.1c	22.4b	17.0d	5.5a	9.5b	14.7

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

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					GALL MIDGE															
Common Name	Trade Name	% Formulation	Rate		% silver shoots															Mean
			g a.i./ha	g or ml of formulation/ha	BMR		JDP	MNC		PTB	RNC	SBP		WGL		RGL	SKL			
					30 DAT	50 DAT	50 DAT	30 DAT	50 DAT	50 DAT	-	64 DAT	84 DAT	30 DAT	50 DAT	50 DAT	30 DAT	50 DAT		
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800 g	26.5a	15.4a	5.9c	11.0ab	2.5a	8.0a	4.7d	8.5a	7.8b	3.6ab	30.6a	6.9a	17.0ab	20.2ab	12.0	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900 g	22.4a	20.7b	1.1a	14.6bc	0.6a	12.9a	3.0c	8.0a	7.0ab	2.7a	28.7a	5.6a	15.7a	19.4a	11.6	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	29.3a	19.3b	1.7a	11.2ab	4.2b	6.0a	1.8b	7.4a	7.3b	2.2a	26.8a	5.2a	15.7a	19.5a	11.3	
Buprofezin	Applaud	25 SC	200	800 ml	28.2a	13.5a	3.4b	11.0ab	1.0a	7.9a	7.3e	6.5a	6.4a	3.3ab	36.8a	7.3a	19.2bc	23.0ab	12.5	
Acephate	Acephate	75 SP	500	667 g	25.3a	24.6b	1.9a	14.4bc	3.3a	10.8a	4.5d	6.6a	4.0a	4.9b	27.5a	6.9a	17.8ab	20.9ab	12.4	
Acephate	RIL-059/F1	95 SG	562.5	592 g	37.7a	33.7c	2.4ab	14.4bc	1.0a	9.2a	2.9c	9.4a	4.5a	6.3b	32.7a	6.6a	17.5ab	19.7a	14.1	
Monocrotophos	Monocrown	36 SL	500	1390 ml	29.3a	32.2c	2.6b	7.5a	1.4a	9.3a	0.9a	6.6a	2.9a	3.9ab	26.2a	6.7a	16.9ab	20.7ab	11.9	
Untreated control					39.0a	42.4d	6.9c	16.6c	3.0a	10.4a	7.7e	14.4b	13.0c	6.7b	35.3a	17.2b	23.2c	25.5b	19.2	

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					LEAF FOLDER											
Common Name	Trade Name	% Formulation	Rate		% damaged leaves											Mean
			g a.i./ha	g or ml of formulation/ha	ADT	FZB	LDN		MLN		MNC	NWG		NLR	NDL	
					75 DAT	62 DAT	25 DAT	60 DAT	50 DAT	80 DAT	- DAT	45 DAT	60 DAT	30 DAT	25 DAT	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800 g	2.1a	8.7c	4.4a	5.4a	2.7a	13.1b	5.0a	7.5ab	6.1a	5.4a	7.4ab	5.1
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900 g	1.4a	5.7b	4.6a	4.0a	1.8a	9.6ab	8.4ab	7.0a	5.5a	5.8a	7.6ab	5
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	1.4a	3.8a	3.9a	3.7a	3.1a	9.7ab	7.5a	8.3b	6.5a	4.6a	10.6ab	4.8
Buprofezin	Applaud	25 SC	200	800 ml	8.6c	4.5a	7.2b	9.3b	2.6a	9.3a	8.3ab	7.8a	6.5a	10.2a	8.7ab	5.7
Acephate	Acephate	75 SP	500	667 g	3.5ab	6.8b	4.8a	4.0a	2.8a	10.1ab	10.2ab	8.5b	7.5b	5.7a	5.8a	4.9
Acephate	RIL-059/F1	95 SG	562.5	592 g	4.0ab	9.2c	4.2a	4.8a	3.2a	9.6ab	5.3a	7.9ab	6.6a	3.9a	18.7b	5.8
Monocrotophos	Monocrown	36 SL	500	1390 ml	2.4a	9.4c	4.3a	2.8a	2.8a	11.6a	9.8a	8.0ab	6.1a	7.5a	7.0ab	5.4
Untreated control					11.8c	11.3d	11.0c	24.8c	4.0a	21.1c	14.6b	9.9c	11.5c	8.2a	9.4ab	8.5

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

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					LEAF FOLDER										Mean
Common Name	Trade Name	%Formulation	Rate		Damaged leaves /10 hills										
			g a.i. /ha	g or ml of formulation/ha	PDC		PUS		RNC		WGL		SBP		
					50 DAT BT	AT	30 DAT	50 DAT	69 DAT BT	73 DAT AT	30 DAT	50 DAT	- BT	- AT	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800 g	34.0a	6.3a	6.3a	3.3a	63.7b	9.0a	30.7b	17.0a	25.0b	23.3ab	21.9
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900 g	30.3a	6.7a	6.0a	3.0a	67.0b	9.0a	22.3b	17.3a	23.3b	21.7ab	20.7
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	32.0a	5.3a	6.3a	2.7a	62.0b	7.0a	27.7b	13.7a	20.3ab	22.0ab	19.9
Buprofezin	Applaud	25 SC	200	800 ml	36.0a	8.0a	6.7a	2.7a	73.3c	51.0d	25.0b	18.0a	21.0ab	26.0b	26.8
Acephate	Acephate	75 SP	500	667 g	31.3a	5.7a	5.3a	3.3a	62.7b	23.0c	15.7ab	21.0a	12.0a	17.7ab	19.8
Acephate	RIL-059/F1	95 SG	562.5	592 g	30.0a	6.3a	8.3a	3.0a	63.3b	17.3b	13.3a	14.0a	28.3b	20.0ab	20.4
Monocrotophos	Monocrown	36 SL	500	1390 ml	34.7a	6.7a	6.0a	4.0a	52.3a	9.7a	19.7ab	11.0a	22.7b	14.0a	18.1
Untreated control	-	-	-	-	29.3a	6.0a	7.0a	7.3b	77.7c	86.3e	19.7ab	22.7a	19.7ab	36.3b	31.2

Table 2.9(Contd.) . Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					WHORL MAGGOT									Mean
Common Name	Trade Name	% Formulation	Rate		% damaged leaves									
			g a.i. /ha	g or ml of formulation/ha	ADT	CHN	FZB	JDP		MLN		PNR		
					25 DAT	30 DAT	41 DAT	35 DAT	60 DAT	30 DAT	50DAT	60 DAT	45 DAT	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800 g	0.8a	5.8b	10.4b	6.1b	5.5a	6.3a	5.6ab	4.8a	7.3a	5.1
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900 g	1.1a	4.1a	8.2ab	5.1ab	5.0a	5.0a	3.9ab	3.8a	5.8a	4.3
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	1.6a	4.3ab	6.3a	5.5ab	5.1a	3.1a	4.0ab	4.4a	8.1a	4.5
Buprofezin	Applaud	25 SC	200	800 ml	1.3a	3.2a	7.1a	7.2b	5.2a	3.6a	3.0a	6.0b	5.6a	4.4
Acephate	Acephate	75 SP	500	667 g	2.8b	3.0a	9.4b	6.5b	5.1a	4.4a	5.0ab	4.4a	5.4a	4.5
Acephate	RIL-059/F1	95 SG	562.5	592 g	2.7b	4.1a	10.0b	5.2ab	5.1a	3.8a	4.6ab	5.1b	7.5a	4.7
Monocrotophos	Monocrown	36 SL	500	1390 ml	2.0b	2.5a	10.5b	4.1a	4.7a	3.8a	6.7b	4.7a	5.4a	4.4
Untreated control	-	-	-	-	6.7c	5.1b	13.7c	7.5b	6.0a	4.5a	7.5b	5.7b	7.0a	6.2

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

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					BROWN PLANTHOPPER														
Common Name	Trade Name	% Formulation	Rate		No. per 10 hills														
			g a.i./ha	g or ml of formulation/ha	BBN		GGV		MND		MTU				NDL	PNR			
					50 DAT	70 DAT	59 DAT		58 DAT	78 DAT	30 DAT	45 DAT	50 DAT	60 DAT	57 DAT	30 DAT	60 DAT	90 DAT	100 DAT
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	4.0a	17.3a	16.5a	5.3b	24.7a	11.7a	4.0a	10.7a	18.7a	26.0a	7.0a	8.7b	23.3a	44.0a	12.0a
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	6.0a	14.0a	18.1a	2.1a	24.3a	9.0a	5.3a	11.7a	27.7ab	24.3a	6.3a	3.3a	30.3b	39.0a	13.3a
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	4.3a	16.7a	17.7a	2.6a	23.3a	7.7a	3.0a	11.0a	16.0a	26.0a	8.5ab	5.0ab	19.7a	33.0a	10.3a
Buprofezin	Applaud	25 SC	200	800 ml	5.3a	17.7a	21.7a	4.9a	26.7a	10.7a	2.0a	5.0a	16.3a	25.3a	9.3ab	3.7a	20.7a	42.3a	6.0a
Acephate	Acephate	75 SP	500	667 g	6.3a	14.0a	27.7a	3.8a	30.0a	8.3a	3.3a	12.0a	39.3bc	35.7ab	10.5ab	3.0a	24.7a	35.3a	11.0a
Acephate	RIL-059/F1	95 SG	562.5	592 g	4.7a	15.3a	33.8a	2.2a	21.3a	7.3a	5.3a	9.7a	28.3ab	66.3c	15.0b	5.0ab	27.7ab	32.3a	7.7a
Monocrotophos	Monocrown	36 SL	500	1390 ml	5.3a	18.3a	52.7a	4.2a	23.3a	11.0a	4.7a	14.3a	52.7c	47.0bc	13.7b	4.7a	29.7b	37.7a	11.7a
Untreated control	-	-	-	-	4.3a	25.0b	62.3a	39.1b	26.7a	13.0a	3.0a	42.3b	131.0d	52.3bc	12.3b	1.7a	19.7a	37.7a	6.0a

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					BROWN PLANTHOPPER										Mean
Common Name	Trade Name	%Formulation	Rate		RPR 70 DAT	WGL			No. per 10 hills						
			g a.i./ha	g or ml of formulation/ha		60 DAT	DAT	KUL							
								54 DAT	58 DAT	62 DAT	78 DAT	82 DAT	86 DAT		
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	6.0ab	64.7ab	51.0a	54.3a	17.7a	11.3a	115.3b	84.0b	47.0a	21.7	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	7.8b	62.0ab	48.0a	50.3a	15.3a	12.3a	98.3b	83.3b	42.0a	20.6	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	5.8ab	52.0a	42.3a	53.3a	13.0a	14.7a	99.3b	97.0b	46.3a	19.8	
Buprofezin	Applaud	25 SC	200	800 ml	5.5a	60.0ab	37.0a	60.7a	11.3a	11.0a	65.0a	51.7a	42.7a	17.9	
Acephate	Acephate	75 SP	500	667 g	6.3a	66.3ab	45.3a	56.0a	29.7b	28.0b	170.7c	259.7c	161.7b	34.3	
Acephate	RIL-059/F1	95 SG	562.5	592 g	5.8a	74.7bc	49.0a	59.3a	41.7c	42.0c	217.7d	348.7d	267.7c	43.6	
Monocrotophos	Monocrown	36 SL	500	1390 ml	5.5a	74.0bc	42.0a	51.7a	35.0bc	32.3b	197.7d	367.0de	327.0d	45.8	
Untreated control	-	-	-	-	8.3b	92.0c	48.7a	52.0a	78.3d	64.7d	151.3c	399.3e	430.3e	55.6	

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

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					WHITEBACKED PLANTHOPPER									
Common Name	Trade Name	% Formulation	Rate		No. per 10 hills									Mean
			g a.i. /ha	g or ml of formulation/ha	NDL			PNR			KUL			
					37 DAT	52 DAT	57 DAT	30 DAT	60 DAT	90 DAT	54 DAT BT	58 DAT AT	62 DAT AT	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	33.3a	138.0a	29.8b	42.3a	30.3a	4.3a	26.0a	13.0ab	6.0a	<b>35.9</b>
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	25.0a	145.0a	15.5ab	35.3a	37.3a	2.3a	26.7a	10.0a	6.0a	<b>33.7</b>
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	31.0a	165.5a	18.0ab	35.3a	34.3a	2.3a	33.0a	8.3a	4.0a	<b>36.9</b>
Buprofezin	Applaud	25 SC	200	800 ml	35.0a	151.3a	14.3a	34.7a	22.7a	5.3a	34.3a	12.7ab	10.0b	<b>35.6</b>
Acephate	Acephate	75 SP	500	667 g	22.0a	130.3a	24.3b	22.0a	33.3a	3.3a	33.3a	15.3b	7.0b	<b>32.3</b>
Acephate	RIL-059/F1	95 SG	562.5	592 g	26.0a	111.1a	19.8b	30.3a	40.7a	2.3a	34.3a	21.3bc	12.7c	<b>33.2</b>
Monocrotophos	Monocrown	36 SL	500	1390 ml	29.8a	118.8a	27.5b	40.0a	28.0a	6.3a	34.0a	16.7bc	8.3b	<b>34.4</b>
Untreated control	-	-	-	-	34.3a	151.8a	54.0c	25.0a	29.0a	6.3a	44.0b	37.7c	19.3d	<b>44.6</b>

Table 2.9(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					GREEN LEAFHOPPER						
Common Name	Trade Name	% Formulation	Rate		No. per 10 hills						Mean
			g a.i. /ha	g or ml of formulation/ha	JDP			RNC		RPR	
					30 DAT	57 DAT	75 DAT	69 DAT BT	73 DAT AT	70 DAT	
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	5.3b	4.0a	13.7b	56.3a	19.7b	6.5a	<b>13.8</b>
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	2.0a	3.7a	13.7b	58.3b	16.0a	8.8a	<b>13.6</b>
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	4.7ab	2.3a	7.7a	52.0a	13.0a	6.5a	<b>11.4</b>
Buprofezin	Applaud	25 SC	200	800 ml	5.0ab	7.0b	7.3a	57.0a	26.0b	9.0a	<b>14.6</b>
Acephate	Acephate	75 SP	500	667 g	5.7b	5.0a	14.3b	62.7b	13.7a	7.5a	<b>14.1</b>
Acephate	RIL-059/F1	95 SG	562.5	592 g	3.7a	2.7a	14.0b	59.7b	11.7a	7.0a	<b>13.1</b>
Monocrotophos	Monocrown	36 SL	500	1390 ml	3.3a	1.7a	9.0a	45.0a	10.3a	7.0a	<b>10.2</b>
Untreated control	-	-	-	-	15.7c	26.7c	17.3b	62.0b	66.7c	11.8b	<b>25.6</b>

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

Table 2.9(Contd.): Influence of insecticide treatments on other pests and natural enemies in Insecticide Evaluation Trial (IET) kharif 2010

INSECTICIDE					Other pests					
Common Name	Trade Name	% Formulation	Rate		(rice hispa, blue beetle, ear head bug and armyworm caterpillar)					
			g a.i. /ha	g or ml of formulation/ha	RHDL		EB	Armyworm caterpillars/10 hills		
					RNC		RNC	REW		
					69 DAT BT	73 DAT AT	110 DAT	1 DBT	3 DAT	10 DAT
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	46.3b	42.7c	3.3b	45.7	6.0b	4.7b
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	45.0b	35.0c	2.7ab	38.7	7.3bc	3.7b
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	41.3a	33.3c	2.0a	39.7	2.0a	0.3a
Buprofezin	Applaud	25 SC	200	800 ml	45.3b	48.0d	11.7d	35.0	12.3c	12.3c
Acephate	Acephate	75 SP	500	667 g	47.7b	40.3c	5.7c	32.7	8.7b	7.3b
Acephate	RIL-059/F1	95 SG	562.5	592 g	43.3a	37.3c	4.0bc	35.7	9.0b	3.3b
Monocrotophos	Monocrown	36 SL	500	1390 ml	31.0a	10.0a	1.3a	27.3	2.3a	0.7a
Untreated control		-			70.0c	75.7d	15.3d	20.7	18.3d	9.3c

INSECTICIDE					NATURAL ENEMIES							
Common Name	Trade Name	% Formulation	Rate		NATURAL ENEMIES							
			g a.i. /ha	g or ml of formulation/ha	MTU		KUL					
					Spiders	Mirid bug	Spiders (No./10 hills)			Mirid bug (No./10 hills)		
					No./20 hills 60 DAT	No. /20 hills 60 DAT	54 DAT BT	58 DAT AT	62 DAT AT	78 DAT BT	82 DAT AT	86 DAT AT
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	5.7a	22.7ab	11.0a	15.0a	14.3a	7.3a	10.3b	11.7c
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	5.7a	13.7b	9.7a	15.7	13.0a	6.3a	17.0a	12.3bc
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	4.7a	37.0a	8.0a	19.0a	12.7a	3.7b	10.0b	7.0c
Buprofezin	Applaud	25 SC	200	800 ml	4.0a	18.3b	14.3a	15.7a	13.7a	5.7a	9.0b	6.3c
Acephate	Acephate	75 SP	500	667 g	4.7a	30.3a	13.3a	15.0a	15.0a	6.0a	13.7a	8.7c
Acephate	RIL-059/F1	95 SG	562.5	592 g	6.3a	26.7a	17.0a	16.7a	13.7a	5.0a	13.0a	20.7b
Monocrotophos	Monocrown	36 SL	500	1390 ml	5.0a	41.7a	9.3a	14.3a	13.7a	5.0a	12.7a	28.3b
Untreated control					2.7b	38.0a	9.0a	14.3a	15.0a	4.3ab	10.0b	45.7a

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

Table 2.10: Influence of insecticide treatments on grain yield in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE					Grain Yield (kg / ha)														
Common Name	Trade Name	Formulation	Rate		BBN	BMR	GGV	FZB	GGT	JDP	LDN	CHN	MND	MTU	MNC	NWG	NLR	NDL	PNR
			g a.i. / ha	g or ml of formulation/ha															
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	160 + 400	800g	3294b	2180a	5141b	2264a	1727a	4212b	7048b	4556b	1984ab	5296a	3900a	3843a	1463a	3538a	2578ab
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	180 + 450	900g	3341b	2110ab	5616b	2331a	1721a	4832a	7384b	5167ab	2229ab	5314a	4033a	4298a	1515a	3400a	2585ab
Buprofezin + Acephate	RIL-049/F1	20 + 50 WP	200 + 500	1000 g	3698ab	2089ab	4754b	2363a	1692a	4818a	7734ab	5167ab	2159ab	5530a	4183a	4071a	1559a	3138b	2607ab
Buprofezin	Applaud	25 SC	200	800 ml	3333b	2280a	5153b	2311a	1681a	4280b	6802bc	6074ab	2312a	5394a	3800a	4071a	1641a	3638a	2533ab
Acephate	Acephate	75 SP	500	667 g	3135b	2085ab	5060b	2299a	1878a	4760a	7800ab	4981ab	2069ab	5365a	4667a	3700b	1563a	3188ab	2326ab
Acephate	RIL-059/F1	95 SG	562.5	592 g	3508ab	1940b	9147a	2218a	1723a	4582ab	8193a	4981ab	2247ab	5424a	4217a	3496bc	1415a	3433a	2459ab
Monocrotophos	Monocrown	36 SL	500	1390 ml	3762a	1953b	4773b	2236a	1433b	4327b	7720ab	5074ab	2285ab	5226a	4700a	4107a	1611a	3363ab	2696a
Untreated control					2675c	1790b	4754b	1762b	1135b	4060b	6343c	6352a	1751b	4753b	2850b	3077c	1167b	2888b	2237b

Table 2.10 (Contd.): Influence of insecticide treatments on grain yield in Insecticide Evaluation Trial (IET) *kharif 2010*

INSECTICIDE			Grain Yield (kg / ha)												% IOC	Grain Yield (kg / ha)					
Common Name	Rate		PDC	PUS	RGL	SBP	MLN	RNC	RPR	REW	BNK	WGB	KUL	Mean		ADT	KJT	PTB	RNR	SKL	WGL
	g a.i. /ha	g or ml of formulation/ha																			
Buprofezin + Acephate	160 + 400	800g	3633a	6458b	3763ab	4117cd	3458a	2103b	6303ab	5707bc	4500ab	5689a	3267bc	3854	13.3	2088a	2416a	1531a	5163a	1608a	4716a
Buprofezin + Acephate	180 + 450	900g	3383a	6563ab	3790a	4179cd	3500a	2287ab	6268ab	5838bc	4556ab	5631a	3373b	3984	17.1	2063a	2214a	1583a	5111a	1600a	4500a
Buprofezin + Acephate	200 + 500	1000 g	3583a	6667ab	4234a	4329c	3528a	2313ab	6321a	6402a	4833a	5694a	3600a	4055	19.2	1850a	2409a	1531a	4823a	1650a	4512a
Buprofezin	200	800 ml	3900a	7083a	3165b	4154cd	3806a	1847b	5875b	4861d	4556ab	5680a	3413a	3919	15.2	1888a	2525a	1677a	4792a	1408a	4640a
Acephate	500	667 g	3917a	6250b	2971b	5030b	3444a	2140ab	6196ab	5317d	4444b	5694a	3307b	3916	15.1	2050a	2742a	1635a	4400a	1400a	4741a
Acephate	562.5	592 g	3850a	6875ab	4249a	4167cd	3681a	2233ab	6080ab	5447cd	4500ab	5875a	3293bc	4138	21.6	2025a	2619a	1635a	4943a	1567a	4508a
Monocrotophos	500	1390 ml	3925a	5938bc	4008a	5531a	3569a	2363a	6317a	6055ab	4556ab	5312a	3373b	4036	18.6	2038a	2705a	1573a	4828a	1483a	4424a
Untreated control			2392b	5521c	2751b	3804d	2444b	1450c	6179ab	4384e	4000b	5119a	3147c	3402		1938a	2127a	1490a	4562a	1242a	4547a

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

## ii) Pesticide compatibility trial (PCT)

During *kharif* 2010, a set of new insecticides and fungicides were included in this trial on evaluation of compatibility of the two groups of chemicals based on their efficacy when applied as tank-mix in the field. The insecticides included a combination product containing ethiprole and imidacloprid (Glamore 80 WG) supplied by Bayer India Pvt. Limited, effective against planthoppers and rynaxypyr (Coragen 20 SC) from E.I. Dupont India Pvt. Ltd. recommended against lepidopteran pests. The fungicides consisted of hexaconazole (Contaf 5 SC) supplied by Rallies India Ltd., effective against sheath blight and tricyclazole (Baan 75 SP), a product of Indofil chemicals recommended for blast. The trial was carried out at 11 locations *viz.*, Aduthurai, Chinsurah, Coimbatore, Gangavathi, Ghaghraghat, Jagdalpur, Pattambi, Moncompu, Nellore, Puducherry, and Sambalpur.

### Treatments

The trial included nine treatments consisting of ethiprole+imidacloprid @ 0.25 g/litre, rynaxypyr @ 0.3 ml/litre, hexaconazole @ 2.0 ml/litre and tricyclazole @ 0.6 ml/litre applied alone as individual treatments and also in four possible combination treatments. Untreated control without any insecticide or fungicide application was also included for comparison. The treatments were replicated thrice and laid out in Randomized Complete Block Design (RCBD).

Observations were recorded on stem borer damage at vegetative and heading stages on ten randomly selected hills and expressed as per cent dead hearts or white ears. Similarly, leaf folder damaged leaves were counted on 10 randomly selected hills per plot and the percentage damaged leaves were calculated. Planthopper populations were recorded on ten randomly selected hills per plot before and after application of treatments. For assessing the severity of blast and sheath blight diseases, percentage disease severity was assessed as the proportion of the leaf area damaged by the disease in relation to the total leaf area of all the plants in a plot before and after application. Towards maturity, the crop was harvested and grain yield / net plot leaving two border rows on all sides was recorded and expressed as kg/ha.

The location-wise dates of sowing, planting, harvesting and pesticide application dates are as follows:

Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
Aduthurai	8-8-2010	30-08-10	29-11-10	3	15, 45 and 60
Chinsurah	5-7-2010	30-07-10	-	-	-
Coimbatore	8-8-2010	2-9-2010	18-01-11	-	-
Gangavathi	15-07-10	21-08-10	6-1-2011	1	59
Ghaghraghat	23-06-10	2-8-2010	20-12-10	2	18 and 77
Jagdapur	8-7-2010	4-8-2010	16-12-10	3	30, 45 and 65
Moncompu	15-05-10	5-6-2010	23-09-10	3	15, 35 and 45
Nellore	15-09-10	19-10-10	-	2	15 and 30
Pattambi	26-06-10	20-07-10	1-11-2010	2	25 and 55
Puducherry	12-6-2010	17-07-10	16-11-10	2	30 and 50
Sambalpur	2-7-2010	3-8-2010	26-11-10	3	15, 54 and 74

## Results

### Pest Infestation (Table 2.11)

The stem borer infestation at vegetative stage was low across locations ranging from a mean of 1.2 to 3.8% DH in pesticide treatments and 7.6 in control. There were significant differences among the pesticide treatments only at Sambalpur and Chinsurah (at 50 DAT). The infestation in insecticides alone (1.8 to 5.2% DH) and combination treatments (0.7 to 7.3% DH) was lower than that in fungicide alone treatments (7.5 to 10.0% DH) and control (10.4 to 18.8% DH). The superiority of rynaxypyr application alone (1.8% DH) and in combination with fungicides (0.7 to 1.0% DH) over other treatments (5.2 to 10.0% DH) and control (18.8% DH) at 50 DAT was evident at Chinsurah. The differences were not so clear at Sambalpur, however treatments, except tricyclazole, were significantly superior (3.2 to 7.7% DH) to control (up to 10.6% DH). The mean infestation also was lower in individual insecticide as well as combination treatments (1.2 to 2.9% DH) compared to fungicides alone (3.2 and 3.8% DH) and control (7.6% DH).

At heading stage, there were significant differences among the treatments at 7 locations. At these locations, the damage was significantly low in rinaxypyr treatments, alone (1.4 to 14.8% WE) and in combination with tricyclazole (0.9 to 13.9% WE) and hexaconazole (1.3 to 17.6% WE) compared to fungicides alone (1.6 to 20.1% WE) and other treatments (1.8 to 23.7% WE) as well as control (8.9 to 28.3% WE). The mean infestation across all the locations was also minimum in rinaxypyr treatments (5.1 to 6.7% WE), while the ethiprole + imidacloprid combination and other treatments were at par (6.9 to 9.3% WE) and control (14.2% WE). Overall, against stem borer, the performance of rinaxypyr treatment was superior particularly when applied alone or in combination with tricyclazole compared to other treatments.

Data on gall midge incidence across two locations, Pattambi and Sambalpur revealed that the insecticide treatments applied alone (10.3 and 12.6% SS) and in combination with fungicides (12.7 to 15.9% SS) showed slightly less damage compared to fungicides alone (14.2 and 16.3% SS) as well as control (16.3% SS).

Brown planthopper populations were recorded upto 66.5 hoppers/hill at Gangavathi while at Jagdalpur, the populations did not exceed 27.3 hoppers/10 hills during 35 to 50 DAT and declined to negligible levels at in all the treatments at 70 DAT. Ethiprole + imidacloprid when applied alone resulted in maximum reduction of the hopper population (84.3%) followed by combination with fungicides (81.7 and 86.5%) compared to rynaxypyr treatments (69.8 to 79.8%) and fungicides applied alone (76.5 and 78.6%). The control plot showed only 15.7% reduction in hopper populations.

Green leafhopper populations ranged from 2.0 to 38.3 hoppers/10 hills in pesticide treatments and 15.0 to 40.0 hoppers/10 hills in control during 35 to 70 DAT at Jagdalpur, while at Aduthurai, the populations did not exceed 5.3 hoppers/10 hills across the treatments including control. The mean populations were lowest in the ethiprole+imidacloprid treatment applied along with hexaconazole and tricyclazole (6.9 and 8.6 hoppers/10 hills, respectively) followed by the ethiprole+imidacloprid applied alone (12.4 hoppers/10 hills) and other treatments (13.8 to 18.1 hoppers/10 hills). All the treatments showed significantly less population than control (24.2 hoppers/10 hills). The GLH populations before and after treatment also followed similar trends with highest reduction in hopper population in ethiprole+imidacloprid mixed with fungicides (76.9 and 68.4 %) followed by the combination insecticide treatment applied alone (63.3%). The percent reduction in hopper population in the both rynaxypyr treatment applied alone (32.7%) and in combination with fungicides (38.4 and 53.8%) was less than that of even fungicides alone treatments (62.3 and 55.2%).

Observations recorded on damage due to defoliators such as leaf folder at Jagdalpur, Moncompu, Nellore and Puducherry, whorl maggot at Chinsurah and Pattambi and blue beetle at Pattambi did not reveal any discernible trend of the compatibility of the pesticides and their combinations due to very low infestation.

## **Blast**

Blast disease was recorded at Ghaghraghat, Jagdalpur, Puducherry and Sambalpur. At Ghaghraghat, there were no significant differences among treatments including control at 77 DAT before treatment, but after the treatment the fungicides when applied alone as well as in combination with insecticides showed significant superiority over insecticide treatments and control. The blast severity did not exceed 5.7% at Puducherry and 11.7% at Sambalpur. At both locations, there were no significant differences among the treatments after their application. However, the data on mean percent reduction in blast incidence across locations after application clearly revealed that the effect of fungicides when applied alone (33.6 and 29.7%) or in combination (26.1 to 28.4%) was at par and significantly superior to insecticides (9.1 and 1.1%) and control(1.5%).

## **Sheath blight**

Sheath blight incidence was high at Pattambi ranging from 33.8 to 62.5% across treatments at 55 DAT and 3.8 to 92.5% at 75 DAT. The differences among the treatments were not so discernible at 55 DAT, however the superiority of fungicides (17.5 and 6.3%) and their combinations (3.8 to 28.8%) over insecticides (81.3 and 55.0%) and control (92.5%) was evident, at 75 DAT. The results showed that there was no adverse impact of the insecticide on the performance of the fungicides when applied in combination.

## **Grain yield (Table 2.12)**

There were significant differences in grain yield among different treatments at 7 locations. The mean grain yield data across the locations revealed that rinaxypyr applied alone was the best treatment showing the highest yield of 4335 kg/ha and 37.7% increase over control (IOC). Its combination with tricyclazole yielded the next highest of 4041 kg/ha with 33.2% IOC. The combination product of ethiprole and imidacloprid also yielded high when applied alone (3980 kg/ha with 32.1% IOC) as well as in combination with hexaconazole (3947 kg/ha with 31.6% IOC) and tricyclazole (3790 kg/ha with 28.7% IOC).

*Pesticide compatibility trial with the objective of evaluating the compatibility of newer insecticide and fungicide formulations as tank mix against major insect pests and diseases of rice and consequent impact on grain yield was carried out at 11 centres during kharif 2010. Based on the performance of the treatments when applied alone vis a vis their respective combinations in reducing pest infestation and their impact on grain yield, it was evident that rinaxypyr when applied alone was the best treatment followed by its combination with tricyclazole both in terms of reducing pest and disease incidence as well as realizing higher yields and superiority in yield increase over control. The results also revealed that there was no adverse impact on the efficacy of either rinaxypyr against stem borer or ethiprole+imidacloprid against plant and leafhoppers due to their combination with fungicides or vice versa confirming the compatibility of the chemicals when used as tank mix in the field.*

Table.2.11 : Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Stem borer incidence (% DH)								Mean
		CHN	MNC	PTB		SBP		ADT		
		50 DAT	50 DAT	30 DAT	50 DAT	64 DAT	84 DAT	30 DAT	50 DAT	
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	5.2b	1.7a	0.0a	0.0a	4.7a	3.9ab	1.5	1.9a	<b>1.9</b>
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	1.8a	1.0a	0.0a	0.0a	5.1ab	3.2a	0.5	2.1a	<b>1.2</b>
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	9.9b	2.3a	5.2a	2.8a	7.6b	8.1bc	1.3	5.7a	<b>3.8</b>
Tricyclazole (Baan 75 SP)	0.6 ml/litre	10.0b	1.2a	3.2a	0.0a	7.7b	7.5b	1.3	4.1a	<b>3.2</b>
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	7.3b	2.2a	4.9a	2.3a	5.4ab	4.7ab	1.8	0.7a	<b>2.9</b>
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	5.8b	0.7a	2.5a	0.5a	7.1b	5.3b	1.6	2.8a	<b>2.5</b>
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	1.0a	0.7a	3.1a	1.4a	6.1ab	5.3b	0.8	6.2a	<b>2.4</b>
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	0.7a	0.5a	1.8a	1.4a	6.6b	6.6b	1.6	7.6a	<b>2.5</b>
Untreated control	-	18.8c	6.1b	17.7b	9.4b	10.6c	10.4c	1.5	6.2a	<b>7.6</b>

Table 2.11(Contd.): Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Stem borer incidence (% WE)								Mean
		CHN	GGT	JDP	MNC	PTB	PDC	SBP	ADT	
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	10.9bc	4.3ab	14.6a	2.3a	17.2ab	1.7a	10.8b	3.2a	<b>8.1</b>
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	1.4a	4.3ab	9.9a	2.4a	14.8ab	2.1a	4.3a	1.7a	<b>5.1</b>
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	6.0b	5.1b	16.4b	1.6a	20.1ab	2.8b	18.1c	4.0a	<b>9.3</b>
Tricyclazole (Baan 75 SP)	0.6 ml/litre	4.3a	5.3b	13.4a	4.0a	10.5a	3.0b	16.4c	3.5a	<b>7.5</b>
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	5.3b	4.9ab	20.0b	1.2a	23.7b	1.7a	12.0bc	2.6a	<b>8.9</b>
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	3.4a	4.0a	17.4b	1.2a	12.2a	1.8a	13.0bc	2.2a	<b>6.9</b>
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	1.3a	4.5ab	17.6b	3.9a	17.3ab	1.3a	5.9ab	1.4a	<b>6.7</b>
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	2.1a	4.8ab	9.7b	0.9a	13.9ab	1.7a	9.1b	2.0a	<b>5.5</b>
Untreated control	-	13.7c	8.9c	21.5b	28.3b	14.8ab	1.5a	21.4c	3.6a	<b>14.2</b>

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

Table 2.11(Contd.): Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Gall midge incidence (%SS)				Mean
		PTB		SBP		
		30 DAT	50 DAT	64 DAT	84 DAT	
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	24.3a	0.4a	9.4ab	7.2a	10.3
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	32.8a	1.7ab	9.1a	6.9a	12.6
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	24.6a	4.3b	13.7ab	14.2c	14.2
Tricyclazole (Baan 75 SP)	0.6 ml/litre	33.2a	3.4ab	14.8b	13.7c	16.3
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	27.3a	3.1ab	14.9b	10.5a	13.9
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	24.7a	0.9a	13.1ab	12.2b	12.7
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	34.5a	1.4a	11.1ab	9.1a	14.0
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	37.1a	2.4ab	13.7ab	10.5a	15.9
Untreated control		29.2a	5.4b	15.9b	14.cb	16.3

Table 2.11(Contd.) Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	BPH incidence (No./hill)		BPH incidence (No. per 10 hills)				Mean % Reduction
		GGV		JDP				
		-		35 DAT		50 DAT		
		BT	AT	BT	AT	BT	AT	
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	16.3a	2.9a	3.7a	1.3a	14.0b	0.0a	84.3
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	19.1a	3.3a	19.0b	6.0a	17.3bc	7.0b	69.8
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	18.9a	4.9a	17.0b	4.3a	18.0bc	1.0a	78.6
Tricyclazole (Baan 75 SP)	0.6 ml/litre	22.0a	4.1a	8.7a	2.7a	17.7b	3.7a	76.5
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	29.2a	2.8a	2.7a	2.3a	2.0a	0.3a	81.7
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	33.7a	4.0a	3.0a	0.3a	4.3a	0.0a	86.5
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	58.8b	3.9a	13.3a	10.3b	5.3a	1.0a	79.8
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	35.1a	3.7a	11.0a	6.7a	12.7b	3.3a	75.8
Untreated control		66.5b	47.6b	14.7a	13.0b	23.3c	27.3c	15.7

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

Table 2.11(Contd.): Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	GLH incidence (No. per 10 hills)							
		JDP						ADT	Mean
		35 DAT		50 DAT		70 DAT			
		BT	AT	BT	AT	BT	AT		
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	23.3a	3.0a	32.3c	14.3a	7.0a	5.0a	1.0a	<b>12.4</b>
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	24.7a	24.7b	35.7c	14.3a	14.0a	11.0a	2.3a	<b>18.1</b>
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	36.3a	18.3b	38.3c	6.7a	6.7a	5.7a	5.3a	<b>16.8</b>
Tricyclazole (Baan 75 SP)	0.6 ml/litre	21.7a	13.7b	35.3c	9.7a	7.7a	5.7a	2.7a	<b>13.8</b>
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	22.0a	2.0a	7.7a	3.3a	9.3a	3.7a	0.3a	<b>6.9</b>
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	21.3a	2.3a	15.3b	6.0a	7.7a	5.7a	1.7a	<b>8.6</b>
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	28.7a	23.0b	21.7b	8.0a	11.3a	7.0a	2.0a	<b>14.5</b>
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	20.3a	16.3b	36.0c	9.3a	13.0a	6.3a	2.7a	<b>14.9</b>
Untreated control	-	29.7a	24.7b	40.0c	34.7b	15.0a	20.7a	5.0a	<b>24.2</b>

Table 2.11(Contd.): Incidence of disease in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Blast severity(%) / 10 hills								Mean	Mean % red.	Sheath blight severity(%)		
		GHG		JDP	PDC		SBP-		PTB			ADT		
		77 DAT			30 DAT				55				75	
		BT**	AT**		DAT	BT	AT	BT	AT				DAT	DAT
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	18.0a	17.3b	23.0ab	4.7b	1.7a	6.8a	7.9a	9.8	8.9	9.1	60.0b	81.3c	2.0
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	18.3a	18.3b	31.0b	3.0a	1.3a	7.1a	8.5a	9.5	9.4	1.1	37.5a	55.0b	1.7
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	18.0a	12.3a	18.0a	4.3b	0.7a	10.8b	9.1a	11.0	7.3	33.6	46.3a	17.5a	1.4
Tricyclazole (Baan 75 SP)	0.6 ml/litre	18.5a	12.0a	15.3a	5.7b	0.7a	9.6b	11.1a	11.3	7.9	29.7	41.3a	6.3a	1.3
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	16.0a	13.0a	19.0a	5.0b	1.0a	11.7b	9.7a	10.9	7.9	27.6	56.3b	28.8b	1.1
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	18.5a	12.5a	16.7a	2.7a	0.7a	8.3a	8.2a	9.8	7.1	27.6	41.3a	12.5a	1.2
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	18.5a	13.3a	20.0a	3.3a	0.3a	9.5b	9.5a	10.4	7.7	26.1	36.3a	11.3a	1.2
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	18.3a	13.3a	16.0a	3.7a	0.7a	9.9b	8.8a	10.6	7.6	28.4	33.8a	3.8a	1.5
Untreated control		19.0a	19.3b	32.0b	2.7a	0.7a	7.7a	9.0a	9.8	9.6	1.5	62.5b	92.5c	1.4

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

Table.2.12: Summary of grain yield in different treatments in Pesticide Compatibility trial (PCT), Kharif 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Grain yield (Kg/ha)								% IOC	Grain yield (Kg/ha)	
		GNG	GHG	JDP	MNC	PTB	PDC	SBP	Mean		ADT	CHN
Ethiprole+imidacloprid (Glamore 80 WG)	0.25 g/litre	10383ab	1741a	3293c	4019b	1417bc	3925ab	5105c	<b>3980</b>	<b>32.1</b>	2083a	3856a
Rynaxypyr (Coragen 20 SC)	0.30 g/litre	9250b	1680a	3820b	6148a	1542b	3733ab	6582a	<b>4335</b>	<b>37.7</b>	1900a	4089a
Hexaconazole (Contaf 5 SC)	2.0 ml/litre	6109d	1277c	3083c	3722b	1476bc	4158a	5105c	<b>3445</b>	<b>21.6</b>	2033a	4036a
Tricyclazole (Baan 75 SP)	0.6 ml/litre	9264b	1300c	3130c	3870b	1740ab	3767ab	4855c	<b>3776</b>	<b>28.5</b>	1933a	4122a
Ethiprole+imidacloprid + hexaconazole	0.25 g + 2.0 ml /litre	10718a	1739a	3475bc	3426bc	1479bc	3408b	5230bc	<b>3947</b>	<b>31.6</b>	2083a	3967a
Ethiprole+imidacloprid + tricyclazole	0.25 g + 0.6 ml /litre	9075b	1639a	3708bc	3833b	1385bc	3717ab	4805c	<b>3790</b>	<b>28.7</b>	1867a	4078a
Rynaxypyr + hexaconazole	0.30 g + 2.0 ml /litre	7847c	1667a	3137c	3556bc	1969a	3692b	5305bc	<b>3692</b>	<b>26.9</b>	2017a	4044a
Rynaxypyr+ tricyclazole	0.30 g + 0.6 ml /litre	9501b	1647a	2778d	3796b	1813ab	3558b	5506b	<b>4041</b>	<b>33.2</b>	1950a	4067a
Untreated control		5248d	1085c	2778d	2444c	1240c	2417c	4329d	<b>2701</b>		1100a	3667a

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

## 2.4 ECOLOGICAL STUDIES

Ecological studies consist of 3 trials viz., i. Influence of rice cultivation systems on insect pest incidence (IRCP), ii.) Effect of organic manures on pest incidence (EOMP) and iii. Trap Crop for Stem borer Management (TCSB). The results of these trials are presented below.

### i) Influence of rice cultivation systems on insect pest incidence (IRCP)

In recent years, alternative methods of rice cultivation are becoming popular among farmers due to their advantages like less water requirement, labour and other resource savings. Among these methods, system of rice intensification (SRI), direct seeded rice (DSR), aerobic rice and alternate wetting and drying (AWD) are accepted by the farmers and are being adopted. These methods have different cultural / agronomic practices that may result in changes in insect pest incidence. Hence, there was a need to study the influence of such rice cultivation systems on insect pest incidence.

In *kharif* 2010, the trial was allotted to five centres but the data were received only from three centres viz. Chinsurah, Ludhiana and Rajendranagar.

Various cultivars grown at each centre as sub-plot treatments are given below:

S.No	Location	Cultivation systems	Cultivars grown	
			Hybrid	Variety
1	Chinsurah	Normal & Direct seeded	KRH2	MTU 7029
2	Rajendranagar	Normal & Direct seeded	KRH2	RNR 2465 (Sugandha samba)
3	Ludhiana	Normal & Direct seeded	NK 3325	Pusa 1121 Punjab Basmati 2 Punjab Mehak 1

This field trial was laid out in split-plot design with cultivation systems as main plots (treatments) *i.e.*, S1) Conventional or Normal method and S2) Direct seeded rice and cultivars as two sub-plots *i.e.*, V1) Hybrid and V2) High yielding variety. The experimental area was divided into seven equal blocks each representing a replication. Each block had two main treatments with two sub-treatments. Thus, each block consisted of four plots. The experimental area at each location had 28 plots and no control measures were applied in any of these plots. Observations on insect pest incidence were recorded on ten randomly selected hills at ten day interval in each plot. At pre-harvest stage, per cent white ears were recorded. Grain yields were recorded from each plot. Grain number and grain weight from ten hills was also obtained.

## Results:

At **Chinsurah**, stem borer, leaf folder and whorl maggot incidence was recorded. But, leaf folder and white ear damage by stem borer was very low to draw any valid conclusions. The pest damage among the cultivation systems was not significant (Table 2.13) indicating that there was not much difference between the pest incidences in both the cultivation systems. There was a significant difference with respect to grain yield wherein direct sown rice recorded maximum yield (3393 kg/ha) as compared to normal transplanted method (2741 kg/ha). Among the cultivars, variety (MTU 7029) recorded higher dead heart damage at 60 DAT (13.71%) that was significantly different from that in the hybrid, KRH2 (6.59%). But, the whorl maggot damage was significantly more in the hybrid (11.92%) as compared to the variety (7.84%). However, the interaction effects are not significant except in case of yield wherein direct seeded rice recorded maximum yield in both the cultivars as compared to normal method.

At **Rajendranagar**, whorl maggot, thrips, hispa and stem borer incidence was recorded (Table 2.14). Thrips incidence was very low to draw valid conclusions. Among the cultivation systems, direct seeded rice recorded significantly lower whorl maggot (1.17%) and hispa (0.19%) damage while white ear damage was high (15.25%) as compared to normal method. Though there were no significant differences among the cultivars with respect to pest incidence but hybrid, KRH2 recorded significantly higher yield (6463 kg/ ha) as compared to RNR 2465 variety (5199 kg/ ha). The interaction was found significant with respect to dead heart damage and grain yield.

At **Ludhiana**, stem borer and leaf folder incidence was observed (Table 2.15). Three varieties *viz.*, Pusa 1121, Punjab Basmati 2 and Punjab Mehak 1 were grown along with a hybrid, NK 3325. There were no significant differences between the cultivation systems with respect to dead heart and white ear damage by stem borer, but leaf folder damage was significantly high in direct seeded rice at both 45 DAT (10.74%) and 60 DAT (14.14%) as compared to normal method. Among the cultivars, Punjab basmati 2 recorded significantly lower leaf folder damage (10.53%) as against hybrid (13.05%) at 60 DAT. Among the cultivation systems, higher grain yield was obtained from normal method (3268 kg/ ha) than direct seeded rice (3039 kg/ ha). Among the cultivars, Punjab Mehak 1 recorded significantly higher yield (3554 kg/ ha) followed by the hybrid (3269 kg/ ha). The interaction was significant with respect to stem borer and leaf folder damage and grain yield.

*Among the two cultivation systems, whorl maggot and hispa damage was low while white ear and leaf folder damage was high in direct seeded rice as compared to normal method. Hybrids registered higher whorl maggot and leaf folder damage and lower dead hearts as compared to the varieties. Across the locations, direct seeded rice recorded higher yield at two locations while normal method recorded higher yield at one location. Hybrids out yielded varieties except at Ludhiana.*

Table 2.13: Influence of rice cultivation systems and cultivars on insect pest incidence and grain yield at **Chinsurah, (IRCP) kharif 2010**

Main plots	Sub- plots	% WMDL 20 DAT	% DH 60 DAT	% DH 80 DAT	Yield (kg/ha)
Normal	Hybrid	12.64(3.60)	6.44(2.45)	3.11(1.82)	3161
	Variety	7.50(2.79)	11.73(3.46)	5.68(2.43)	2321
Direct seeded	Hybrid	11.20(3.40)	6.75(2.65)	4.73(2.17)	3393
	Variety	8.18(2.92)	15.70(3.97)	8.44(2.91)	3393
<i>LSD 0.05</i>	<i>M in S</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	388
	<i>S in M</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	383
<b>Cultivation systems</b>					
Normal		10.07(3.19)	9.08(2.95)	4.39(2.12)	2741
Direct seeded		9.69(3.16)	11.22(3.31)	6.59(2.54)	3393
<i>LSD 0.05</i>	<i>Main</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	103
<b>Cultivars</b>					
	Hybrid	11.92(3.50)	6.59(2.55)	3.92(1.99)	3277
	Variety	7.84(2.85)	13.71(3.71)	7.06(2.67)	2857
<i>LSD 0.05</i>	<i>Sub</i>	0.29	0.65	0.61	271

Table 2.14: Influence of rice cultivation systems and cultivars on insect pest incidence and grain yield at **Rajendranagar, (IRCP) kharif 2010**

Main plots	Sub- plots	% WMDL	% HDL	% DH 53 DAT	% WE Pre-harvest	Yield (kg/ ha)
Normal	Hybrid	13.00(3.65)	2.59(1.73)	6.41(2.57)	12.41(3.55)	5869
	Variety	12.72(3.60)	2.54(1.73)	7.01(2.72)	7.72(2.74)	4985
Direct seeded	Hybrid	1.16(1.28)	0.19(0.82)	8.47(2.93)	14.30(3.82)	7057
	Variety	1.17(1.24)	0.20(0.82)	3.85(2.00)	16.21(4.04)	5412
<i>LSD 0.05</i>	<i>M in S</i>	<i>NS</i>	<i>NS</i>	0.77	<i>NS</i>	453
	<i>S in M</i>	<i>NS</i>	<i>NS</i>	0.73	<i>NS</i>	440
<b>Cultivation systems</b>						
Normal		12.86(3.62)	2.56(1.73)	6.71(2.64)	10.07(3.15)	5427
Direct seeded		1.17(1.26)	0.19(0.82)	6.16(2.47)	15.25(3.93)	6234
<i>LSD 0.05</i>	<i>Main</i>	0.47	0.22	<i>NS</i>	0.59	197
<b>Cultivars</b>						
	Hybrid	7.08(2.47)	1.39(1.28)	7.44(2.75)	13.36(3.69)	6463
	Variety	6.95(2.42)	1.37(1.28)	5.43(2.36)	11.96(3.39)	5199
<i>LSD 0.05</i>	<i>Sub</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	<i>NS</i>	311

Figures in parenthesis are square root transformed values

Table 2.15: Influence of rice cultivation systems and cultivars on insect pest incidence and grain yield at Ludhiana, (IRCP) Kharif 2010

Main plots	Sub-plots	% DH 45 DAT	% DH 60 DAT	% WE	% LFDL 45 DAT	% LFDL 60 DAT	Yield kg/ ha
<b>Normal</b>	<b>Hybrid</b>	2.09(1.44)	2.18(1.47)	2.63(1.62)	7.32(2.70)	9.42(3.07)	3519
	<b>Variety 1</b>	2.81(1.67)	3.15(1.76)	2.66(1.62)	6.41(2.52)	11.04(3.31)	3003
	<b>Variety 2</b>	2.88(1.69)	3.29(1.81)	2.85(1.67)	5.89(2.42)	8.47(2.91)	3004
	<b>Variety 3</b>	2.58(1.61)	2.00(1.41)	2.27(1.50)	6.06(2.46)	8.51(2.92)	3547
<b>Direct seeded</b>	<b>Hybrid</b>	3.57(1.88)	3.14(1.77)	3.27(1.81)	11.83(3.43)	16.67(4.08)	3019
	<b>Variety 1</b>	2.61(1.61)	2.49(1.58)	2.97(1.72)	9.65(3.10)	13.39(3.66)	2875
	<b>Variety 2</b>	2.40(1.55)	2.21(1.49)	3.17(1.77)	10.11(3.18)	12.60(3.54)	2698
	<b>Variety 3</b>	2.58(1.61)	2.40(1.55)	2.64(1.62)	11.38(3.37)	13.91(3.73)	3562
<i>LSD 0.05</i>	<i>M in S</i>	0.25	0.23	NS	NS	0.3	281
	<i>S in M</i>	0.21	0.19	NS	NS	0.25	244
<b>Cultivation systems</b>							
<b>Normal</b>		2.59(1.60)	2.65(1.61)	2.60(1.60)	6.42(2.53)	9.36(3.05)	3268
<b>Direct seeded</b>		2.79(1.66)	2.56(1.60)	3.01(1.73)	10.74(3.27)	14.14(3.75)	3039
<i>LSD 0.05</i>	<i>Main</i>	NS	NS	NS	0.3	0.25	209
<b>Cultivars</b>							
	<b>Hybrid</b>	2.83(1.66)	2.66(1.62)	2.95(1.71)	9.57(3.07)	13.05(3.57)	3269
	<b>Variety 1</b>	2.71(1.64)	2.82(1.67)	2.82(1.67)	8.03(2.81)	12.22(3.48)	2939
	<b>Variety 2</b>	2.64(1.62)	2.75(1.65)	3.01(1.72)	8.00(2.80)	10.53(3.23)	2851
	<b>Variety 3</b>	2.58(1.61)	2.20(1.62)	2.45(1.56)	8.72(2.91)	11.21(3.32)	3554
<i>LSD 0.05</i>	<i>Sub</i>	NS	0.14	NS	0.17	0.18	173

Figures in parenthesis are square root transformed values

Variety 1= Pusa 1121

Variety 2= Punjab Basmati 2

Variety 3= Punjab Mehak 1

## ii) Effect of organic manures on pest incidence (EOMP)

With the increase in the use of organic manures in rice production by the farmers there is a need to know the impact of these organic materials on insect pest incidence and subsequent impact on grain yield. Hence, the present trial was formulated and being conducted since 2004. During *kharif* season, the trial was carried out at six locations *viz.* Maruteru, Ludhiana, Rajendranagar, Titabar, Mandya and Ranchi.

This field trial consisted of six treatments with four replications in a randomized block design. Treatments include (1) Untreated control without application of organic manures or fertilizers, (2) 100 per cent recommended fertilizer dose (RFD), (3) Farm yard manure @ 10 tons per hectare, (4) Green manure - *Sesbania rostrata* or any other green manure - incorporation, (5) green manure as in T4 + 50 per cent recommended N as top dressing in two splits (GM + 50% N) and (6) application of vermicompost or poultry manure as per the local recommendation. No insecticide was applied in any of the treatments either in nursery or in main field. Insect pest incidence was recorded on ten randomly selected hills in each replication. Plot wise grain yield was also recorded to know the effect of organic manures.

### Results

**Maruteru:** Stem borer damage was low and not significant (<5% DH and 10 – 15% WE) across the treatments (Table 2.16). Recommended fertilizer dose treatment recorded maximum number of BPH (336 / 20 hills) and was significantly different from all other treatments. Lowest number of BPH were recorded in untreated control (64) that was at par with GM + 50% N (77) and vermicompost (88). Whorl maggot damage was low in RFD (21%) and was at par with all other treatments except untreated control (37%) and GM +50% N (34%). Highest grain yield was obtained from RFD (5627 kg/ ha) despite recording higher pest damage and was at par with all other treatments but significantly higher than untreated control (4741 kg/ha).

**Ludhiana:** Stem borer damage i.e., dead hearts and white ears were found very low and not significantly different among the treatments (Table 2.17). Despite two fold higher dead heart damage and 2.5 fold higher leaf folder damage, RFD treatment resulted in 250 kg additional grain yield in comparison with vermicompost treated plot.

**Rajendranagar:** Though stem borer, thrips, whorl maggot and hispa damages were recorded in different treatments, none of them were statistically significant among the treatments tested. Grain yield recorded in RFD (5003 kg/ ha) was highest and significantly different from untreated control (4261 kg/ ha) but was at par with all other treatments.

**Titabar:** Dead hearts and silver shoots at 30 DAT, caseworm at 50 DAT and white ears at pre-harvest were recorded but were not significant among the

treatments due to low damage levels (Table 2.18). Dead hearts at 50 DAT were low in vermicompost (1.8%) and GM + 50%N (2.2%) that were significantly different from other treatments including untreated control (10.5%). Silver shoots at 50 DAT were low in green manure applied plots (2.1%) and was at par with FYM treatment (2.4%) and RFD (3.7%) but was significantly different from untreated control (4.3%). Highest yield was recorded from vermicompost plots (9190 kg/ha) and was significantly different from all other treatments with untreated control (2875 kg/ha) recording the lowest yield.

**Mandya:** Whorl maggot, gall midge and white ears by stem borer, though recorded were not significant among the treatments (Table 2.19). Lowest numbers of BPH were observed in GM + 50% N (16.3) which was significantly lower than all other treatments and highest numbers were recorded in GM applied plots (27.8). Leaf folder damage was found significantly low in untreated control (58.3%) that was at par with GM, FYM and RFD. Thrips damage was found low in untreated control (45.8%) and high in GM + 50% N (85.3%) which was significantly different from other treatments. Though highest grain yield was obtained from RFD, the differences in yield among the treatments were not significant.

**Ranchi:** At this location two extra treatments i.e., Karanj cake (KC) and Neem cake (NC) @ 2.5 t/ ha were included based on the local needs (Table 2.20). Stem borer damage was lowest in NC (1.9% DH) and KC (2.8% DH) that was significantly different from other treatments with highest damage in RFD (19.9% DH). Similarly gall midge damage was lowest in NC (1.1% SS) that was at par with KC (1.3% SS) and untreated control (1.9% SS) and high in RFD (10% SS). White ear damage was low in all the treatments except in RFD (12.3%). GLH and ear head bug populations, leaf folder and hispa damage were found lowest and at par with each other in NC, KC and untreated control and highest damage was recorded in RFD and GM + 50% N. Maximum yield was recorded in RFD (4138 kg/ ha) despite higher pest damage and minimum yield in untreated control (975 kg/ ha).

*Across the locations, stem borer, leaf folder, gall midge, GLH and hispa damage was high in recommended fertilizer dose treatment and low in untreated control except at Ranchi wherein neem cake and karanj cake applied plots recorded low pest incidence. Highest grain yield was obtained from recommended fertilizer dose treatment at four locations despite high pest pressure and damage. Vermicompost application resulted in variable performance across locations; lower planthopper populations with similar yield at Maruteru, lower pest damage and lower yield at Ranchi and Ludhiana, and no difference in pest incidence and yield at Mandya when compared with the RFD treatment.*

Table 2.16: Effect of organic manures on insect pest incidence and grain yield at **Maruteru (EOMP), Kharif 2010**

Treatments	SB % DH 50 DAT	BPH No/ 20 hills 50 DAT	WM %WMDL 50 DAT	Yield kg/ha
Untreated control (UC)	2.3(1.6)b	64.5 (8.0)a	37.0(6.1)d	4741c
Recommended Fertilizer Dose (RFD)	0.3(0.9)a	336.8(18.3)d	21.0(4.5)a	5627a
Farm Yard Manure @ 10 t/ ha (FYM)	0.2(0.8)a	110.8(10.5)b	28.0(5.3)abc	5258ab
Green Manure (GM)	0.2(0.8)a	197.5(14.0)c	24.0(4.9)ab	5074ab
GM + 50% N top dressing in 2 split doses	0.2(0.8)a	76.8(8.7)ab	34.0(5.8)bcd	5533a
Vermicompost @ 2t/ ha (VC)	0.1(0.8)a	88.3(9.2)ab	29.5(5.4)abcd	5407ab
CV (%)	17.2	25.1	23.5	5.5

Variety = MTU 7029; Figures in parenthesis are square root transformed values  
Means in a column followed by different letters are significantly different at  $p=0.05$

Table 2.17: Effect of organic manures on insect pest incidence and grain yield at **Ludhiana (EOMP), Kharif 2010**

Treatments	% DH 60 DAT	% LFDL 60 DAT	Yield kg/ha
Untreated control (UC)	2.8(1.7)b	8.5(2.9)b	1519d
Recommended Fertilizer Dose (RFD)	2.9(1.7)b	14.2(3.8)c	2843a
Farm Yard Manure @ 10 t/ ha (FYM)	1.6(1.3)a	7.2(2.7)b	2096c
Green Manure (GM)	1.8(1.3)a	9.3(3.0)b	2337bc
GM + 50% N top dressing in 2 split doses	2.1(1.5)ab	8.9(3.0)b	2783a
Vermicompost @ 2t/ ha (VC)	1.5(1.2)a	5.5(2.3)a	2602ab
CV (%)	22.2	10.6	9

Variety = Super Basmati; Figures in parenthesis are square root transformed values  
Means in a column followed by different letters are significantly different at  $p=0.05$ ;

Table 2.18: Effect of organic manures on insect pest incidence and grain yield at **Titabar, (EOMP), Kharif 2010**

Treatments	% DH 50 DAT	% SS 50 DAT	Yield kg/ha
Untreated control (UC)	10.5(3.3)b	4.3(2.2)b	2875 d
Recommended Fertilizer Dose (RFD)	9.1(3.1)b	3.7(2.0)ab	4560b
Farm Yard Manure @ 10 t/ ha (FYM)	7.4(2.8)b	2.4(1.6)a	4400bc
Green Manure (GM)	7.1(2.7)b	2.1(1.6)a	4215c
GM + 50% N top dressing in 2 split doses	2.2(1.6)a	5.7(2.5)b	4312bc
Vermicompost @ 2t/ ha (VC)	1.8(1.5)a	3.9(2.1)ab	9190a
CV (%)	41.9	35	3.69

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

Figures in parenthesis are square root transformed values

Table 2.19: Effect of organic manures on insect pest incidence and grain yield at **Mandya (EOMP)**, *Kharif 2010*

Treatments	BPH	LEAF FOLDER	THRIPS	Yield kg/ha
	No/ 20hills 72 DAT	% damaged leaves 33 DAT	% damaged leaves 33 DAT	
Untreated control (UC)	23.8(4.9)bc	58.3(7.6)a	45.8(6.7)a	<b>2778a</b>
Recommended Fertilizer Dose (RFD)	20.0(4.5)ab	65.5(8.1)ab	70.3(8.4)bc	<b>3194a</b>
Farm Yard Manure @ 10 t/ ha (FYM)	20.0(4.5)ab	61.3(7.8)a	71.0(8.4)bc	<b>2987a</b>
Green Manure (GM)	27.8(5.3)c	59.0(7.7)a	61.0(7.8)ab	<b>2926a</b>
GM + 50% N top dressing in 2 split doses	16.3(4.0)a	78.0(8.8)b	85.3(9.2)c	<b>2876a</b>
Vermicompost @ 2t/ ha (VC)	20.3(4.5)ab	78.3(8.8)b	69.5(8.3)bc	<b>3130a</b>
CV (%)	16.2	15.3	18.9	<b>7.7</b>

Variety = CTH 1 ; Means in a column followed by different letters are significantly different at p= 0.05  
 Figures in parenthesis are square root transformed values

Table 2.20: Effect of organic manures on insect pest incidence and grain yield at **Ranchi (EOMP)**, *Kharif 2010*

Treatments	SB	GM	SB	GLH	LF	HISPA	EB	Yield kg/ha
	% DH 50 DAT	% SS 50 DAT	% WE Pre harvest	No./ 10 hills 55 DAT	% LFDL 70 DAT	% HDL 60 DAT	No./ 10 hills 110 DAT	
Untreated control (UC)	5.5(2.3)b	1.9(1.4)a	0.3(0.5)a	39.3(6.3)c	6.3(2.5)a	2.5(1.5)a	1.8(1.3)a	<b>975e</b>
Recommended Fertilizer Dose (RFD)	19.9(4.5)e	10.0(3.1)c	12.3(3.5)f	86.5(9.3)e	76.8(8.8)f	28.8(5.4)d	24.0(4.9)d	<b>4138a</b>
Farm Yard Manure @ 10 t/ ha (FYM)	13.7(3.7)d	5.8(2.4)b	5.5(2.3)e	45.8(6.7)c	38.5(6.2)d	20.8(4.5)c	12.5(3.5)c	<b>2538d</b>
Green Manure (GM)	5.9(2.4)bc	5.8(2.4)b	4.2(2.0)de	43.0(6.6c	36.8(6.1)d	21.0(4.6)c	12.3(3.5)c	<b>2544d</b>
GM + 50% N top dressing in 2 split doses	15.5(3.9)d	4.4(2.1)b	6.0(2.4)e	62.3(7.9)d	57.0(7.5)e	32.8(5.7)d	21.8(4.7)d	<b>3763b</b>
Vermicompost @ 2t/ ha (VC)	7.9(2.8)c	4.3(2.1)b	2.8(1.7)cd	26.5(5.1)b	27.5(5.2)c	19.8(4.4)c	10.0(3.2)c	<b>2609d</b>
Karanj cake @ 2.5 t/ ha (KC)	2.8(1.6)a	1.3(1.1)a	1.5(1.2)bc	3.5(1.8)a	13.0(3.6)b	9.3(3.0)b	3.8(1.9)b	<b>3233bc</b>
Neem cake @ 2.5 t/ha (NC)	1.9(1.4)a	1.1(1.0)a	0.7(0.8)ab	5.5(2.3)a	11.0(3.3)b	3.5(1.8)a	2.5(1.5)ab	<b>3045c</b>
CV (%)	14.4	28.1	36.3	17.5	14.4	19.1	18.7	<b>10.7</b>

Variety = Birsamati: Means in a column followed by different letters are significantly different at p= 0.05;  
 Figures in parenthesis are square root transformed values

### iii) Trap Crop for Stem borer Management (TCSB)

Yellow stem borer (YSB) is the dominant pest in rice ecosystem. Except for timely insecticidal application and use of sex pheromones for monitoring and mass trapping, no other control options are available. Research studies at DRR and FLDs taken up in farmers field proved that transplanting of one row of trap crop (Pusa basmati 1) as an inter crop for every 9 rows of main crop (2.5-3 m) in east-west direction would minimize stem borer damage in the main crop. Pusa Basmati 1, an aromatic fine grained rice variety had more stem borer damage than other varieties. Yellow stem borer being a monophagous pest, only a susceptible rice variety could be used as a trap crop. The sowing time of the trap crop (Pusa Basmati 1) should be adjusted such that the trap crop flowers one week before flowering of the main crop.

This is the second year of the trial. The trial was opted by 7 centres out of which 6 centres conducted the trial. The objective of the trial was to minimize the damage by yellow stem borer (YSB) in the main crop by planting a susceptible variety as an inter (trap) crop. The main crop variety is a local popular variety. The experiment was laid out with two main treatments 1) main crop alone 2) main crop with trap crop and two sub treatments 1) no insecticide treatment 2) need based application of insecticide, with 4 replications in each treatment. Observations on total tillers and number of dead hearts were recorded at 30 and 50 DAT; panicle bearing tillers, and number of white ears at pre harvest from 25 hills per replication. If the dead heart damage exceeds 20% in the trap crop a spray of insecticide was recommended. Grain yield (main crop yield and trap crop yield) was recorded from a uniform area of 3X 3sq m. at two places in each replication. At the time of harvest 10 hills from each treatment were dissected out to estimate the stage of the insect in the trap crop variety. The information pertaining to all the management practices are summarized in Table 2.21. At two locations viz., Chinsurah and Ghaghraghat, one spray of monocrotophos was applied; at Raipur two insecticidal sprays of monocrotophos and at Pusa and Karjat a spray of Cartap hydrochloride was applied in the sub treatments where insecticide application was recommended. No insecticide was applied in treatments at Rajendranagar. The results of this trial are discussed location wise:

**Chinsurah:** Main crop variety grown was Swarna (MTU 7029). The dead heart (1.84% at 30 DAT and 2.13% at 50 DAT) damage and white ear (3.95%) damage was significantly low in the main treatment where main crop variety was grown along with trap crop as compared to the treatment where only main crop variety was grown. The grain yield was also higher in this treatment (6651kg/ha) as compared to main crop which was grown alone (4029 kg/ha). BCR was very low and varied from 0.93-1.86 (Table 2.22).

Dead heart damage at 50 DAT (1.35%) and white ear (4.52%) damage were significantly low in the sub treatment where a need based application of monocrotophos was given as compared to treatment with no insecticidal

control (6.43%DH; 6.84% WE) (Table 2.25). A significant difference in grain yield was observed between treated (mean yield of 5679 kg/ha) and untreated plots (mean yield of 5000 kg/ha). Interaction effects were not significant.

**Ghaghraghat:** Jal Priya was the main crop variety grown. No stem borer damage was observed at vegetative phase. At reproductive phase white ear damage varied from 7.51% to 12.2% among various treatments. Significant difference in WE damage in the main crop was observed in the main treatments with (8.12%) and without trap crop (10.4%). The main treatments where trap crop was grown had higher grain yield (1976 kg/ha) as compared to treatment without trap crop (1497 kg/ha) (Table 2.23). Main treatments where insecticide was applied had significantly lower white ear damage (8.0%) as compared to untreated control (10.46% WE). Significant difference in grain yield also was recorded between treatments with (1580.6 kg/ha) and without insecticidal application (1883.8kg/ha). BCR varied from 0.99-1.42 among the treatments. Interaction effects for yield were significant.

**Karjat:** Karjat 2 was the main crop variety. Stem borer incidence was very low *i.e.* 2.04%-3.35% DH. White ear damage was as high as 15.11-20.1% across treatments. White ear damage in the main crop +trap crop was 15.5 % as compared to 18.01% damage in treatment where main crop alone was grown though statistically non significant. No significant difference in grain yield was observed between the treatments where main crop only was grown (3368kg/ha) and main crop with trap crop (3565kg/ha). Insecticidal treatment resulted in significantly higher grain yield (3985kg/ha) as compared to untreated control (2947 kg/ha).BCR varied from 1.37-1.85 among the treatments and the monetary gain obtained by growing trap crop was 4.4% (Table 2.24)

**Raipur:** Swarna was the main crop variety. Stem borer damage at 30 DAT varied from 5.1-7.2% DH and at 50 DAT from 7.9-10.6% DH across treatments. White ear damage was significantly lower (17.79% white ear) and the grain yield (5369 kg/ha) was significantly higher in the treatment where main crop was grown with trap crop as compared to the treatment where only main crop was grown which had 19.24% WE and recorded a grain yield of 5055 kg/ha (Table 2.25). Dead heart damage at 50 DAT (8.10%) was significantly lower in the main treatment with need based insecticide application as compared to control which had 10.3 %DH. Dead heart damage at 30 DAT, white ear damage and grain yield did not differ between the insecticide treated (5.4%DH;17.5%WE and 5306g/ha, respectively) and untreated plots (6.98% DH;10.3%WE; 5118kg/ha, respectively). BCR varied from 2.69-2.82 among the treatments and the monetary gain obtained by growing trap crop was 5%.

**Rajendranagar:** BPT 5204 was the main crop variety grown. Stem borer incidence was very low *i.e.* 1.09%-2.92 % DH and 3.54-4.06% WE to discern the impact of trap crop on stem borer damage (Table 2.26). No significant difference in grain yield was observed between the treatments

where main crop only was grown (5227kg/ha) and main crop with trap crop (5749 kg/ha). BCR varied from 2.019-2.196 between the two main treatments and the monetary gain obtained by growing trap crop was 8.84%.

**Pusa:** The main crop variety was Rajendra Kasturi. Dead heart damage varied from 7.3-18.1% and white ear damage ranged from 5.2 -9.7% across treatments (Table 2.27). In the treatment where main crop was grown with trap crop, stem borer damage at 30 DAT (12.6% DH), 50 DAT (6.99%DH) and white ear (5.95%) damage were significantly lower as compared to treatment where main crop was grown alone (13.8% DH at 30 DAT, 12.7% DH at 50 DAT and 8.4 %WE) but there was no significant difference in grain yield. A spray of cartap hydrochloride as a need based application lowered stem borer damage (12.7% at 30 DAT; 6.72% DH at 50 DAT and 6.1 %WE ) over untreated control (13.7% DH, 12.9% DH and 8.2%WE) and higher grain yields (6219 kg/ha) as compared to control (5819kg/ha).

*Dead heart damage at Chinsurah and Pusa and white ear damage by stem borer at Chinsurah, Raipur Pusa and Gaghraghat were significantly lower in the main treatment where trap crop (Pusa Basmati) was grown along with main crop. The total grain yield was also higher in treatment with main crop +trap crop as compared to main crop only at these locations. Stem borer incidence per se was low at Karjat for dead heart damage and at Rajendranagar through out crop growth to derive the impact of trap crop on stem borer damage in main crop at these locations. The benefit cost ratio varied from 0.99-2.82 across locations and the monetary gain obtained by growing trap crop along with main crop was 4.4% at Karjat, 8.8% at Rajendranagar and 5% Raipur.*

Table 2.21: Management practices in various locations in **TCSB**, *kharif* 2010

	CHINSURAH	GHAGHRAGHAT	RAIPUR	RAJENDRANAGAR	PUSA	KARJAT
<b>I GENERAL INFORMATION</b>						
1 Location	Research farm	Research farm	Research farm	Farmers field, Ethbarpally, Moinabad Mandal, Ranga .Reddy, District.	Research farm	Research farm
2 Main crop variety	MTU 7029 (Swarna)	Jalpriya	Swarna	BPT 5204	Rajendra Kasturi	Karjat - 2
3 Date of sowing of main crop	13 -7 - 2010	8 - 7 - 2010	7 - 7- 2010	9 - 6 - 2010	6 - 9 - 2010	-
4 Trap crop Variety	Pusa Basmati -1	Pusa Basmati 1	Pusa Basmati 1	Pusa Basmati -1	Pusa Basmati-1	Pusa Basmati-1
5 Date of sowing of trap crop :	19 - 7 - 2010	8 - 7 - 2010	1 - 7 - 2010	24 - 6 - 2010	6/14/2010	-
6 Treatment details: Area	8m x 10m / replication	22m x 11m = 232 sq m	11 x 07 meter for each treatment replication	500m <sup>2</sup> / treatment	3 x 6 m <sup>2</sup>	Plot size Gross 13.80 m x 12.00m
7 No. of replications	Four	Four	Four	Four	Four	Four
8 No of trap crop rows sown in the field in each replication	Five	24 rows	Four	8 rows / replication	Four	Six
<b>II Agronomic practices</b>						
1 Type of main crop planting a) In regular rows b) At Random	Regular rows	In regular rows	Regular rows Spacing 20 cm x 15 cm	Random In rows (1 row after every 2.5m in east west direction)	In Regular rows	-
2 Type of trap crop planting	1 row after 9 rows	After 8 rows of main plant	By manual transplanting with the help of rope. Simultaneous with the main crop variety.	-	9 Main crop 1 Trap crop	One row of trap crop after every nine
3 Difficulty faced while planting trap crop	Slow transplanting	We have to be watchful for planting of trap crop	No	No difficulty	-	Nil
4 Fertilizers applied						
a)Basal	- -	N, P, K @ 40, 40, 40 kg/ ha -	NPK 100:60:40 kg/ha. 33.3 kg N+ 60 kg P+ 40 kg K as basal through Urea, SSP & MOP.	DAP 1 bag, SSP 1.0bag  Urea - 1 bag, No potash Zinc Sulphate spray	NPK -	N:P:K 100:50:50 -

				Urea 1.5 bag		
b)Top dressing		N @ 20 kg/ ha at tillering stage	33.3 kg/ha at Tillering	Potash 20kg	-	-
		N @ 20 kg/ ha at booting stage	33.3 kg/ha at PI stage	-	-	-
5 Herbicide application	4 KG Butachlor	No	No (One manual weeding)	Yes Oxadiargyl (Topstar) 40g/acre	No	No
	3 Days after planting			3-5 days after planting	-	-
6 Incidence of other pests	NO	No	YSB was the major pest Traces of LF	Yes. Gall midge incidence recorded at 71 DAT	Leaf folder	Cartap
7 Details of insecticide application		Need based In T3 & T4 only	-	-	-	-
a. Name of the insecticide	Monocrotophos 36%EC	Monocrotophos 36 SC	Monocrotophos 36 %		Cartap hydrochloride 50SP	Hydrochloride 50WP
b. Dose applied	2 ML / Litre	500 g.a.i./ ha at	0.05 % Conc. Twice	-	300 g ai./ha	-
c.Time of application	-	Booting stage	23-09-2010 I spray 18-10-2010 II spray (Tillering & PI stage)	-	16 – 8 - 2010	-

Table2.22: Effect of trap crop on stem borer damage and grain yield in TCSB trial at Chinsurah, kharif 2010

Treatments		Stem borer damage			Total grain yield Kg/ha (MC+TC)	Cost of cultivation (Rs./ha)		
		Dead hearts (%)		WE(%)		Total costs	Gross returns	B:C
Main	Sub	30 DAT	50 DAT	Prior to harvest				
Main crop alone	No insecticide application	3.13(1.76)	9.35(3.06)	8.68(2.94)	3676.4	39469	36764	0.93
	Need based insecticide application	3.37(1.80)	1.95(1.39)	6.12(2.4)	4381.9	45719	43810	0.96
Main crop with trap crop	No insecticide application	1.16(1.06)	3.50(1.85)	4.99(2.23)	6325	39671	73912	1.86
	Need based insecticide application	2.53	0.75	2.92	6977.78	45922	81410	1.77
CD_MinS		NS	1.67 (NS)	NS	NS			
CD_SinM		NS	1.6 (NS)	NS	NS			
<b>Planting type</b>								
Main crop alone		3.25(1.78)	5.65(2.22)	7.398(2.67)	4029.17			
Main crop with trap crop		1.84(1.33)	2.13(1.3)	3.95(1.95)	6651.39			
<b>LSD in main</b>		1.16	0.58(0.38)	2.42(0.596)	678.46			
CV_Main		28.7(13.6)	9.4 (13.6)	26.8(16.2)	7.98			
<b>Insecticide application</b>								
No insecticides		2.14(1.41)	6.43(2.45)	6.84(2.59)	5000.69			
Need based Insecticide application		2.95(1.70)	1.35(1.07)	4.52(2.04)	5679.86			
LSD in sub		NS	1.1( 0.44)	2.2(0.51)	564.9			
CV_Sub		36.72 (17.58)	23.82(20.5)	32.10(18.1)	8.65			

Values in parentheses are sqrt transformed ; Price of swarna @ 1000- per q and Pusa Basmati 1 @ 1500- per q MC= main crop; TC= trap crop

Table 2.23: Effect of trap crop on stem borer damage and grain yield in TCSB trial at Ghaghraghat, kharif 2010

Treatments		Stem borer damage White ear(%) Prior to harvest	Total grain yield (MC+TC) Kg/ha	Cost of cultivation (Rs./ha)		
Main	Sub			Total costs	Gross returns	B:C
Main crop alone	No insecticide application	12.2(3.49)	1402.8	65301	64483	0.99
	Need based insecticide application	8.5 (2.92)	1593.1	68577	82328	1.2
Main crop with trap crop	No insecticide application	8.7 (2.95)	1758.3	66594	80043	1.2
	Need based insecticide application	7.5 (2.72)	2194.4	69870	99137	1.42
CD_MinS		NS	115.4			
CD_SinM		NS	103.8			
<b>Planting type</b>						
Main crop alone		10.4(3.2)	1497			
With trap crop		8.1 (2.84)	1976			
<b>LSD in main</b>		0.44(0.09)	73.5			
CV		12.98(5.5)	2.65			
<b>Insecticide application</b>						
No insecticides		10.5(3.22)	1580.6			
Need based insecticide application		8.03(2.82)	1893.8			
<b>LSD in sub</b>		1.4 (0.25)	73.91			
CV		12.6(6.68)	3.45			

Values in parentheses are sqrt transformed ; MC= main crop; TC= trap crop

Table 2.24: Stem borer incidence and grain yield in **TCSB** at **Karjat**, *kharif* 2009

Treatment		Stem borer damage			Total grain yield Kg/ha (MC+TC)	Cost of cultivation (Rs./ha)		
		Dead hearts (%)		WE(%)		Total costs	Gross returns	B:C
Main	Sub	30 DAT	50 DAT	Prior to harvest				
Main crop alone	No insecticide application	2.18 (1.46)	3.35(1.81)	20.0(4.36)	2861.1	22662	31042	1.37
	insecticide application	2.04(1.42)	2.42(1.55)	15.99(3.87)	3875.0	23364	42044	1.80
Main crop with trap crop	No insecticide application	2.2(1.49)	2.05(1.41)	15.96(3.98)	3034.7	23254	33308	1.43
	insecticide application	2.49(1.55)	2.07(1.42)	15.1 (3.87)	4095.8	23956	44420	1.85
CD_MinS		NS	NS	NS	NS			
CD_SinM		NS	NS	NS	NS			
<b>Planting type</b>								
Main crop alone		2.11	2.9	18.01	3368.1			
With trap crop		2.35	2.1	15.5	3565.2			
<b>LSD in main</b>		NS	NS	NS	NS			
CV_Main		24.8(16.7)	40.38(12.8)	31.1(23.3)	11.2			
<b>Insecticide application</b>								
No insecticides		2.2	2.7	17.999	2947.9			
Need based Insecticide application		2.26	2.25	15.6	3985.4			
<b>LSD in Sub</b>		NS	NS	NS	389.997			
CV_SuB		32.8(16.7)	25.5 (12.8)	46.94(23.26)	9.2			

Values in parentheses are sqrt transformed ; MC= main crop; TC= trap crop

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Table 2.25: Effect of trap crop on stem borer damage and grain yield in **TCSB** trial at **Raipur**, *kharif* 2010

Treatments		Stem borer damage			Total grain yield Kg/ha (MC+TC)	Cost of cultivation (Rs./ha)		
		Dead hearts (%)		WE(%)		Total costs	Total returns	B:C
Main	Sub	30 DAT	50 DAT	Prior to harvest				
Main crop alone	No insecticide application	7.16(2.54)	9.92(3.14)	20.2(4.49)	4958.3	18831.2	50706.8	2.69
	Need based insecticide application	5.1(2.18)	7.89(2.80)	18.25(4.27)	5152.8	21428.6	52690.9	2.82
Main crop with trap crop	No insecticide application	6.80(2.53)	10.6(3.26)	18.7(4.32)	5278.5	19090.9	53.979.5	2.46
	Need based insecticide application	5.67(2.33)	8.306(2.87)	16.84(4.09)	5459.7	21683.3	55837.8	2.58
CD_MinS		NS	NS	NS	NS			
CD_SinM		NS	NS	NS	NS			
<b>Planting type</b>								
Main crop alone		6.15(2.36)	8.90(2.97)	19.24(4.38)	5055.6			
Main crop with trap crop		6.24(2.43)	9.5(3.06)	17.8(4.21)	5369.1			
<b>LSD in main</b>		NS	NS	0.81(0.09)	NS			
CV		50.63	10.44	2.75	7.2			
<b>Insecticide application</b>								
No insecticides		6.98(2.53)	10.3(3.198)	19.5(4.41)	5118.40			
Need based insecticide application		5.40(2.25)	8.10(2.84)	17.5(4.2)	5306.3			
<b>LSD in sub</b>		NS	2.0(0.335)	NS	NS			
CV_SUB		49.4(26.3)	17.97(9.07)	11.5(5.86)	3.7			

Values in parentheses are sqrt transformed, Price of Swarna @ Rs1000- per q and Pusa Basmati 1 @ 1500- per q; Monetary gain 5%  
MC= main crop; TC= trap crop

Table 2.26: Effect of trap crop on stem borer damage and grain yield in **TCSB** trial at **Rajendranagar**, *kharif* 2010

Treatment	Stem borer incidence			Total grain yield (MC+TC) Kg/ha	Cost of cultivation (Rs./ha)		
	DH (%)		WE(%)		Total costs/ha	Total returns	B:C
	30 DAT	50 DAT	Prior to harvest				
Main crop alone	1.38 (0.74)	2.47(1.9)	4.06(1.4)	5227.1	26675	53838	2.02
Main crop with trap crop	1.09(0.78)	2.92(1.5)	3.54(1.8)	5749.3	28075	61671.1	2.196
Mean	0.09(0.76)	2.95(1.7)	2.38(1.6)	6402.4			
<b>LSD in main</b>	NS	NS	NS	NS			
CV	102.97(34.0)	70.2(32.09)	16.47	16.47(8.09)			

Values in parentheses are sqrt transformed ; Price of BPT 5204 @ Rs1030- per q and Pusa Basmati 1 @ 1500- per q; Monetary gain 8.84%

Table 2.27: Effect of trap crop on stem borer damage and grain yield in **TCSB** trial at **Pusa**, *kharif* 2010

Treatments		Stem borer damage			Total grain yield Kg/ha (MC+TC)
Main	Sub	Dead hearts (%)		WE(%)	
		30 DAT	50 DAT	PH	
Main crop alone	No insecticide application	14.4(3.79)	18.1(4.24)	9.7(3.1)	5819.4
	Need based insecticide application	13.26(3.6)	7.3(2.69)	7.1(2.66)	6222.2
Main crop with trap crop	No insecticide application	12.97(3.6)	7.8(2.79)	6.8(2.596)	5820.0
	Need based insecticide application	12.15(3.48)	6.2(2.47)	5.2(2.27)	6361.1
CD_MinS		NS	NS	NS	NS
CD_SinM		NS	NS	NS	NS
<b>Planting type</b>					
Main crop alone		13.8 (3.72)	12.7(3.47)	8.4(2.88)	6020.8
Main crop with trap crop		12.6(3.54)	6.99(2.63)	5.95(2.43)	6090.6
<b>LSD in main</b>		0.82(0.12)	1.3 (0.24)	0.80(0.11)	NS
CV_Main		3.9(2.04)	8.5(4.9)	7.01(2.7)	6.181
<b>Insecticide application</b>					
No insecticides		13.7(3.70)	12.9 (3.52)	8.2(2.85)	5819.7
Need based Insecticide application		12.7(3.56)	6.7 (2.59)	6.1 (2.5)	6291.7
LSD in sub		0.6 (0.081)	0.6(0.11)	0.98(0.18)	236.9
CV_Sub		3.7 (1.8)	4.9(2.9)	11.20(5.7)	3.20

Values in parentheses are sqrt. transformed

## 2.5 BIOCONTROL AND BIODIVERSITY STUDIES

### iv) Monitoring of pest species and their natural enemies (MPNE)

This trial, initiated in 2008 combining the objectives of monitoring of species composition of rice pests along with their natural enemies was conducted at 20 centers viz., Aduthurai Coimbatore, Karaikal, Rajendranagar, Nellore and Warangal (South India) Ludhiana, Kaul, Pantnagar, Ghaghraghat and New Delhi (Northern India), Chinsurah, Bankura, Sambalpur and Pusa (Eastern India), Karjat and Nawagam (Western India), Raipur and Rewa (Central India) Malan (Hills) and Titabar (North eastern India).

The study involved observations to be recorded at regular intervals, from an area of 1000 m<sup>2</sup> unsprayed plot, on the endemic pest species and their natural enemy populations

#### Results

##### 1. Stem borer:

**Species composition:** Observations on stem borers were received from 11 centres. At Ludhiana three species of stem borer viz., YSB, WSB and PSB were observed at maximum tillering and flowering stages of crop growth (Fig. 2.3). The YSB accounted for 26-45% of the population over the crop growth stages, WSB for 0-25 per cent while PSB increased from 30 to 73 per cent as the crop matured. At Pantnagar, though two species were observed, the YSB dominated (95.8-98.7 %) while PSB accounted for 1-4 per cent of the population. At Navsari, two types of larvae were observed, white (7.07%) and yellow (91.69%). The YSB was the most dominant species in other centres like Raipur, Nellore, Rajendranagar and Faizabad where it accounted for 99-100% of the population. Other borers present at Rajendranagar were SSB and PSB. At Gagrghat, the population YSB was 79.49% and the other species was PSB (20.51%).

**Natural enemies: Egg parasites-** The egg parasitisation varied from 32.44% at Raipur to 59.33% at Sambalpur. The egg mass parasitisation ranged from 10.0 % at Nawagam and Sambalpur to 91.7 % at Pantnagar. Three parasitoids viz., *Tetrastichus*, *Telenomus* and *Trichogramma* were reported (Fig. 2.4). Parasitisation by only *Tetrastichus shoenobii* was reported from Nawagam while it was also dominant at Pantnagar (66.8%). *Telenomus* was recorded as the major egg parasitoid from Raipur (100%) and Rajendranagar (53.61%). At Rajendranagar all three parasitoids viz., *Tetrastichus*, *Telenomus* and *Trichogramma* while at Pantnagar only two species were present. At Chiplitima (Sambalpur) *Trichogramma* was the only species causing up to 59.3 per cent parasitisation of eggs.

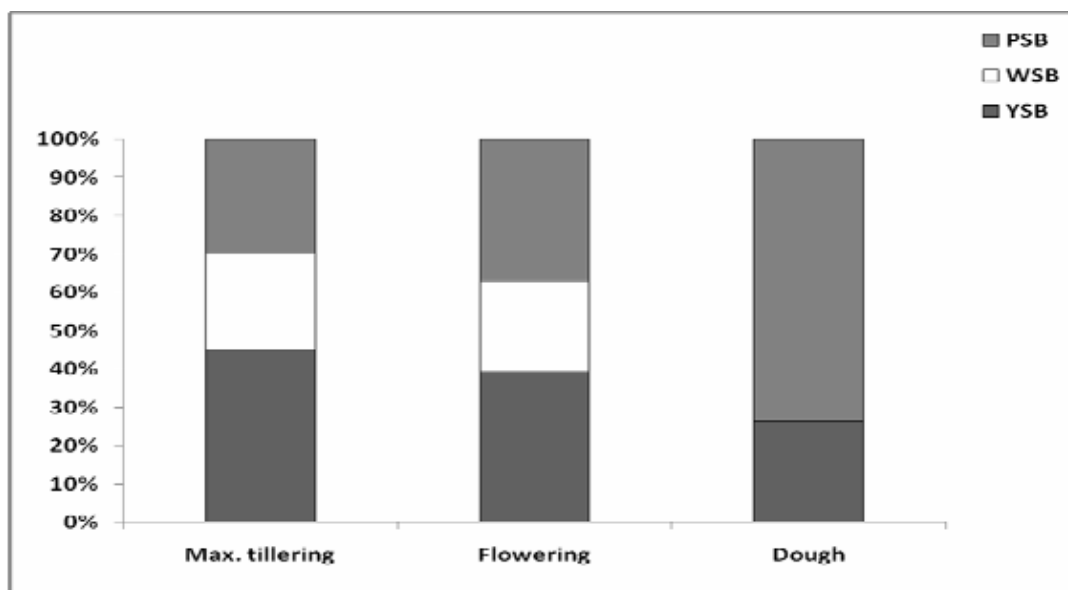


Fig. 2.3: Stem borer species composition at Ludhiana

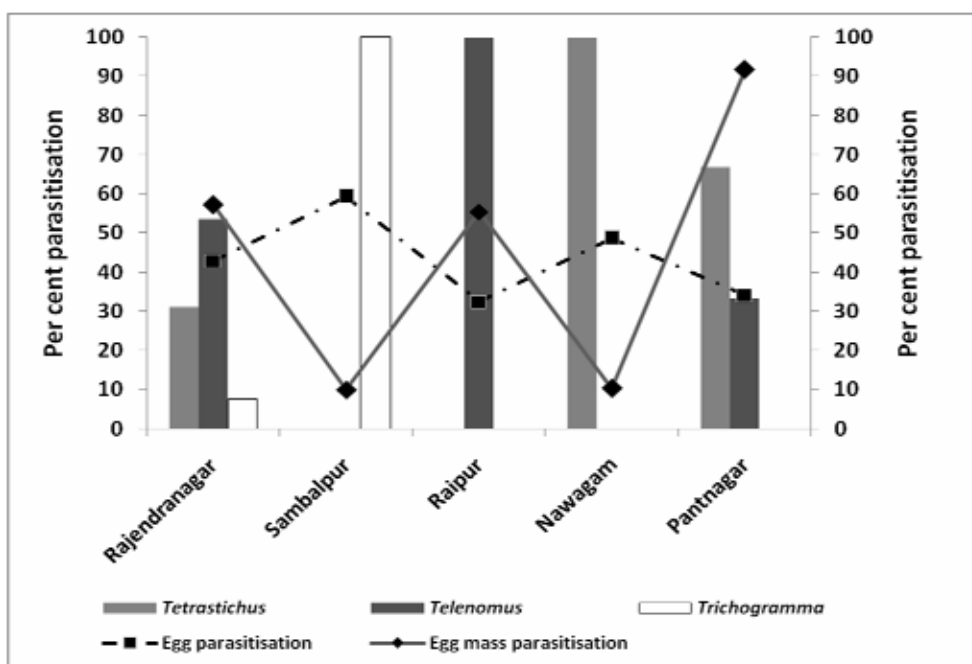


Fig 2.4. Egg parasitisation of stem borer at various centres – Kharif 2010

## Leaf Folder

**Species composition:** Observations on leaf folder were recorded at six centres viz., Aduthurai, Karaikal, Nawagam, Raipur and Malan. At Aduthurai, three species of leaf folder were observed and the dominant species was *Marasmia patnalis* accounting for more than 80 per cent of the population followed by *Cnaphalocrocis medinalis* (9-16%). *Brachmia* was present only during the active tillering phase up to 9 per cent of the population. At Karaikal, two leaf folder species were reported and were equally abundant. Based on larval characteristics, *C. medinalis* accounted for 68 per cent and *Marasmia* 32%. Based on adult emergence and sweep net counts *C. medinalis* accounted for 44-53% of population while *Marasmia* was 46-56%. In Nawagam, Malan, Ludhiana and Raipur the population was 100% *C. medinalis*.

**Natural enemies:** At Aduthurai the larval parasites observed were *Macrocentrus phillipinensis*, *Xanthopimpla*, *Apanteles* (single and gregarious). *Macrocentrus* parasitisation increased from 4 per cent at active tillering stage to 28 per cent at milky phase. Parasitisation by non gregarious *Apanteles* (*Cotesia*) sp. ranged from 16-24 per cent over the crop growth stages. At Nawagam, the pupal parasitism was 37.3% and larval parasitism was 1%. *Xanthopimpla* sp. was the larval pupal parasitoid observed, while the nongregarious *Apanteles* sp. was observed from larvae. Three larval parasitoids, *Macrocentrus* sp., *Charops* sp and *Apanteles* sp. were recorded at Malan resulting in up to 76 per cent parasitisation. Non gregarious *Apanteles* sp was the key larval parasitoid causing 64 per cent parasitisation. Low level of parasitisation was observed at Karaikal and the species reported are non gregarious *Apanteles* sp. (28%), *Brachymeria* (8%) and *Macrocentrus phillipinensis* (28%).

At Ludhiana sweep net samples were taken to assess natural enemy population. The parasitoids recorded were *Xanthopimpla* and other ichneumonids, *Charops* and other braconids. The predators recorded were *Brumus* sp. and other coccinellids, damselflies, staphylinids and spiders belonging to the families - Araenidae, Tetragnathidae, Salticidae, Oxyopidae and Lycosidae.

## Hoppers

**Species composition:** Two centres viz., New Delhi and Warangal reported on the status of hoppers and their natural enemies. At New Delhi, the brown plant hopper (BPH), white backed plant hopper (WBPH) and green leaf hopper (GLH) were observed on 50, DAT. The mean BPH population per hill increased from 0.02 to 3.85 near the time of harvest whereas the WBPH population declined from 1.95 to 0.15/hill. The overall BPH - WBPH ratio was 1:2. In Warangal the plant hopper population was observed on two dates from 60 DAT. It consisted only of the Brown plant hopper with a mean of 7/hill and a maximum of 25/ hill.

**Natural enemies:** The predators of hoppers were observed at New Delhi and Warangal. At Warangal spiders were the most abundant predator with a mean of 8 spiders per 10 hills followed by green mirid (2.8/10hills) and coccinellids (1.2/10hills). At New Delhi, spiders were more prevalent (5.3/10hills) followed by green mirid and staphylinids (2.4/10hills) and brown mirid (0.2/10hills).

### Gundhi bug

Information on gundhi bug was received from one centre *viz.*, Raipur. *Leptocorisa acuta* was the only species present. No data was received on the natural enemies of gundhi bug.

### Gall midge

Data on gall midge were received from 4 locations *viz.*, Raipur, Sambalpur, Moncompu and Warangal. At Warangal, the mean galls observed from 100 hills were 2.6/hill and the parasitized galls were an average of 15.6 per cent per hill. At Moncompu, a mean of 1.22 galls were observed per hill and the mean parasitisation was 58.41 with a range of 0-100% per hill. The per cent parasitised galls observed at Sambalpur was 6.2-26 % on various dates of observation (Fig 2.5). At Raipur an average of one gall was observed per hill with a parasitisation rate of 11.1 per cent. The species observed at Moncompu and Raipur was *Platygaster oryzae*.

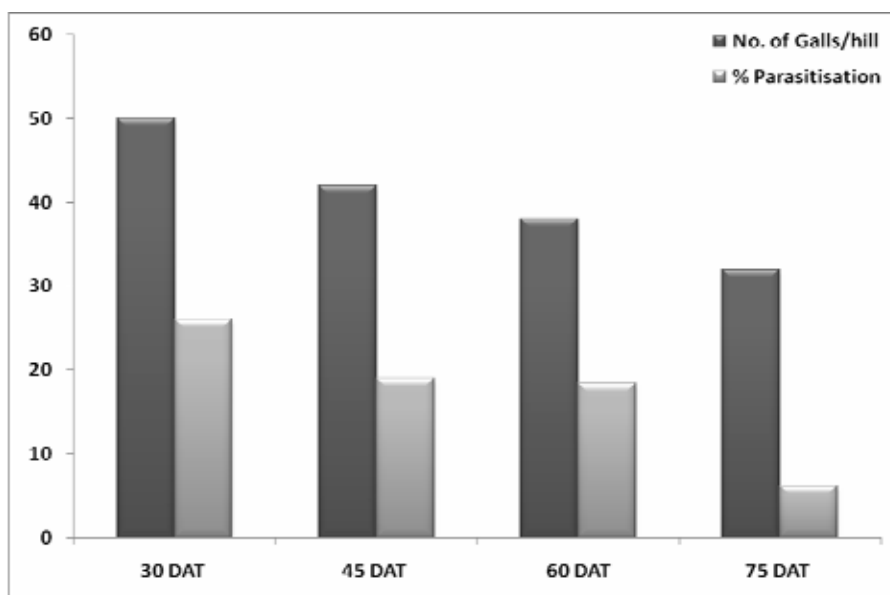


Fig 2.5. Gall midge damage and parasitised galls at **Sambalpur** (Kharif 2010)

## ii) **Ecological Engineering for Planthopper Management(EEPM)**

This new trial was proposed with the objective to use non-pesticidal methods to manage planthopper pests by enhancing natural enemy fitness through floral diversity and thereby increase natural biological control and to augment egg predators of hoppers. The methodology advocated was to plant two plots of 1000m<sup>2</sup> each (i) Ecologically engineered plots with non-pesticidal interventions compared to (ii) Farmers' practice with commonly used insecticides. One of the interventions of ecological engineering is increasing floral diversity through locally available flowering weeds/ bund crops that can be a good nectar source. This in turn would attract natural enemies like egg parasitoids which exert natural biological control on the pest population. The observations to be recorded in each plot were

1. Visual counts of hoppers on 50 – 100 hills
2. Counts of mirid predators – both nymphs and adults on these hills
3. Drynid parasitisation based on cocoon count
4. Egg baiting for studying egg parasitisation

The trial was taken up at only two centres – Mandya and Kaul.

At **Mandya**, an attempt was made to increase floral diversity by **growing cowpea on the bunds**. The pulse crop was sown 37 days after rice crop was transplanted. Data on population of hoppers and spiders/10hills and other natural enemies were recorded at 90 and 105 DAT. A paired t-test was performed that does not assume equal variances (n=10). The mean population of BPH/10 hills in plots with cowpea on the bunds (58.6) was not significantly different than the BPH population per 10 hills in plots without cowpea around (31.4) (t = 1.5). Similarly spider population did not differ significantly in the two plots. The plot yields were 22.01kg and 28.28 kg with and without cowpea. On cowpea plant the natural enemies observed were coccinellids and predatory crickets(Fig. 2.6).

At **Kaul**, the hoppers and their natural enemies were sampled in plots that were untreated, followed farmers' practice and plots with alleyways, as recommended under ecological engineering interventions. The population of hoppers was lowest in farmers practice plots but the highest number of mirid-bugs was recorded in plots with alleyways for management of hoppers (Fig. 2.7)

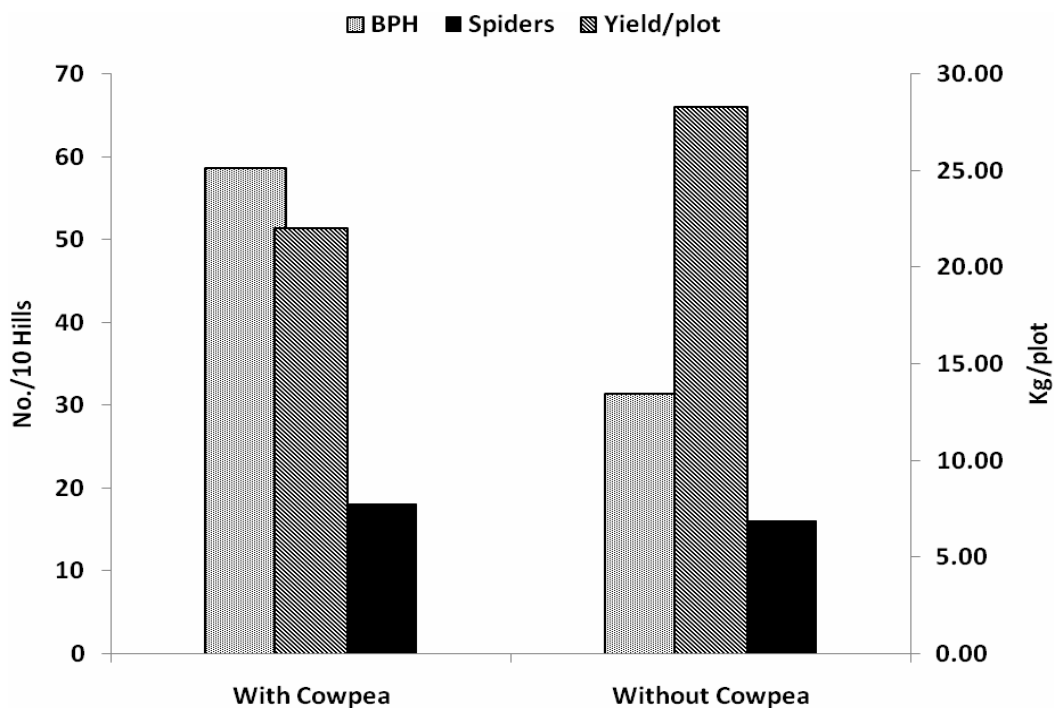


Fig 2.6. Effect of ecological engineering on hoppers and spiders at **Mandya**

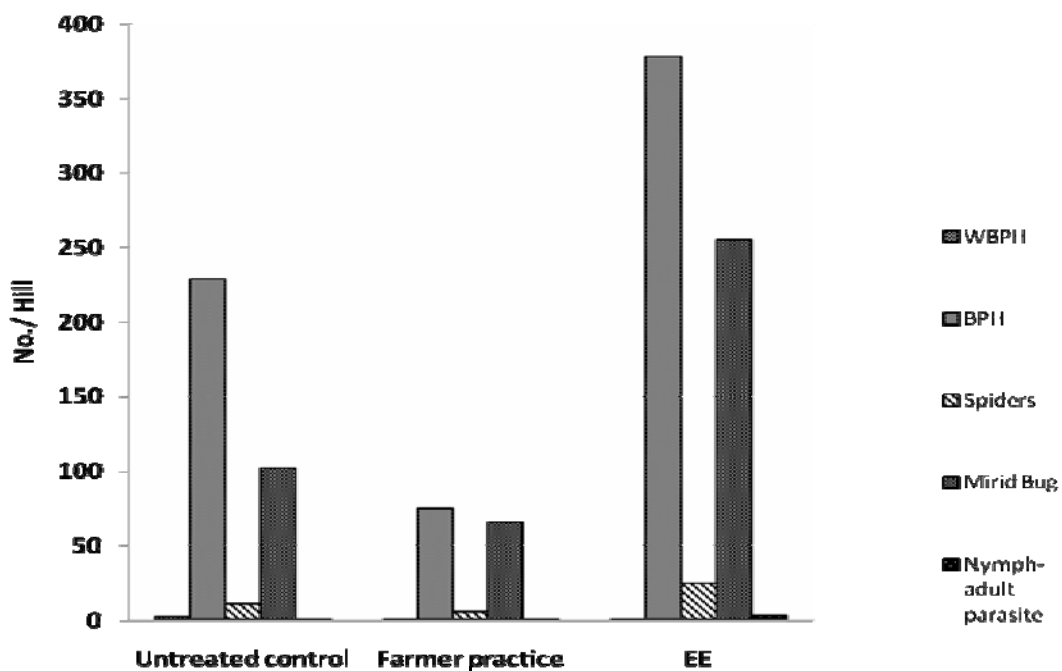


Fig 2.7. Hoppers and their natural enemies in various treatments at **Kaul**

## 2.6 INTEGRATED PEST MANAGEMENT

This section includes 2 trials *i.e.*, i. A new trial on Yield loss estimation (YLET) and ii. On-farm integrated pest management (OIPM).

### **i. Yield loss estimation trial (YLET)**

In rice, yield losses occur due to many constraints of which biotic factors play a major role. The information on yield losses caused by insect pests in rice, particularly loss by a specific insect is limited and is imprecise in most of the reports. Simulation studies do not provide a clear picture of actual field situation. Hence, a new trial was initiated this year on yield loss estimation in the field. The major objective of this trial was to estimate the yield losses due to specific pest infestation at different crop growth stages and at varying levels. This was done by the use of chemicals under following treatments to create different levels of pest infestation at different crop growth stages and also by the augmentation of the specific pest at various periods to get the desired level of damage.

Different treatments imposed are as follows:

T1 = No protection in nursery and main field (untreated control)

T2 = Protection in nursery only and no protection in main field (Application of Carbofuran 3 G @ 1.1 kg ai/ ha, 5 - 7 days before pulling seedlings from nursery)

T3 = Protection in nursery and main field up to 30 DAT (Application of Carbofuran 3 G @ 1.1 kg ai/ ha, 5 - 7 days before pulling seedlings from nursery + application of Carbofuran 3 G @ 1 kg ai/ ha in the main field at 20 DAT).

T4 = Protection in nursery and main field up to 60 DAT (Application of Carbofuran 3 G @ 1.1 kg ai/ ha, 5 - 7 days before pulling seedlings from nursery + application of Carbofuran 3 G @ 1 kg ai/ ha in the main field at 20 DAT + one spray of cartap hydrochloride 50 WP @ 600 g ai/ ha at 40 DAT).

T5 = Protection in nursery and main field up to booting stage (Application of Carbofuran 3 G @ 1.1 kg ai/ ha, 5 - 7 days before pulling seedlings from nursery + application of Carbofuran 3 G @ 1 kg ai/ ha in the main field at 20 DAT + two sprays of cartap hydrochloride 50 WP @ 600 g ai/ ha at 40 DAT & 60 DAT ).

T6 = No protection in nursery and main field up to booting stage (One spray of Cartap hydrochloride 50 WP @ 600 g ai/ ha after 60 DAT (at booting depending on the variety).

T7 = No protection in nursery and main field up to 60 DAT (Two sprays of Cartap hydrochloride 50 WP @ 600 g ai/ ha at 60 DAT and 15 days after first spray or at booting).

T8 = No protection in nursery and main field up to 30 DAT (Three sprays of Cartap hydrochloride 50 WP @ 600 g ai/ ha at 30 DAT, 60 DAT and at booting).

### **Observations**

In each plot, two one square meter areas were marked for pest observations. In one quadrat, natural pest incidence was recorded. In another quadrat, pest was augmented by releasing same stage of the insect in equal numbers at 25, 45 and 65 DAT in all the treatments. Pest damage was recorded at 10 days interval starting from 15 DAT till harvest. At each observation, in marked areas, numbers of dead hearts, white ears, damaged leaves and other pests were recorded. Finally yield was recorded in each marked quadrat.

This year, the field trial was carried out for two insect pests at six locations *viz.*, Puducherry, Jagdalpur and Aduthurai for leaf folder and Chinsurah, Ludhiana and Ghaghraghat for stem borer. At Ludhiana and Ghaghraghat, insects were not augmented and hence only natural damage was considered.

### **Results**

In spite of augmentation, the damage obtained was not significant across the treatments and hence, regression analysis was done for drawing valid conclusions.

#### **Leaf folder**

At **Puducherry**, leaf folder was augmented by releasing equal number of third instar larvae in all the treatments. Observations on damage were recorded at 25, 35, 45 and 55 DAT. The number of damaged leaves varied from 16 to 61 per quadrat with mean maximum of 49.5 DL/ sq.m and minimum of 24.7 DL per square meter. Yield varied between 135 to 225 g per square meter. Step down regression analysis (Table 2.28) revealed that damaged leaves at 35, 45 DAT and dead hearts at 25 DAT influenced the yield ( $r^2 = 0.35$ ). At **Jagdalpur**, leaf folder was augmented by releasing 20 larvae (mixed population of second and third instars) in all the treatments. Leaf damage recorded from 15 DAT to pre-harvest stage was considered for analysis and interpretation. Damaged leaves ranged from 0 to 70 per quadrat with mean maximum of 31.2 DL/ sq.m and minimum of 11 DL/

sq.m. A negative relation was observed between damaged leaves and yield and step down regression analysis revealed that damaged leaves at 15, 35 and 55 DAT had significant impact on yield ( $r^2 = 0.33$ ). At **Aduthurai**, 15 neonate larvae were released at 10 DAT and 25 were released at 45 DAT. Damaged leaves were recorded from 15 to 55 DAT and at 65 DAT and pre-harvest, only damaged flag leaves were recorded. Damaged leaves ranged from 0 to 34 per square meter with mean maximum of 8.2 DL/ sq.m and minimum of 0.0DL/ sq.m. Flag leaf damage varied from 0 to 24 with mean maximum of 21.5 damaged flag leaves per square meter. Step down regression analysis revealed that damaged leaves at 55 DAT alone had influence on yield (Table 2.28).

### **Stem borer**

At **Chinsurah**, stem borer was augmented by pinning one egg mass per square meter in all the treatments at 35 DAT. Dead hearts varied from 0 to 18 per square meter with mean maximum of 13.5 DH/ sq.m and minimum of 0.0 DH per square meter. Yield varied between 225 to 550 g per square meter. White ears ranged from 0 to 20 and had a significant negative impact on yield ( $r^2 = 0.11$ ). At **Ludhiana**, only natural incidence of dead hearts and white ears were recorded. Dead heart damage varied from 0.75 to 4.92% and white ear damage varied from 0.9 to 6.93%. Step down regression analysis (Table 2.28) revealed that per cent white ears and per cent damaged leaves at 65 DAT had an impact on yield ( $r^2 = 0.89$ ). At **Ghaghraghat**, natural incidence of white ears varied between 2.25 to 15.56%. For every 1% increase in white ear damage, there was 8.38 g yield loss ( $r^2 = 0.28$ ).

*A new trial on yield loss estimation was initiated this year for two insect pest's viz., leaf folder and stem borer by natural and artificial infestations and protected vs unprotected treatments. Step down regression analysis revealed that white ears had significant impact on yield at Chinsurah and Ludhiana ( $r^2 = 0.89$ ). However, this year, in spite of augmentative releases, due to heavy rainfall in many locations, damage obtained was not sufficient enough to cause the impact on yield.*

Table 2.28: Step down regression analysis of yield vs damage levels at different crop growth periods

Location	Regression equation	Multiple R	r <sup>2</sup>
Puducherry	$Y = 127.80 + 0.43 X_1^* + 0.75 X_2^{**} + 0.80 X_3$ wherein $X_1 = \text{DL/ m}^2$ at 35 DAT $X_2 = \text{DL/ m}^2$ at 45 DAT $X_3 = \text{DH/ m}^2$ at 25 DAT	0.59**	0.35
Jagdapur	$Y = 675.12 + 10.35X_1^* - 4.12 X_2^{**} - 2.64X_3^*$ Wherein, $X_1 = \text{DL/ m}^2$ at 15 DAT $X_2 = \text{DL/ m}^2$ at 35 DAT $X_3 = \text{DL/ m}^2$ at 55 DAT	0.57**	0.33
Aduthurai	$Y = 312.95 + 11.99 X_1^{\text{NS}} + 1.61 X_2^*$ Wherein $X_1 = \text{DL/ m}^2$ at 35 DAT $X_2 = \text{DL/ m}^2$ at 55 DAT	0.38**	0.15
Chinsurah	$Y = 445.62 - 7.21 X_1^{**}$ Wherein, $X_1 = \text{WE/ m}^2$	0.33*	0.11
Ludhiana	$Y = 4418.93 - 173.30 X_1^* - 72.05 X_2^*$ Wherein $X_1 = \text{Per cent white ears}$ $X_2 = \text{Per cent DL at 65 DAT}$	0.94**	0.89
Ghaghrahat	$Y = 198.14 - 8.382 X_1$ Wherein $X_1 = \text{White ears / m}^2$	0.53*	0.28

\* Significant at P = 0.05; \*\* Significant at P = 0.01

## ii) On-Farm Integrated Pest Management (OIPM)

IPM aims to maintain the pest populations below the economic injury level with least ecological disturbances. Keeping this in mind, effective interventions identified in previous chapters were included in this trial in different IPM modules and evaluated along with farmers' practices at different locations. The main objective of this OIPM trial was to assess and validate these location specific IPM modules along with farmer's practices. The three IPM modules evaluated this year included: 1) insecticide module (IPM I) wherein insect pests were controlled exclusively by chemicals, 2) non-insecticide module (IPM II) consisting of growing a tolerant variety, use of pheromones for monitoring and mass trapping of yellow stem borer and 3) a combination of insecticide and non-insecticide modules (IPM III) that has all the components of IPM II and need based chemical use.

In *kharif* 2010 the trial was conducted at three locations *viz.*, Karjat, Warangal and Pusa. Pest management practices followed at each location under each module are given in Table 2.29. The area under each module varied from 25 m<sup>2</sup> to 3000 m<sup>2</sup> at different locations. Each module was divided into six sub-plots, each representing a replication. In each sub-plot, insect pest incidence was recorded on ten randomly selected hills. Grain yield was also recorded from each replication. Cost of cultivation was estimated to derive Benefit cost ratio.

At **Karjat**, stem borer damage was too low (< 5% DH and < 10% WE) to draw valid conclusions (Table 2.30). Grain yield obtained was significantly high in IPM III (6057 kg/ ha) that was at par with IPM II (5673 kg/ ha) as compared to farmers practices. BC ratio was better in Farmers practices (5.53) though the grain yield was less due to low cost of cultivation

At **Pusa**, stem borer damage was significantly high at both 25 and 55 DAT in all the IPM modules and farmers' practices indicating that none of the practices followed were effective in reducing the damage to below economic injury level (Table 2.31). Across the modules, dead hearts were significantly low in IPM III (13.8% at 25 DAT & 21.9% at 55 DAT) as compared to other IPM modules. Maximum yield was obtained in IPM III (5513 kg/ ha) and was at par with that in IPM I (5340 kg/ ha). BC ratio was high in IPM II (5.24) which was mainly due to the low cost of cultivation in spite of relatively low yield recorded (4980 kg/ha).

At **Warangal**, gall midge damage was significantly high in IPM II module (26.5% to 27.7% SS) as compared to farmers practices (11.6 to 17.7% SS). Leaf folder damage was significantly high in farmers' practices (32.2 to 48.7 %DL) than in IPM modules at different time periods (Table 2.32). At 35 and 45 DAT, BPH population was significantly high in farmers' practices (58.0 & 83, respectively) whereas at 65 and 75 DAT, the population was high in IPM II module (49.0 & 45.5, respectively). The stem

borer damage was low (< 5% DH). Though the differences in grain yield among various modules was not significant, maximum grain yield was obtained in IPM I module (6141 kg/ ha) followed by IPM III (6013 kg/ ha). BC ratio was high in IPM I (6.19) and IPM III (5.96) due to high grain yield.

*Validation of IPM modules at three locations revealed that BPH and gall midge populations could be managed effectively with one need based application of chemicals.*

Table 2.29: Pest management practices followed in different IPM modules at various locations (**OIPM**), *Kharif* 2010

Centres	IPM Module I	IPM Module II	IPM Module III	Farmers practice (FP)
	(Insecticide based module)	(Non- insecticide based Module)	(Combination of IPM modules 1 & 2)	
KARJAT	<p>Variety = Karjat -3</p> <p>i) Summer ploughing ii)Clipping of leaf tips of seedlings before planting iii) Application of Carbofuran 3 G @ 16.5 Kg /ha at 55DAT iv) Fertilizer dose (NPK) : 100:50:50</p>	<p>Variety = Ratna</p> <p>i)Summer ploughing ii)Clipping of leaf tips of seedlings before planting iii) Growing stem borer tolerant variety- Ratna iv) Fertilizer dose (NPK) : 100:50:50 v) Installation of 20 pheromone traps /ha. and changing the lure 3 times at 25 days interval starting from 15 DAT</p>	<p>Variety = Karjat -3</p> <p>i)Summer ploughing ii)Clipping of leaf tips of seedlings before planting iii) Application of carbofuran 3 G @ 16.5 Kg /ha. 55DAT iv) Fertilizer dose (NPK) : 100:50:50 v) Installation of 20 pheromone traps /ha. and changing the lure 3 times at 25 days interval starting from 15 DAT</p>	<p>Variety = Karjat -3</p> <p>i) Summer ploughing ii)Growing high yielding variety- Karjat – 3 iii) Conventional farmers practices iv) Fertilizer dose (NPK) : 100:0:0</p>
WARANGAL	<p>Variety = BPT 5204</p> <p>i) Summer ploughing ii)Clipping of leaf tips of seedlings before planting iii) Application of carbofuran 3G @ 160g/ cent nursery at 10 days before planting (DBP) iv) Spraying imidacloprid @ 0.25 ml per litre water</p>	<p>Variety = Surekha</p> <p>i) Summer ploughing ii)Clipping of leaf tips of seedlings before planting iii) Pheromone mass trapping starting from 25 DAT</p>	<p>Variety = BPT 5204</p> <p>i) Summer ploughing ii)Clipping of leaf tips of seedlings before planting iii) Application of carbofuran 3G @ 160g/ cent nursery at 10 days before planting (DBP) iv) Spraying imidacloprid @ 0.25 ml per litre water v) Pheromone mass trapping starting from 25 DAT</p>	<p>Variety = BPT 5204</p> <p>i) Summer ploughing ii)Clipping of leaf tips of seedlings before planting ii)Application of carbofuran 3G @ 160g/ cent nursery at 10 days before planting (DBP) iii) Spraying imidacloprid @ 0.25 ml per litre water iv) Spraying acephate @ 1.5 g / litre water</p>
PUSA	<p>Variety = Rajendra kasturi</p> <p>i) Summer ploughing ii) Application of carbofuran 3G @1.1 kg ai/ha iii) Application of carbofuran 3G @1.0 kg ai/ha at 25 DAT iv)Application of cartap hydrochloride 50 SP @ 300 g ai/ ha at 45 and 60 DAT</p>	<p>Variety = Rajendra kasturi</p> <p>i) Summer ploughing ii) Pheromone mass trapping with 5 mg/ lure @ 20 traps/ ha at the time of transplanting</p>	<p>Variety = Rajendra kasturi</p> <p>i) Summer ploughing ii) Application of carbofuran 3G @1.1 kg ai/ha</p>	<p>Variety = Rajendra kasturi</p> <p>i) Summer ploughing ii) Application of carbofuran 3G @1.1 kg ai/ha</p>

Table 2.30: Insect pest incidence, grain yield and benefit cost ratio in **OIPM** trial at **Karjat**, *Kharif* 2010

Module type	% DH	% DH	% WE	Yield kg/ ha	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BCR
	45 DAT	55 DAT	Pre harvest					
IPM I	3.2(1.8)bc	2.0(1.4)a	5.5(2.0)a	5397bc	51811	11786	40025	4.4
IPM II	3.0(1.7)ab	2.2(1.5)a	5.4(2.2)a	5673ab	54460	11034	43426	4.94
IPM III	2.2(1.5)a	2.2(1.5)a	5.3(2.2)a	6057a	58147	12726	45421	4.57
FP	4.1(2.0)c	4.3(2.1)b	9.5(4.3)b	4913c	47164	8522	38642	5.53
CV (%)	15.5	30.2	28.5	8.7				

Figures in a column followed by different letters are statistically significant at p = 0.05

Price of paddy : Karjat 3 & Ratna (Rs 960 / q); BCR = Benefit cost ratio (Gross returns / cost of cultivation)

Table 2.31: Insect pest incidence, grain yield and benefit cost ratio in **OIPM** trial at **Pusa**, *Kharif* 2010

Module type	% DH 25 DAT	% DH 55 DAT	Yield kg/ ha	Gross returns (Rs)	Cost of cultivation (Rs.)	Net returns (Rs)	BCR
IPM I	16.0(3.9)ab	24.2(4.9)bc	5340ab	53400	11950	41450	4.47
IPM II	20.6(4.5)bc	29.0(5.3)c	4980bc	49800	9500	40300	5.24
IPM III	13.8(3.6)a	21.9(4.7)a	5513a	55130	12250	42880	4.50
FP	21.9(4.7)c	28.7(5.3)c	4653c	46530	9950	36580	4.68
CV (%)	23.2	15.9	7.64	-	-	-	-

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Figures in a column followed by different letters are statistically significant at  $p = 0.05$  ;  
Price of paddy = Rs.1000/q; BCR = Benefit cost ratio (Gross returns / cost of cultivation)

Table 2.32: Insect pest incidence, grain yield and benefit cost ratio in **OIPM** trial at **Warangal, Kharif 2010**

<b>Module type</b>	<b>% DH 55 DAT</b>	<b>% SS 35 DAT</b>	<b>% SS 55 DAT</b>	<b>% SS 85 DAT</b>	<b>% LFDL 45 DAT</b>	<b>% LFDL 55 DAT</b>	<b>% LFDL 75 DAT</b>	<b>% LFDL 85 DAT</b>	<b>BPH 35 DAT</b>	<b>BPH 45 DAT</b>	<b>BPH 65 DAT</b>	<b>BPH 75 DAT</b>
IPM I	0.9(0.7)a	17.2(4.1)a	11.5(3.4)a	10.3(3.2)b	23.3(4.8)a	24.0(4.8)a	21.2(4.6)a	18.0(4.2)a	26.0(5.0)a	57.3(7.6)ab	29.7(5.4)a	31.3(5.6)a
IPM II	2.3(1.5)b	27.7(5.2)b	26.5(5.0)b	6.8(2.6)a	25.3(4.9)a	26.7(5.1)a	26.2(5.1)ab	19.8(4.4)a	34.3(5.8)ab	72.5(8.5)bc	49.0(7.0)b	45.5(6.7)b
IPM III	2.2(1.3)ab	16.5(4.0)a	19.1(4.3)b	7.4(2.7)ab	23.0(4.8)a	29.8(5.4)ab	26.3(5.1)ab	25.8(5.1)b	50.5(7.1)bc	51.7(7.2)a	39.3(6.2)ab	35.2(5.9)ab
FP	0.5(0.6)a	17.7(4.2)a	11.6(3.4)a	6.9(2.6)a	48.7(7.0)b	36.7(6.0)b	32.2(5.6)b	32.7(5.7)b	58.0(7.5)c	83.0(9.0)c	34.8(5.9)a	33.7(5.8)a
CV (%)	53.6	26.4	19.8	13.4	16.9	11.7	11.2	9.4	19.3	11.2	11.3	10.4

Figures in a column followed by different letters are statistically significant at  $p = 0.05$

<b>Module type</b>	<b>Yield kg/ha</b>	<b>Gross returns (Rs)</b>	<b>Cost of cultivation (Rs)</b>	<b>Net returns (Rs)</b>	<b>BCR</b>
IPM I	6141a	73692	11910	61782	6.19
IPM II	5265a	63180	11360	51820	5.56
IPM III	6013a	72156	12110	60046	5.96
FP	5815a	69780	12160	57620	5.74

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Price of paddy = Rs. 1200 / q; BCR = Benefit cost ratio (Gross returns / cost of cultivation)

## **2.7 MONITORING POPULATION DYNAMICS OF INSECT PESTS THROUGH LIGHT TRAP COLLECTIONS**

Monitoring population dynamics of insect pests in relation to changes in weather parameters, crop phenology, growing season and cropping systems is vital for designing ecologically sound and economical pest management strategies. Further, knowledge on population dynamics of insect pests at a given location is also essential for implementing location specific IPM strategies and precision agriculture technologies. In India rice is grown in different agroclimatic zones under diverse cropping systems. The population dynamics of major as well as minor insect pests vary under such diverse cropping systems and geographical locations. Further, abiotic factors like temperature, humidity, sunshine hours, rainfall etc., and biotic factors like natural enemies such as parasites and predators significantly influence the population dynamics of insect pests. Concerted efforts are being made to monitor the population dynamics of insect pests at different locations across the country every year to understand the short and long term changes in the pest scenario. The assessments of insect populations are being made using light traps.

The light trap catches of various insect pests at different centers are collected every day along with the corresponding data on macro weather parameters. The weekly cumulative abundance of different insect pests, weekly averages of rainfall, maximum temperature (max. temp.), minimum temperature (min. temp.), morning relative humidity (RH), evening RH and sun shine hours (SSH) are computed from the daily data. For computing weekly data, each month is divided into 4 standard weeks: 1<sup>st</sup> week (Day 1-7); 2<sup>nd</sup> week (Day 8-15); 3<sup>rd</sup> week (day 16-22) and 4<sup>th</sup> week (day 23 - end of the month).

The observations on light trap collections of insect pests, their natural enemies and weather parameters recorded during the year (Jan-Dec, 2010) have been received from 28 locations. Detailed data are available in the softcopy format and may be requested from DRR. Only the summary tables and trends are presented here.

### **ANDHRA PRADESH**

#### **1. Rajendranagar ( January to December 2010 )**

The major insect pests recorded in light traps catches at Rajendranagar center were yellow stem borer, green leafhopper, brown plant hopper. Other pests like gall midge, leaf folder, and other stem borers were observed in low numbers. The natural enemies recorded were coccinellids and mirid bugs. The peak population of YSB (302 females + 283 males) occurred during 3<sup>rd</sup> week of April. Another peak for *kharif* season was during first week of October. Gall midge was more during October month

with a peak population (125) during October 2<sup>nd</sup> week. Leaf folder occurred in low numbers with two peaks during April 3<sup>rd</sup> week (115) and September 4<sup>th</sup> week (153). Moderate populations of green leafhopper (*N. virescens*) occurred throughout the year with the highest catch (2690) during 2<sup>nd</sup> week of October. BPH populations were recorded during both *rabi* and *kharif* season with the peak populations (4580, 3205) occurring during second week of October and 4<sup>th</sup> week of March, respectively. Mirid bug populations were prevalent in both *kharif* and *rabi* with the highest population (5550) during fourth week of March. The October and April months recorded simultaneous occurrence of moderate populations of all major pests including YSB, GM, LF, GLH, BPH and moderate population of mirid bugs.

## **2. Maruteru** (January to December 2010)

The population of yellow stem borer was more during the *kharif* season compared to the *rabi* season at this centre. Peak population of YSB (5185 females + 503 males) prevailed during 1<sup>st</sup> week of May. Gall midge population was prevalent mainly during March-April in *rabi* season and Oct-Dec in *Kahrif* season with the highest catch (630) during last week of October. Low population of leaf folder was present with a peak (171) occurring during last week of November. High populations of BPH (15190), WBPH (1320), and ZZLH (1876) occurred during 3<sup>rd</sup> and 4<sup>th</sup> week of March. Green leafhopper population was at its peak (12460) during 4<sup>th</sup> week of October. Among natural enemies, high populations of mirid bug (12086) and coccinellids (2102) were recorded during 3<sup>rd</sup> week of October and April, respectively.

## **3. Warangal** (April to December 2010)

At this centre, yellow stem borer, gall midge, GLH, BPH and leaf folder were recorded in light trap catches. High populations of pest insects were observed in catches in October month during *kharif* and in April during *rabi* seasons. Peak population of YSB (133 females + 176 males), other stem borers (2983), gall midge (1900) and GLH (3525) were recorded during last week of October. During this period mild weather conditions (max temp. 27.2, min temp. 21.8 °C, RH morn. 81.0%, and 36.8 mm rainfall) were prevailing. Peak populations of leaf folder (48) and BPH (3359) were recorded during 2<sup>nd</sup> week of October.

## **4. Ragolu** (January to December 2010)

Stem borers occurred at this center almost throughout the year with the highest population (380) during last week of January. Gall midge was mainly confined to *kharif* season with the highest population (420) occurring during 3<sup>rd</sup> week of October. Leaf folder was noticed only during *rabi* and the highest catch (76) recorded during second week of April. Green leafhopper, mainly *N. virescens* was prevalent in *kharif* and the peak population (2185) recorded during last week of October. BPH population was highest (1850)

during 3<sup>rd</sup> week of July while the WBPH population was highest (1165) during 2<sup>nd</sup> week of October. Weather during October was mild with a max. temp., (29-30 °C), min. temp., (24-26 °C), high RH (82-92%) and moderate sunshine (3.1 to 3.7 SSH). Grass hoppers were also caught in light traps in low numbers at this centre.

#### **5. Nellore** (Jan to December 2010)

At this center, Yellow stem borer occurred throughout the year with two peaks, one (189) during September 3<sup>rd</sup> week and the second (59) during April second week. Gall midge population and leaf folder populations were present in low numbers throughout the year. Green leafhopper population was highest (156) during 2<sup>nd</sup> week of October.

Peak populations of Yellow Stem borer recorded during 2010 was relatively low compared to those recorded during 2009 at Maruteru and Warangal centres while the reverse trend was noticed for BPH at these centres. The peak populations of gall midge recorded at Warangal and Ragolu during 2010 were considerably low compared to those observed in 2009. This may be due to the occurrence drought during 2009-10 and unseasonal rains in October during 2010-11. Overall, the population peaks of important pests like yellow stem borer, BPH and gall midge as observed in light trap catches gradually decreased during 2008-2010 compared to the levels observed during 2007, across the centres in the state.

### **TAMIL NADU**

#### **6. Aduthurai** (January to December 2010)

Moderate to high populations of yellow stem borer were prevalent throughout the year with the high catches during December to February and peak population (1320 females + 805 males) occurring during 4<sup>th</sup> week of December. Maximum population of other stem borers (88), green leafhoppers (5570) and other insects (58500) also recorded during this week. This week was characterized by moderate max. temp. and min. temp. (28.1 °C and 20.6 °C), high humidity (94.6 %), low sunshine (3.6 SSH) with 59.4 mm rainfall. The populations of gall midge (525) and leaf folder (322) were maximum during first and second week of December. Maximum populations of black bugs (38595) and BPH (5200) were observed during fourth week of August and fourth week of October respectively. High numbers of blue beetles (1150) and WLH (164) were also observed in light trap catches during 2<sup>nd</sup> week of March and 3<sup>rd</sup> week of November respectively.

#### **7. Coimbatore** (January to December 2010)

Pest populations were in general were low in light trap catches observed at this center. Yellow stem borer was prevalent in low numbers throughout the year with its peak (93) occurring during first week of February. Leaf folder was prevalent in low numbers from July to December

with its peak (34) occurring during second week of September. The peak population of GLH (1430) and BPH (1390) occurred during first week of February. WBPH registered its peak activity (920) during first week of January.

## **PUDUCHERRY**

### **8. Puducherry** (January to December 2010)

Yellow stem borer occurred in low to moderate numbers throughout the year with the highest catch (229 female + 48 males) occurring during second week of February. Leaf folder, BPH, WBPH, Gundhi bug and green leafhopper (*N. virescens*) also recorded their presence throughout the year although in low numbers. BPH population was at its peak (212) during fourth week of September while WBPH also registered peak (51) population during the fourth week of July. Gundhi bug occurred in highest number during last week of August.

### **9. Karaikal** (January to December 2010)

Yellow stem borer, GLH, Leaf folder, BPH and WBPH were observed only in very low numbers at this centre. However, no extremes in weather parameters that could account for such low population levels of major pests during this period were observed.

The peak populations of yellow stem borer recorded at both the above centres during current year were relatively low compared to those observed in the previous year. However, population peaks for leaf folder and BPH were high during this year compared to the previous year. Overall, the peak populations of YSB, BPH and Leaf folder during 2009 & 2010 were low compared to those recorded in 2008 at Puducherry centres.

## **KERALA**

### **10. Pattambi** (January to December 2010)

Yellow stem borer was recorded the highest catch (686) during second week of January. Low populations of gall midge and leaf folder recorded during September month. Peak populations of Green leafhopper *N. virescens* (1915), *N. nigropictus* (1334) were recorded during first week of February. This week was characterized by moderate max. temp. (34.5 °C), low min. temp. (21.4 °C), RH (64.7 %), bright sunshine (8.9 SSH) with no rainfall. Among the other pests registered in low numbers at this centre include BPH, white leafhopper, case worm, rice bug and gundhi bug. Among the predators green mirid bug registered its activity both during *kharif* and *rabi* seasons with the highest catch (64930) during last week of January.

### **11. Moncompu** (January-December 2010)

Yellow stem borer, gall midge and leaf folder were prevalent in both kharif and rabi seasons while BPH, GLH and WBPH were in high numbers in rabi. Peak population of yellow stem borer (260 females+ 170 males), other stem borers (137), leaf folder (426), GLH (4601 *N. v* + 5839 *N.n*) and WBPH (2115) were recorded during last week of January. During this week, max. temp. (33.2), min. temp. (23.7) RH 91% and SSH (9.4) and no rainfall were recorded. Peak populations of gall midge (1245) and BPH (4222) were recorded during first and second week of February respectively. Other insects recorded in light trap catches at this centre include rice bug and blue beetle.

## **KARNATAKA**

### **12. Mandya** (January to December 2010)

Very low numbers of yellow stem borer, GLH and BPH were recorded occasionally in light trap catches at this centre. However, no extremes in weather parameters that could account for such low population levels of major pests during this period were observed.

### **13. Gangavathi** (January to December 2010)

Yellow stem borer, leaf folder, GLH and BPH were present at this centre both during *rabi* and *kharif* seasons in moderate numbers. The peak catch of YSB (1499 females + 634 males) was recorded during last week of April. The peak populations of BPH (137), GLH (107) and Leaf folder (105) were recorded during the last week of September, October and March, respectively.

This shows that in general, the abundance of major pests at these locations is considerably less except for YSB in Gangavathi area during this year. At Gangavathi, the peak catches of YSB fluctuated during 2008-2010 while that of BPH gradually decreased [2008 (468); 2009 (336); 2010 (147)] during this period. The peak catches of YSB at Mandya drastically reduced during the current year (31) compared to the previous two years (297 & 516). This may be due to the drought unseasonal rains during the last two years.

## **MAHARASHTRA**

### **14. Karjat** (January to December 2010)

Peak populations of yellow stem borer (257 females + 189 males) was registered during fourth week of September at this centre. During this period, moderate max. temp., (33.8 °C), moderate min temp (24.3 °C), high RH (96.4%), moderate sunshine (6.0 SSH) and 115.6 mm rainfall prevailed. Peak populations of GLH (*Nv*, 1999+ *Nn* 1719) were recorded during first week of November. Leaf folder, case worm and army worm were observed in

very low numbers. Gundhi bug recorded highest activity during second week of October. The peak catches of YSB at this center recorded during 2010 (444) and 2009 (202) were relatively less compared to that observed during 2008 (1308). This may be due to the drought (2009) unseasonal rains (2010).

#### **15. Sakoli** (January to December 2010)

Gall midge was predominant from July to October months with peak population (634) occurring during second week of October. Gall midge was absent in *rabi* season catches. Yellow stem borer was caught in the trap during May to September in low numbers with peak catch (145 females + 73 males) during fourth week of August. Populations of BPH (1112), WBPH (899) were highest during fourth week of October. Peak population of GLH (1676) was recorded during last week of September. Leaf folder population was observed only in September and October months. Peak populations of ladybird beetles (75) were recorded during 3<sup>rd</sup> week of October.

The peak catches of gall midge at this center recorded during 2010 (634) and 2009 (298) were relatively less compared to that observed during 2008 (6651). This may be due to the drought (2009) unseasonal rains (2010). The total rainfall during the preceding three weeks was more during 2010 (108.0 mm) compared to that recorded in 2008 (59.8 mm) and 2009 (38.00 mm).

### **ORISSA**

#### **16. Sambalpur** (June to November 2010)

GLH *N. virescens* (653) registered peak population during fourth week of October. The peak populations of other pests: Yellow stem borer (25 females + 17 males), Leaf folder (14), *N. nigropictus* (58), BPH (131), WBPH (91) and gall midge (32) were relatively very low in numbers during the period of observation at this center.

### **CHATTISGARH**

#### **17. Raipur** (June to December 2010)

The populations of GLH *N. virescens* (340) and BPH (1798) were maximum during the second week of November at this center. This period was characterized by optimum max. temp. (29.9 °C), low min. temp (23.2 °C), high RH (93.9 %), moderate sunshine (6.3 SSH) with 6.5 mm rainfall. Maximum population of yellow stem borer (148 females+ 153 males) was recorded during fourth week of September. Populations of case worm, leaf folder and WBPH recorded at this center were relatively very low.

### **18. Jagdalpur** (August- December, 2010)

High gall midge populations were recorded during October-November months with peak population (568) recorded during third week of October. Very high population of GLH (164278) also observed during this week. Peak populations of BPH (2507) and WBPH (1380) occurred during 2<sup>nd</sup> week of November. Other pests observed in low numbers at this centre include YSB, zigzag leafhopper and gundhi bug.

## **GUJARAT**

### **19. Nawagam** (May to December 2010)

GLH *N. virescens* (176) and leaf folder (218) occurred at this centre with peak activity during first week of October. Peak population of WBPH (389) and grasshoppers (239) were recorded during fourth week of September. This period was characterized by moderate maximum temperature (34.3 °C), low min. temp (24.6 °C), RH (80.3%), bright sunshine (8.0 SSH) and no rainfall. Low peak population of yellow stem borer (99) was also recorded at this centre. The peak catches of WBPH at this centre fluctuated during the last three years: 2008 (1051), 2009 (208) and 2010 (389).

## **HARYANA**

### **20. Kaul** (July to December 2010)

Populations of Green leafhopper (182) and BPH (8408) were maximum during the third week of October while the populations of white leafhopper (41) and WBPH (154) were maximum during the third week of September. The weather during the fourth week of September was characterized by mean max temp. 31.4 °C, min temp. 19.6 °C, RH 99%, sunshine (8.4 SSH) with no rainfall. Other pests like YSB, other stem borers and leaf folder were also recorded in very low numbers at this center. The peak catches of BPH at this centre fluctuated drastically during the last three years: 2008 (22264), 2009 (11) and 2010 (8408) indicating that it is a pest to be reckon at this place.

## **UTTAR PRADESH**

### **21. Faizabad** (June to December 2010)

At this centre, low peak populations of yellow stem borer (10), leaf folder (30), gall midge (4) and gundhi bug (10) were occurred during October -November months. About 100 mm rainfall was recorded during the October month. Peak population of GLH (8455) was recorded during the third week of September.

## UTTARANCHAL

### 22. Pantnagar (June to November 2010)

Maximum population of yellow stem borer (409) occurred during second week of August. Leaf folder with low numbers registered its peak activity (23) during second week of October while the peak activity of BPH (9960) and WBPH (4023) recorded during third and second week of October respectively. GLH *N. virescens* was also present in low numbers with its highest activity (108) during third week of October. Peak activity of gundhi bug occurred during the second week of October. The peak populations of planthoppers observed in light trap catches during this year were significantly high [BPH (9960); WBPH (4023)] compared to those of previous year [BPH (231), WBPH (86)]. This suggests that planthoppers on the increase in the state.

## WEST BENGAL

### 23. Chinsurah (January - December 2010)

Yellow stem borer was caught in the trap throughout the year with peak catches during fourth week of May (80 females + 130 males) and second week of November (96 females + 88 males). Leaf folder registered its peak (20) during the same week. The max. temp., min. temp, RH and SSH during the week were 31.6 °C, 19.8 °C, 94.9%, 7.7, respectively. Green leafhopper (*Nv.*214 + *Nn.* 172), and WBPH (126) registered their peak activity during the 2<sup>nd</sup> week of October. Peak population of BPH (302) was observed during third week of April. In addition, low numbers of leaf folder, other stem borers, white leafhopper and *Recilia dorsalis* were also reported at this centre.

### 24. Bankura (March to November 2010)

Yellow stem borer occurred in low number with its peak (31 females + 30 males) during second week of November. Very low populations of leaf folder, GLH (*N. virescens* and *N. nigropictus*) and Rice bug were recorded at this centre.

## HIMACHAL PRADESH

### 25. Malan (June to December 2010)

Very low numbers of yellow stem borers, GLH, WBPH, black beetles and case worm were recorded during the observation period at this center. Population of leaf folder was highest during (249) during fourth week of September. Peak population of BPH (147) was observed during fourth week of June.

## JAMMU AND KASHMIR

### 26. Khudwani (May to October 2010)

At this centre, very low population of other stem borers, leaf folder, gall midge and black beetles were observed in light trap catches.

## PUNJAB

### 27. Ludhiana (February to December, 2010)

The peak populations of major pests: YSB (19), PSB (25), GLH (17) and WBPH (120) observed in light trap catches at this centre were very low. BPH activity was high during September and October months with peak population (539) recorded during third week of October. Natural enemies like coccinellids, damsel fly, etc were also recorded in very low numbers. The peak populations of planthoppers observed in light trap catches during this year were significantly high compared to those of previous two years. This suggests that planthoppers on the increase in the state.

## MANIPUR

### 28. Wangbal (August to November, 2010)

Very low numbers of yellow stem borer, gall midge, leaf folder, green leafhopper and BPH were recorded in light trap catches during the period of observation at this centre.

## CONCLUSIONS

Dynamics of populations of major insect pests of rice along with the corresponding meteorological factors were reported from 28 centers during the year 2010.

**Yellow stem borer** was reported from 26 centers with the highest peak catch (5185 females + 503 males) occurring during first week of May at Maruteru. This suggests that this pest appears to be maintaining its status as number one pest of rice in India. (Fig 2.8)

**Gall midge** was reported from 14 centers, with the highest catch of 1900 insects per week during last week of October at Warangal. Thus gall midge continued to damage the crop at low levels in localized pockets. (Fig 2.9)

**Brown planthoppers** were reported from 22 centers, with maximum peak population (15190 insects / week) occurring during third week of March at Maruteru. Thus, BPH is spreading to new areas causing severe

damage. **WBPH** was present at 16 centers with the highest population of 4023 insects/week occurring during second week of October at Pantnagar. Thus WBPH is also spreading to new areas and becoming important along with BPH. (Fig. 2. 10)

Although occurrence of **Leaf folder** was reported from 24 centers, populations were very low in many centers. The highest population of 426 per week recorded during fourth week of January at Moncompu. Thus, leaf folder is maintaining its presence in more regions of the country.

**Green leafhoppers** were reported from 25 centers with the highest population of 172336 during third week of October at Jagdalpur. Thus, this pest is maintaining its abundance, both in area and magnitude. Among other insect pests, case worm, gundhi bug, white leaf hopper, pink stem borer, zigzag leaf hopper, blue beetle, grass hopper, black bug were important to a lesser magnitude. Among the natural enemies, mirid bugs and coccinellids were reported from many centers.

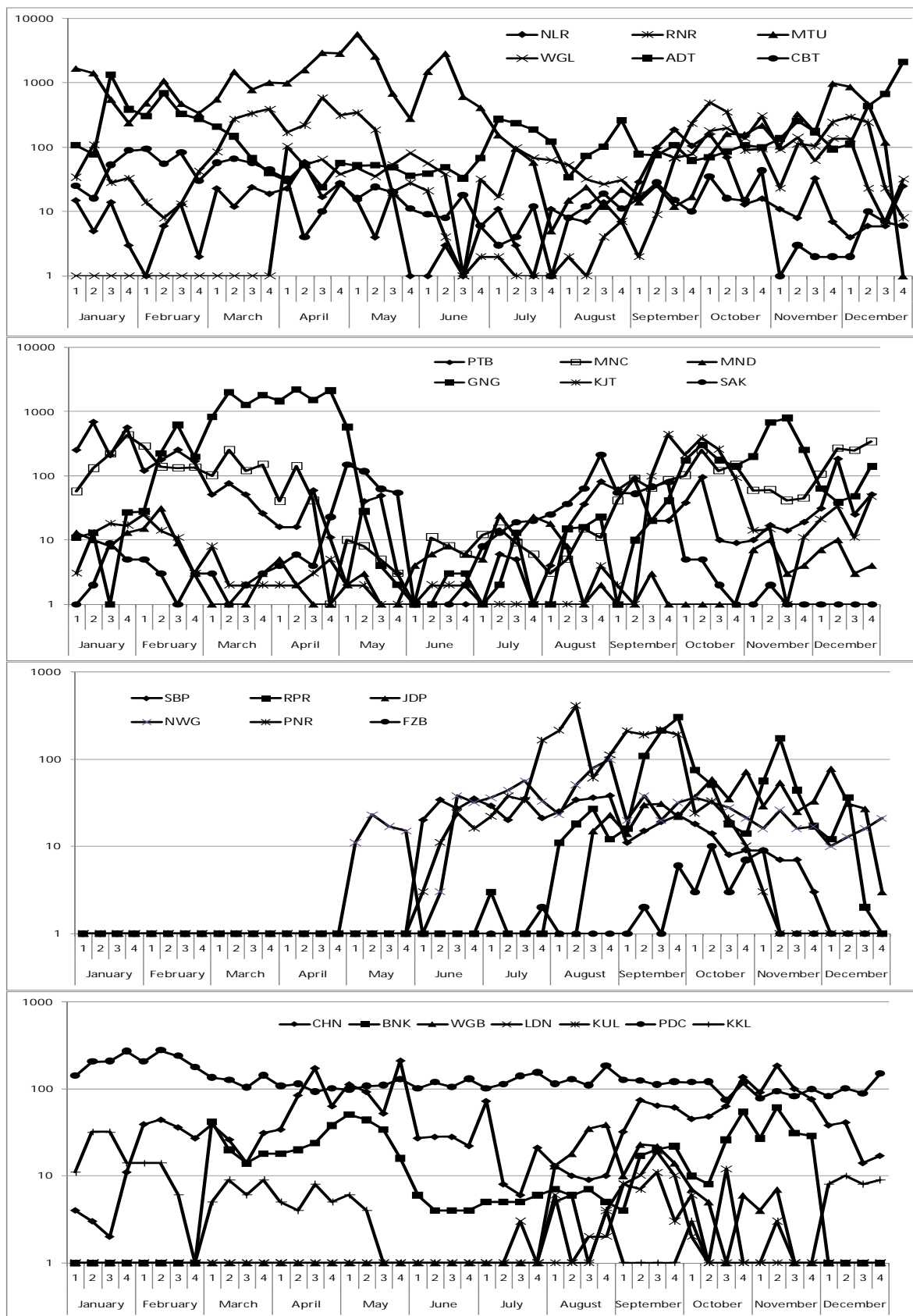


Fig. 2.8: Weekly light trap catches of yellow stem borer (on log scale) reported from different locations (see Appendix I for location details)

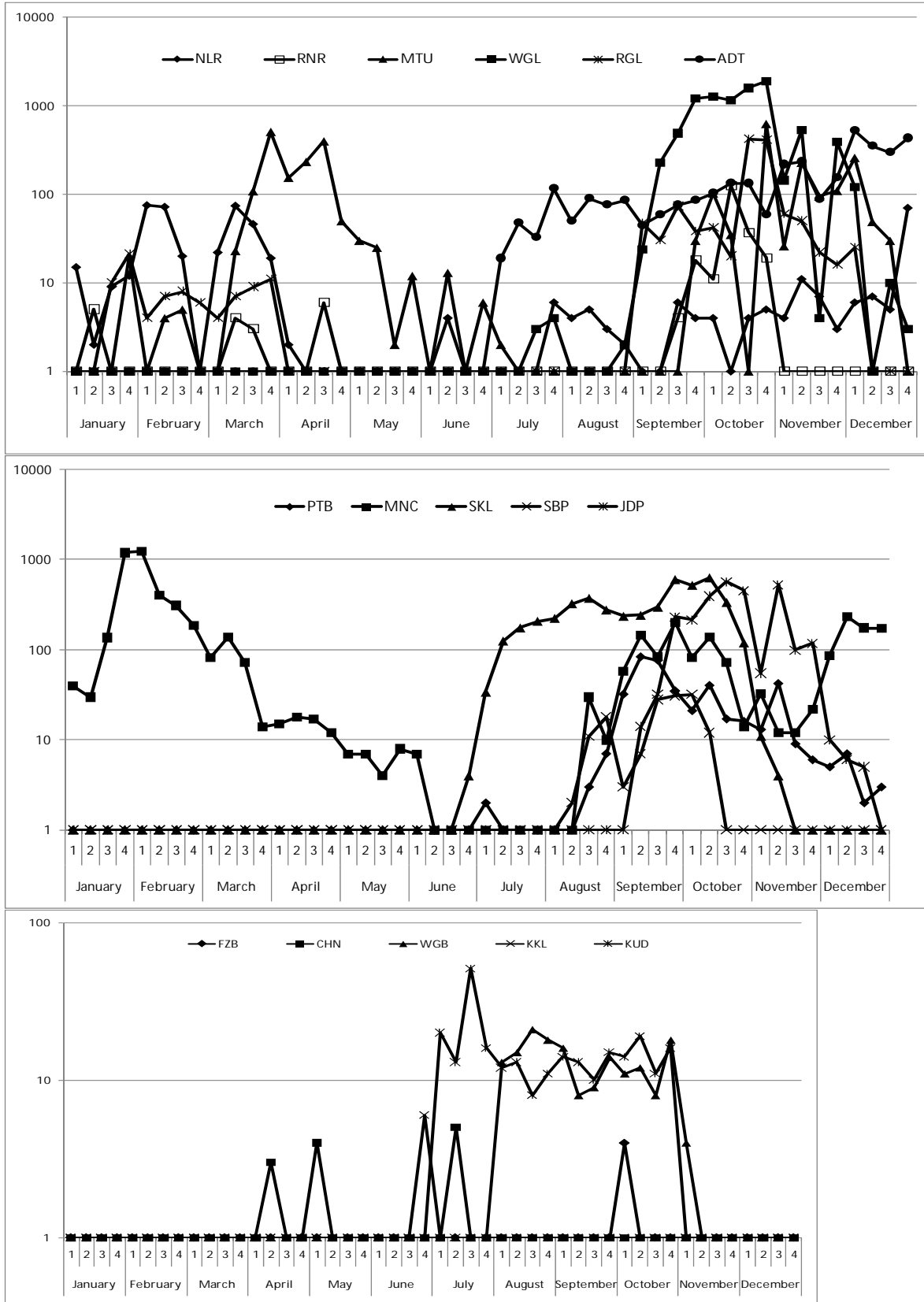


Fig. 2.9: Weekly light trap catches of gall midge (on log scale) reported from different locations (see Appendix I for location details)

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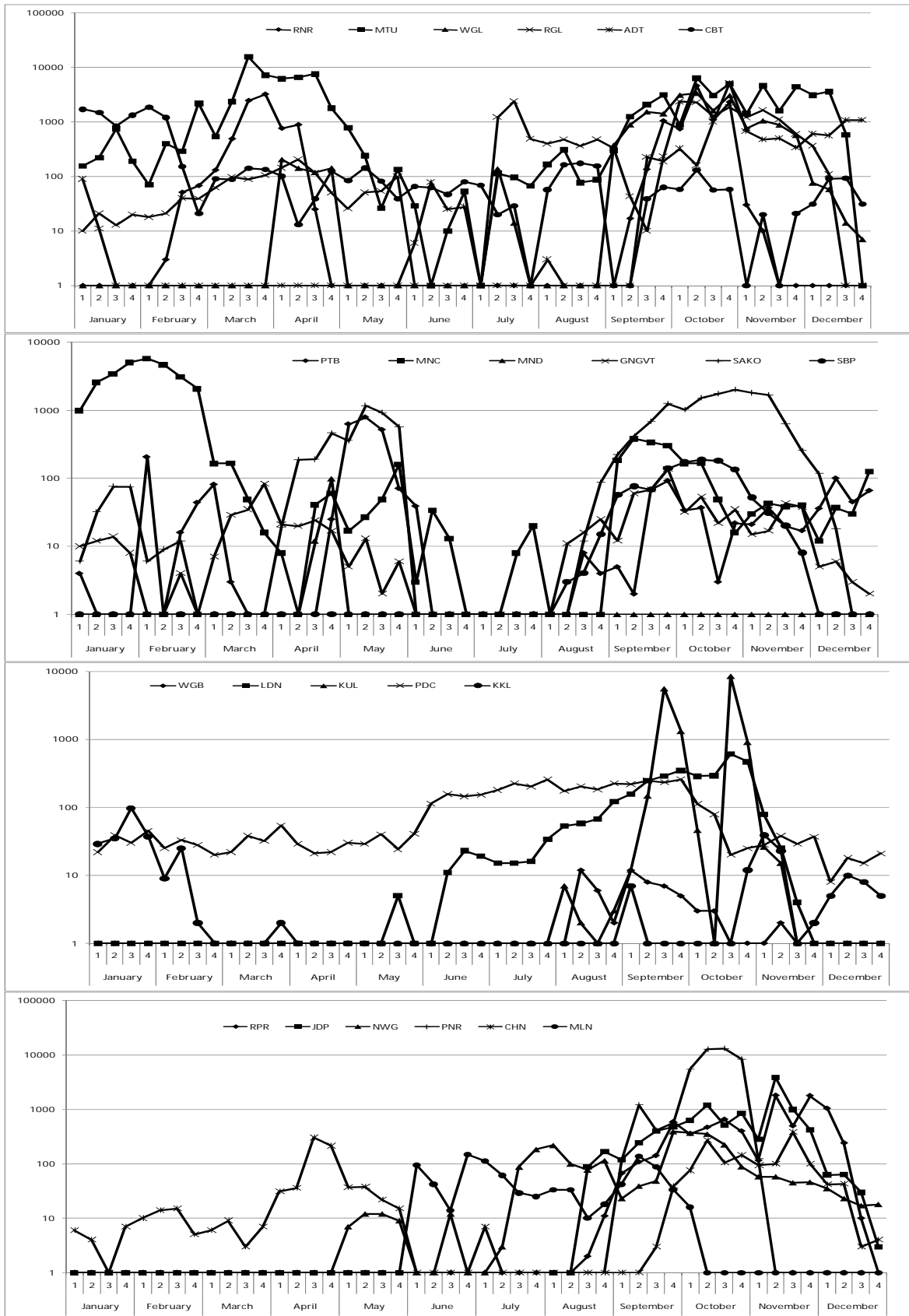


Fig. 2.10: Weekly light trap catches of planthoppers (on log scale) recorded at different locations (see Appendix I for location details)

## SUMMARY

During rabi 2010, 7 trials covering chemical control, ecological studies, biocontrol and biodiversity studies and IPM were conducted at 19 locations

**Insecticide evaluation trial** carried out at 11 locations revealed no discernible trends in the performance of different treatments due to low pest incidence in most of the locations. Yield point of view, acephate 75 SP was the best treatment followed by acephate 95 SG, flubendiamide + buprofezin mixture and standard check, monocrotophos.

**Pesticide compatibility trial** was carried out at 7 locations. Based on the performance of the treatments when applied alone vis a vis their respective combinations in reducing pest infestation and their impact on grain yield, it was evident that spinosad when applied alone was the best treatment and its efficacy in combination with fungicides was better than that of flubendiamide. The fungicides also performed better in combination than when applied alone in reducing the disease.

In the trial on **Influence of rice cultivation systems on insect pest incidence (IRCP)** conducted at 3 locations, under unprotected conditions, dead heart and white ear damage was significantly low in SRI than normal method except at Chinsurah wherein dead heart damage was more in SRI (27.61%) as against normal method (9.69%). Similarly, gall midge damage at Ragolu was low in SRI (2.63 to 6.57%SS) as compared to normal method (4.45 to 11.20%SS). Contradicting reports were obtained with respect to whorl maggot wherein at Chinsurah, the damage was high in normal method (21.18%) while at Pattambi it was high in SRI (24.37%). Hybrids out yielded varieties and SRI system recorded higher yield than normal method.

**Effect of organic manures on pest incidence (EOMP)** trial was conducted at two locations. Low dead heart (31.31%) and white ear (32.57%) damage was found in vermicompost treatment as against recommended fertilizer dose (56.28% DH & 69.18% WE) at Gangavathi. Whorl maggot and thrips damage recorded at Rajendranagar, though high, was not significant across the treatments. At both locations, GM + 50% N recorded higher grain yield (4203 -6262 kg/ha) compared to other treatments.

In the trial on **Trap crop for stem borer management trial (TCSB)** carried out at 3 locations, growing of trap crop significantly reduced dead heart damage at 30 DAT in Kshitish (Chinsurah) and white ear damage in TPS 3 (Killikulam) and Jyothy (Moncompu).

**Monitoring of pest species and their natural enemies (MPNE)** trial was carried out at 3 locations. YSB was dominant in all centres during vegetative phase. The dominant egg parasitoids were *Trichogramma* and *Telenomus* sp.,

Assessment of IPM modules at Pattambi and Karjat in the **On-Farm Integrated Pest Management (OIPM)** trial revealed that the general pest incidence was too low to draw valid conclusions. However, whorl maggot damage was low in farmers' practices as compared to other IPM modules. At Pattambi, BC ratio was highest in IPM III (2.79) followed by IPM II (2.57) and IPM I (2.4).

## 2.1 CHEMICAL CONTROL STUDIES

Use of insecticides in rice assumes more importance during *rabi* season for farmers growing more than one rice crop in a year because pest population and pesticide application is relatively less affected by the weather factors, particularly in the later stages of crop growth. Hence, screening of newer insecticides through the insecticide evaluation trial (IET) as well as evaluation of pesticides applied as tank mix to know their compatibility through pesticide compatibility trial (PCT) were continued at different locations, during *rabi* 2010.

### i) Insecticide evaluation trial (IET)

#### Treatments: (Table)

In this trial, two products viz., Flubendiamide 4% + Buprofezin 20% SC @ 875 ml/ha (35 g a.i. + 175 g a.i./ha) supplied by Rallis India Limited and ii. Dinotefuron 20 SG @ 150 and 200 g/ha (30 and 40 g a.i./ha) supplied by Indofil Chemicals Company were repeated for evaluation following their testing in *Kharif* 2009 along with the new formulation of acephate, Acephate 95% SG (RIL-059/F1 95% SG) @ 562 g a.i./ha from Rallis India Limited in comparison to single product insecticides, flubendiamide (Takumi 20 WG @ 35 g a.i./ha), buprofezin (Applaud 25 SC @ 175 g a.i./ha), acephate 75% SP @ 600 g a.i./ha, standard check insecticide monocrotophos (Monocrown 36 SL) applied @ 500 g a.i./ha and an untreated control treatment without any insecticide application. The insecticides were applied at different locations on need basis, but an initial application at 10 DAT was included to assess the efficacy of the treatments around 25 to 30 DAT. The insecticides were applied as high volume sprays @ 500 litres of spray fluid/ha. At each location, the trial was laid out in Randomized Complete Block Design with nine treatments and three replications. Observations on insect pests were recorded as per standard procedures at regular intervals. 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. The data was analysed statistically using ANOVA test for Random complete Block design for each date of application at each location as well as for yield at harvest. The performance of the different treatments was assessed based on their comparative efficacy at each DAT as well as their performance against pooled means of each pest damage, across observations and over locations. Yield obtained in each treatment was also pooled across the locations and included for assessing the effectiveness of each treatment.

**Locations: 11** (Aduthurai, Chinsurah, Coimbatore, Gangavathi, Karjat, Moncompu, Nellore, Pattambi, Puducherry, Ragolu, and Rajendranagar)

Location-wise time and frequency of insecticide application and dates of sowing, planting and harvest were as follows:

Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
Aduthurai	06-10-09	05-11-09	25-02-10	3	10, 45 and 60
Chinsurah	20-12-09	28.02.10	26-05-10	2	25 and 70
Coimbatore	13-01-10	08-02-10	19-05-10	1	45
Gangavathi	22-12-09	31-01-10	01-05-10	1	67
Karjat	19-12-09	03-02-10	20-05-10	2	19 and 60
Moncompu	04-12-09	23-12-09	24-04-10	2	22 and 47
Nellore	10-11-09	14-12-09	29-03-10	2	10 and 30
Pattambi	17-11-09	14-12-09	12-03-10	3	10, 45 and 60
Puducherry	14-01-10	18-02-10	13-05-10	2	30 and 50
Ragolu	25-01-10	26-02-10	26-05-10	2	10 and 40
Rajendranagar	21-11-09	06-01-10	26-04-10	2	14 and 63

## Results

### Pest Infestation (Table 2.33)

**Stem borer** infestation during vegetative stage was low and recorded upto a maximum of 17.2% DH in the insecticide treatments and upto 21.9% DH in untreated control, across different locations, during 30 to 50 DAT. There were significant differences among the treatments only at two locations, Aduthurai Ragolu and Moncompu. The mean infestation was upto 5% DH in insecticide treatments and 6.6% DH in untreated control. Flubendiamide+ buprofezin and flubendiamide (2.8% DH), were at par with acephate 75 WP and standard check, monocrotophos (2.9% DH) and superior to other treatments (3.4 to 5.0% DH) and untreated control (6.6% DH).

At heading stage, stem borer infestation was very high at Moncompu (23.2 to 60.9% WE) and moderate at Chinsurah and Pattambi (9.5 to 22.7% WE), however there were no significant differences among the treatments at these three locations as well as at Ragolu and Karjat. At Aduthurai, Puducherry and Rajendranagar, there were significant differences among the treatments, however the mean infestation over all locations ranged narrowly between 12.8 and 16.6% WE across the treatments including untreated control.

**Gall midge** incidence was recorded at five locations but was negligible at three centres, Aduthurai, Nellore and Pattambi. Mean incidence across the two remaining locations viz., Moncompu and Ragolu showed that the insecticide treatments (5.3 to 9.4% SS) were superior to untreated control (17.0% SS). Among the newer products, acephate 95 SG (5.3% SS) and Flubendiamide + buprofezin (5.6% SS) were superior to standard checks, monocrotophos (5.7% SS) and acephate 75 WP (7.3% SS).

**Leaf folder** damage at Aduthurai and Moncompu did not exceed 6.9% DL in insecticide treatments, while it ranged between 5.2 and 11.8% DL in untreated control. Mean infestation across these two locations showed that all treatments (2.6 to 5.6% DL) were significantly superior to control (8.6% DL). Among the insecticide treatments, flubendiamide (2.6% DL) and acephate 95 SG (2.8% DL) were at par with standard checks, monocrotophos and acephate 75 SP (2.2 and 2.6% DL, respectively). At Puducherry, there was significant reduction in leaf folder damage after application, but, there were no significant differences among the treatments before (29.7 to 44.0 DL/10 hills) and after application (2.3 to 4.7 DL/10 hills).

**Brown planthopper** population was recorded only at Aduthurai upto a maximum of 21.0 hoppers/hill in insecticide treatments and 27.0 hoppers/hill in untreated control at 70 DAT. The infestation was the lowest in both dinotefuran treatments (1.5 and 2.5 hoppers/hill, respectively) on par with acephate 95 SG (1.8 hoppers/hill) flubendiamide+buprofezin treatment (2.5 hoppers/hill) and buprofezin (3.8 hoppers/hill) These treatments showed significantly lower BPH numbers compared to that of standard checks, monocrotophos (5.3 hoppers/hill) and acephate 75 SP (5.8 hoppers/hill). All the treatments were superior to untreated control (27.0 hoppers/hill).

**Green leafhopper** population was recorded only at Puducherry and there were no significant differences among the treatments before and after application of treatments.

In case of other foliage feeders, **whorl maggot** infestation was recorded at three locations, Chinsurah, Pattambi and Rajendranagar, while **thrip** and **hispa** damage was recorded only at Rajendranagar. There were no discernible differences among the treatments including untreated control.

### **Grain Yield (Table 2.34)**

The differences in grain yield among treatments were significant at 5 locations. Based on the mean yield of these locations, acephate 75 SP treatment recorded the highest yield (3442 kg/ha) with 32.3 % increase over control (IOC) followed by acephate 95 SG (3207 kg/ha), Flubendiamide + buprofezin mixture (3040 kg/ha) and monocrotophos (3012 kg/ha) with yield increases of 27.3, 23.3 and 22.6%, respectively. Dinotefuron 20 SG @ 40 g a.i./ha and 35 g a.i./ha were the next best treatments with yields of 2996 kg/ha (22.2% IOC) and 2871 kg/ha (18.8% IOC), respectively. Flubendiamide treatment yielded 2809 kg/ha (17.0 % IOC), while buprofezin treatment showed an yield of 2711 kg/ha (14.0% IOC).

*Insecticide evaluation trial was carried out at 11 centres during rabi 2010. Based on the performance of the insecticide treatments for their efficacy in reducing pest infestation it was evident that there were no discernible trends in the performance of different treatments due to low pest incidence in most of the locations. Yield point of view, acephate 75 SP was the best treatment followed by acephate 95 SG, flubendiamide + buprofezin mixture and standard check, monocrotophos.*

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Table 2.33: Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) Rabi 2010

INSECTICIDE					STEM BORER											Mean
Common Name	Trade Name	% Formulation	Rate		% dead hearts											
			g a.i. /ha	g or ml of formulation/ha	ADT		CHN		MNC	PTB		RGL		RNR		
					30 DAT	50 DAT	30 DAT	45 DAT	30 DAT	30 DAT	50 DAT	30 DAT	50 DAT	50 DAT	78 DAT	
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	875 ml	2.4ab	2.1ab	6.4a	1.5a	1.6a	2.6a	4.3a	1.9a	5.7ab	0.6a	4.1a	2.8
Flubendiamide	Takumi	20 WG	35	175 g	0.6a	1.4a	6.4a	1.9a	2.5a	3.7a	3.1a	2.3a	7.9b	0.8a	2.7a	2.8
Buprofezin	Applaud	25 SC	175	700 ml	4.5b	3.8b	5.5a	3.4a	3.0a	3.9a	4.6a	2.3a	6.9ab	1.2a	4.1a	3.4
Acephate	RIL-059/F1	95 SG	562.5	592 g	1.0a	2.2ab	11.2a	7.4a	4.2a	3.1a	5.0a	2.6a	7.6b	2.1a	4.0a	4.1
Dinotefuran	-	20 SG	40	200 g	3.5b	6.6b	17.2a	4.7a	4.7a	3.9a	3.1a	2.0a	9.4b	3.6a	6.4a	5.0
Dinotefuran	-	20 SG	30	150 g	3.8b	6.2b	8.1a	4.1a	4.5a	5.0a	6.0a	5.2b	9.7b	1.6a	4.1a	4.5
Acephate	Acephate	75 SP	600	800 g	0.5a	1.2a	4.6a	3.2a	3.9a	3.1a	5.1a	2.3a	5.0a	1.0a	5.2a	2.9
Monocrotophos	Monocrown	36 SL	500	1390 ml	0.6a	1.9a	5.1a	2.7a	1.4a	5.3a	5.1a	1.8a	5.8ab	0.7a	3.9a	2.9
Untreated control					5.7b	10.8c	2.2a	7.9a	21.9b	3.3a	5.3a	7.8b	14.8c	2.6a	5.9a	6.6

Table 2.33(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) Rabi 2010

INSECTICIDE					STEM BORER									Mean
Common Name	Trade Name	% Formulation	Rate		% White ears									
			g a.i. /ha	g or ml of formulation/ha	ADT	CHN	KJT	MNC	PTB	PDC	RGL	RNR		
					ADT	CHN	KJT	MNC	PTB	PDC	RGL	RNR		
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	875 ml	3.4a	21.7a	2.4a	44.6a	19.5a	1.2a	10.6a	0.7a	13.0	
Flubendiamide	Takumi	20 WG	35	175 g	3.1a	9.5a	2.6a	51.8a	19.1a	1.2a	12.1a	2.6a	12.8	
Buprofezin	Applaud	25 SC	175	700 ml	11.4b	22.6a	2.9a	60.9a	19.7a	1.5a	11.4a	2.7b	16.6	
Acephate	RIL-059/F1	95 SG	562.5	592 g	9.1b	18.7a	3.1a	51.0a	22.0a	1.6a	10.6a	3.0bc	14.9	
Dinotefuran	-	20 SG	40	200 g	10.3b	16.5a	4.0a	57.6a	19.1a	1.3a	10.0a	2.4a	15.1	
Dinotefuran	-	20 SG	30	150 g	11.0b	22.7a	2.9a	53.2a	18.7a	1.9a	11.7a	3.3bc	15.6	
Acephate	Acephate	75 SP	600	800 g	8.7b	16.7a	3.7a	54.5a	19.8a	1.2a	7.5a	3.9bc	14.5	
Monocrotophos	Monocrown	36 SL	500	1390 ml	4.5ab	14.5a	3.1a	54.6a	22.7a	1.2a	8.0a	2.3a	13.9	
Untreated control					19.4c	22.1a	4.4a	23.2a	22.3a	10.5b	11.7a	6.4c	15.0	

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

Table 2.33(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET), Rabi 2010

INSECTICIDE					GALL MIDGE		
Common Name	Trade Name	% Formulation	Rate		% silver shoots		Mean
			g a.i. /ha	g or ml of formulation/ha	MNC 30 DAT	RGL 50 DAT	
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	875 m	6.1a	5.2a	5.6
Flubendiamide	Takumi	20 WG	35	175 g	8.1a	6.1b	7.1
Buprofezin	Applaud	25 SC	175	700 ml	8.0a	5.4a	6.7
Acephate	RIL-059/F1	95 SG	562.5	592 g	5.2a	5.5a	5.3
Dinotefuran	-	20 SG	40	200 g	10.7a	6.4b	8.6
Dinotefuran	-	20 SG	30	150 g	12.1a	6.7b	9.4
Acephate	Acephate	75 SP	600	800 g	9.8a	4.7a	7.3
Monocrotophos	Monocrown	36 SL	500	1390 ml	7.0a	4.5a	5.7
Untreated control	-	-	-	-	23.9b	10.1c	17.0

Table 2.33(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET), Rabi 2010

INSECTICIDE					LEAF FOLDER						
Common Name	Trade Name	% Formulation	Rate		% leaf damage					No./10 hills	
			g a.i. /ha	g or ml of formulation/ha	ADT		MNC		Mean	PDC	
					50 DAT	85 DAT	30 DAT	50 DAT		50 DAT	BT
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	875 ml	2.6a	3.3ab	5.4b	2.2a	3.4	42.7a	3.0a
Flubendiamide	Takumi	20 WG	35	175 g	2.0a	1.8a	2.7ab	4.1a	2.6	37.0a	2.7a
Buprofezin	Applaud	25 SC	175	700 ml	6.2c	6.8c	3.3ab	6.3b	5.6	44.0a	4.0a
Acephate	RIL-059/F1	95 SG	562.5	592 g	3.6b	3.2ab	3.3ab	1.1a	2.8	43.3a	2.3a
Dinotefuran	-	20 SG	40	200 g	4.7b	6.9c	3.4ab	3.1a	4.5	37.7a	3.7a
Dinotefuran	-	20 SG	30	150 g	6.7c	7.3c	3.4ab	1.2a	4.6	35.3a	4.0a
Acephate	Acephate	75 SP	600	800 g	1.5a	4.0b	3.5ab	1.3a	2.6	43.0a	4.7a
Monocrotophos	Monocrown	36 SL	500	1390 ml	1.4a	3.5ab	1.8a	2.3a	2.2	42.7a	4.3a
Untreated control	-	-	-	-	7.5c	9.8c	11.8c	5.2b	8.6	29.7a	3.7a

Table 2.33(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) Rabi 2010

INSECTICIDE					No. per 10 hills		
Common Name	Trade Name	% Formulation	Rate		GLH		BPH
			g a.i. /ha	g or ml of formulation/ha	PDC 30 DAT		ADT 70 DAT
					BT	AT	-
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	875 ml	17.0a	6.0a	2.5a
Flubendiamide	Takumi	20 WG	35	175 g	18.3a	6.7a	21.0c
Buprofezin	Applaud	25 SC	175	700 ml	19.3a	5.7a	3.8a
Acephate	RIL-059/F1	95 SG	562.5	592 g	20.3a	6.0a	1.8a
Dinotefuran	-	20 SG	40	200 g	16.3a	6.0a	2.5a
Dinotefuran	-	20 SG	30	150 g	18.0a	4.0a	1.5a
Acephate	Acephate	75 SP	600	800 g	18.3a	4.3a	5.8b
Monocrotophos	Monocrown	36 SL	500	1390 ml	19.7a	4.7a	5.3b
Untreated control	-	-	-	-	18.3a	3.0a	27.0c

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

Table 2.33(Contd.): Influence of insecticide treatments on incidence of insect pests in Insecticide Evaluation Trial (IET) Rabi 2010

INSECTICIDE					WHORL MAGGOT					THRIPS	HISPA	
Common Name	Trade Name	% Formulation	Rate		% damaged leaves					Mean	% DL	% DL
			g a.i./ha	g or ml of formulation/ha	CHN	PTB	RNR				RNR	RNR
					30 DAT	45 DAT	25 DAT	45 DAT	35 DAT		35 DAT	35 DAT
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	-	14.1a	13.6d	6.8a	2.5a	8.8a	8.1	6.9a	3.1a
Flubendiamide Buprofezin	Takumi Applaud	20 WG 25 SC	35 175	- 700 ml	12.7a 13.4a	13.8d 11.4c	7.6a 10.4a	2.9a 3.8a	10.8a 11.0a	8.5 8.9	4.3a 3.7a	1.0a 2.8a
Acephate	RIL-059/F1	95 SG	562.5	592 g	10.8a	8.3b	9.5a	3.9a	10.0a	7.6	3.4a	1.9a
Dinotefuran	-	20 SG	40	200 g	13.9a	8.1b	8.1a	4.2a	7.5a	7.4	3.1a	0.9a
Dinotefuran	-	20 SG	30	150 g	14.7a	9.0bc	7.6a	3.9a	6.2a	7.3	6.0a	0.7a
Acephate	Acephate	75 SP	600	800 g	18.1a	11.5c	7.2a	4.1a	10.0a	9.0	4.8a	2.1a
Monocrotophos	Monocrown	36 SL	500	1390 ml	14.6a	6.0a	9.1a	4.7a	7.4a	7.4	2.3a	0.6a
Untreated control	-	-	-	-	15.3a	14.3d	7.9a	4.1a	9.4a	9.0	3.0a	2.3a

Table 2.34: Influence of insecticide treatments on grain yield in Insecticide Evaluation Trial (IET), Rabi 2010

INSECTICIDE					Grain yield (kg/ha)							Grain yield (kg/ha)			
Common Name	Trade Name	% Formulation	Rate		ADT	GNG	MNC	PDC	RGL	Mean	% IOC	CHN	KJT	PTB	RNR
			g a.i./ha	g or ml of formulation/ha											
Flubendiamide + Buprofezin	RIL-IS-109	-	35+175	875 ml	1896a	3303ab	2500a	2600b	4900ab	3040	23.3	3981a	2821a	2236a	8065a
Flubendiamide Buprofezin	Takumi Applaud	20 WG 25 SC	35 175	175 g 700 ml	1688ab 1615b	2927c 2983c	2588a 1900a	2644b 2556b	4200bc 4500b	2809 2711	17.0 14.0	4444a 4167a	2865a 3154a	2139a 1917a	7332a 7301a
Acephate	RIL-059/F1	95 SG	562.5	592 g	1740a	3177bc	2613a	3856a	4651ab	3207	27.3	4074a	3306a	2139a	6796a
Dinotefuran	-	20 SG	40	200 g	1458b	3675a	2563a	2433bc	4850ab	2996	22.2	3981a	2778a	2028a	7730a
Dinotefuran	-	20 SG	30	150 g	1552b	3444a	2625a	2033bc	4700ab	2871	18.8	3519a	3009a	1944a	6827a
Acephate	Acephate	75 SP	600	800 g	1792a	3073bc	3350a	3944a	5051a	3442	32.3	3704a	3183a	1986a	8153a
Monocrotophos	Monocrown	36 SL	500	1390 ml	1781a	2798cd	1740a	3589a	5151a	3012	22.6	4352a	3168a	2236a	8473a
Untreated control	-	-	-	-	1625b	2647d	1719a	1956c	3711c	2331	-	4167a	2742a	1972a	7069a

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

## ii. Pesticide compatibility trial (PCT)

During *rabi* 2010, this trial was carried out at 7 locations viz., Chinsurah, Coimbatore, Gangavathi, Moncompu, Nellore, Pattambi and Puducherry.

The location-wise dates of sowing, planting, harvesting and pesticide application dates are as follows:

Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
Chinsurah	5-7-2010	30-07-10	-	-	-
Coimbatore	13-01-10	8-2-2010	19-05-10	1	46
Gangavathi	22-12-09	31-01-10	1-5-2010	1	68
Moncompu	13-12-09	2-12-09	4-5-2010	1	-
Nellore	10-11-09	14-12-09	29-03-10	4	10,36,47 and 62
Pattambi	17-10-09	14-12-09	13-03-10	2	30 and 50
Puducherry	14-01-10	18-02-10	13-05-10	2	29 and 47

## Treatments

The trial consisted of nine treatments viz., two insecticides, flubendiamide and spinosad each at 0.25 g a.i./litre, and two fungicides, isoprothiolane (1.5 ml/litre) and tricyclazole (0.6 g /litre] as separate treatments and also in four possible combination treatments. Untreated control without any insecticide or fungicide application was included for comparison. The trial was laid out in Randomized Complete Bock Design (RCBD) with three replications for each treatment. Observations were recorded on stem borer damage at vegetative and heading stages on ten randomly selected hills and expressed as per cent dead hearts or white ears. Similarly, leaf folder damage was calculated based on count of total and damaged leaves on 10 randomly selected hills per plot. For assessing the severity of blast disease, percentage disease severity was assessed as the pr the plants in a plot. At harvest, grain yield / net plot leaving two border rows on all sides was recorded and expressed as kg/ha.

## Results

### Pest Infestation (Table 2.35)

Stem borer dead heart damage at vegetative stage was recorded upto 34.0% DH across treatments at 5 locations. There were significant differences among the treatments at Chinsurah, Puducherry and Gangavathi. The mean infestation in these locations was lower in insecticides alone (7.9 and 8.8% DH) and combination treatments(8.0 to 9.2% DH) than that in fungicide alone treatments (10.1 & 11.9% DH) and control (13.8% DH).

White ear incidence due to stem borer was recorded up to a maximum of 33.5% across the treatments. Spinosad and its combination treatments showed lower incidence (8.5 to 10.3% WE) compared to flubendiamide and its combination treatments (11.1 to 11.7% WE). The fungicide treatments (13.0 and 13.8 % WE) and control (16.1% WE) showed higher infestation.

Leaf folder damage was recorded at four locations. There were no significant differences among the treatments due to low pest damage at Moncompu, while negligible damage was observed at Pattambi and Coimbatore. At Puducherry, the leaf folder damage before and after the treatment in all the treatments including untreated control was at par, at 30 DAT. At 50 DAT, there were significant differences among the treatments after the application. Both insecticides showed significant reduction in leaf folder damage when applied alone (90.0 and 90.8%) as well as in combination with fungicides (85.9 to 91.8% reduction) compared to fungicide alone treatments (62.2 and 64.0% reduction) and control (36.5%). The mean reduction values of both 30 and 50 DAT showed that spinosad was slightly better than flubendiamide in combination with fungicides.

### **Blast**

Blast disease was recorded only at Nellore. The blast severity ranged from 9.2 to 65.2% before treatment and 2.7 to 66.5% after treatment. There were significant differences among the treatments. The percent reduction in disease was significantly high in tricyclazole treatment when applied in combination with insecticides (62.3 and 64.9%) than when applied alone (37.7%). Similar trend was seen in case of isoprothiolane which did not reduce the disease when applied alone but in combination with insecticides resulted in 62.8 and 68.9% reduction of blast severity. However, tricyclazole was superior to isoprothiolane.

### **Grain Yield (Table 2.36)**

Differences in grain yield were significant among different treatments at four locations. The mean grain yield data across the locations revealed that spinosad application alone resulted in the highest yield of 2950 kg/ha, with 41.1% increase in yield over control, followed by the individual treatment of isoprothiolane which yielded 2941 kg/ha with 40.9% increase over control (IOC). Tricyclazole application alone resulted in an yield of 2844 kg/ha with 38.9% IOC. The yield range in combination treatments was 2498 to 2711 and % IOC varied between 30.5 and 35.4%. The control plot yielded 1737 kg/ha.

*Pesticide compatibility trial was carried out at 7 centres during rabi 2010. Based on the performance of the treatments when applied alone vis a vis their respective combinations in reducing pest infestation and their impact on grain yield, it was evident that spinosad when applied alone was the best treatment and its efficacy in combination with fungicides was better than that of flubendiamide. The fungicides also performed better in combination than when applied alone in reducing the disease.*

Table 2.35. Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Rabi 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Incidence of stem borer (% DH)										Mean
		CHN		MNC		PTB		PDC		GNG		
		30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	
Flubendiamide (Takumi 20 SC)	0.25 g/litre	1.4a	4.5a	3.2a	3.2a	12.8a	23.7a	2.0a	1.6a	17.3a	18.4b	8.8
Spinosad (45 SC)	0.25 g/litre	1.2a	4.7a	5.3a	4.7a	10.2a	22.5a	1.3a	1.4a	17.5a	10.0a	7.9
Isoprothiolane Fuzi 1	1.5 ml/litre	3.3a	17.1bc	4.3a	4.6a	4.2a	25.8a	1.4a	1.4a	21.1b	18.3b	10.1
Tricyclazole (Baan)	0.6 ml/litre	7.3b	12.2b	2.3a	2.6a	6.4a	24.6a	1.1a	2.0a	34.0d	26.6c	11.9
Flubendiamide + Isoprothiolane	0.25 g + 1.5 ml /litre	1.3a	2.2a	1.9a	3.3a	7.3a	20.6a	1.4a	2.3a	27.8c	24.0c	9.2
Flubendiamide + Tricyclazole	0.25 g + 0.6 ml /litre	2.2a	3.0a	2.9a	3.0a	8.6a	24.7a	1.6a	1.3a	24.0b	19.6b	9.1
Spinosad + Isoprothiolane	0.25 g + 1.5 ml /litre	1.7a	4.7a	1.6a	2.4a	6.0a	25.1a	1.5a	2.0a	27.4c	7.4a	8.0
Spinosad + tricyclazole	0.25 g + 0.6 ml /litre	2.1a	2.3a	3.7a	4.8a	7.2a	22.9a	2.7a	1.9a	29.3c	15.2b	9.2
Untreated control		7.8b	18.6c	3.4a	3.0a	5.1a	23.1a	9.8b	8.3b	30.1d	28.5c	13.8

Table 2.35 (Contd.): Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Rabi 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Incidence of stem borer (% WE)					Mean
		CHN	MNC	PTB	PDC	GNG	
Flubendiamide (Takumi 20 SC)	0.25 g/litre	3.5a	5.9a	21.6a	1.2a	23.6c	11.1
Spinosad (45 SC)	0.25 g/litre	4.6a	8.7a	20.5a	1.7a	7.7a	8.6
Isoprothiolane Fuzi 1	1.5 ml/litre	12.3b	11.2a	26.5a	2.9b	15.9b	13.8
Tricyclazole (Baan)	0.6 ml/litre	13.8b	10.3a	12.9a	2.7b	25.5c	13.0
Flubendiamide + Isoprothiolane	0.25 g + 1.5 ml /litre	2.9a	10.0a	21.4a	1.4a	23.0c	11.7
Flubendiamide + Tricyclazole	0.25 g + 0.6 ml /litre	4.2a	11.9a	18.3a	1.8a	21.3c	11.5
Spinosad + Isoprothiolane	0.25 g + 1.5 ml /litre	4.0a	9.2a	19.0a	1.4a	8.8a	8.5
Spinosad + tricyclazole	0.25 g + 0.6 ml /litre	2.5a	10.6a	22.3a	1.9a	14.1b	10.3
Untreated control		13.2b	11.3a	20.8a	1.6a	33.5d	16.1

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

Table 2.35 (Contd.): Incidence of insect pests in different treatments in Pesticide Compatibility trial (PCT), Rabi 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	LEAF FOLDER						
		% damaged leaves			Damaged leaves / 10 hills			
		MNC		PTB	PDC			
		30 DAT	50 DAT	45 DAT	30 DAT		50 DAT	
			1 BT	8 AT	1 BT	8 AT		
Flubendiamide (Takumi 20 SC)	0.25 g/litre	9.5a	1.4a	1.1	16.3a	2.0a	60.0a	6.0a
Spinosad (45 SC)	0.25 g/litre	8.3a	2.8a	0.6	16.3a	2.7a	68.7a	6.3a
Isoprothiolane Fuzi 1	1.5 ml/litre	8.0a	2.0a	0.1	13.7a	5.7a	90.0a	34.0b
Tricyclazole (Baan)	0.6 ml/litre	6.4a	1.3a	0.2	11.0a	4.3a	74.0a	26.7b
Flubendiamide + Isoprothiolane	0.25 g + 1.5 ml /litre	7.0a	1.5a	0.1	11.0a	4.3a	49.0a	4.0a
Flubendiamide + Tricyclazole	0.25 g + 0.6 ml /litre	7.0a	0.9a	0.2	10.3a	3.3a	56.0a	6.7a
Spinosad + Isoprothiolane	0.25 g + 1.5 ml /litre	5.6a	0.9a	0.3	12.3a	3.0a	54.3a	7.7a
Spinosad + tricyclazole	0.25 g + 0.6 ml /litre	7.1a	2.1a	0.3	15.7a	3.0a	59.7a	5.0a
Untreated control		4.8a	4.6a	0.5	13.7a	7.7a	130.7b	83.0c

Table 2.35 (Contd.): Incidence of disease in different treatments in Pesticide Compatibility trial (PCT), Rabi 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Blast % severity/10 hills (60 DAT)	
		NLR	
		BT	AT
Flubendiamide (Takumi 20 SC)	0.25 g/litre	13.8a	20.9b
Spinosad (45 SC)	0.25 g/litre	13.5a	12.9a
Isoprothiolane Fuzi 1	1.5 ml/litre	9.2a	9.4a
Tricyclazole (Baan)	0.6 ml/litre	15.6a	9.7a
Flubendiamide + Isoprothiolane	0.25 g + 1.5 ml /litre	20.3a	2.7a
Flubendiamide + Tricyclazole	0.25 g + 0.6 ml /litre	30.2b	3.4a
Spinosad + Isoprothiolane	0.25 g + 1.5 ml /litre	65.1c	20.2b
Spinosad + tricyclazole	0.25 g + 0.6 ml /litre	50.6c	17.8b
Untreated control		65.2c	66.5c

Table 2.36: Summary of grain yield in different treatments in Pesticide Compatibility trial (PCT), Rabi 2010

Insecticide/Fungicide	Dose g/ml per litre of spray fluid	Grain yield (Kg/ha)					% IOC	Grain yield (Kg/ha)	
		MNC	NLR	PDC	GNG	Mean		CHN	PTB
Flubendiamide (Takumi 20 C)	0.25 g/litre	2000a	1635c	2475a	3675b	2446	29.0	3333a	2155a
Spinosad (45 SC)	0.25 g/litre	3000a	2075bc	2583a	4143a	2950	41.1	3356a	1881a
Isoprothiolane Fuzi 1	1.5 ml/litre	2400a	3303a	2575a	3486b	2941	40.9	3533a	3607a
Tricyclazole (Baan)	0.6 ml/litre	2625a	3030a	2475a	3246bc	2844	38.9	3956a	2214a
Flubendiamide + Isoprothiolane	0.25 g + 1.5 ml /litre	2250a	3030a	2308a	3172c	2690	35.4	4978a	2274a
Flubendiamide + Tricyclazole	0.25 g + 0.6 ml /litre	2413a	2468b	2225a	2972cd	2519	31.1	3844a	2119a
Spinosad + Isoprothiolane	0.25 g + 1.5 ml /litre	2188a	1845bc	2358a	3601b	2498	30.5	4044a	2071a
Spinosad + tricyclazole	0.25 g + 0.6 ml /litre	2313a	2065bc	2525a	3943ab	2711	35.9	4289a	2143a
Untreated control		1750b	648d	1858b	2692d	1737		3378a	1952a

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

## 2.2 ECOLOGICAL STUDIES

### i. Influence of rice cultivation systems on insect pest incidence (IRCP)

In *Rabi* 2010, IRCP trial was conducted at three locations *viz.*, Pattambi, Ragolu and Chinsurah. The main objective of this trial was to assess the insect pest incidence in various cultivation systems and their impact on yield. During this season, normal and SRI systems were evaluated at all the three locations.

The field trial was laid out in split-plot design with cultivation systems as main treatments *i.e.*, S1) Conventional or Normal method and S2) SRI and cultivars as two sub-plots *i.e.*, V1) Hybrid and V2) High yielding variety. The experimental area was divided into seven equal blocks each representing a replication. Each block had two main treatments with two sub-treatments. Thus, each block consisted of four plots. The experimental area at each location had 28 plots and no control measures were applied in any of these plots. Observations on insect pest incidence were recorded on ten randomly selected hills at ten day interval in each plot. At pre-harvest stage, per cent white ears were recorded. Grain yields were recorded from each plot. Grain number and grain weight from ten hills was also obtained.

### Results

At **Pattambi**, CORH3 hybrid and Jyothi variety were grown under normal and SRI methods of rice cultivation (Table 2.37). Stem borer, leaf folder, whorl maggot and case worm damage was recorded. Leaf folder and case worm damage was low to draw valid conclusions. Dead heart (5.8 – 11.9 %) and white ear (38.2%) damage was significantly high in normal method as compared to SRI (2.4 - 2.9% DH & 16.5% WE). But, the whorl maggot damage was significantly high in SRI (12.67 – 24.37% DL) than in normal method (6.11 – 14.06%DL). Among the cultivars, dead heart damage at 40 DAT was significantly low in Hybrid, CORH 3 (6%) than in Jyothi variety (8.27%) whereas there were no significant differences with respect to white ears and whorl maggot damage. Interaction was non- significant with respect to pest incidence. SRI recorded maximum yield of 7091 kg/ ha than normal method (2807kg/ ha). Among the cultivars, Jyothi variety (5507 kg/ ha) out yielded the hybrid CORH3 (4391 kg/ ha). In the interaction, hybrid under normal method recorded higher yield (3372 kg/ ha) whereas variety under SRI recorded higher yield (8772 kg/ ha).

At **Ragolu**, Arize 6444 hybrid and Cotton dorasannalu variety were grown under normal and SRI method (Table 2.38). Stem borer and gall midge damage was recorded. Dead heart (2.69 – 9.20%) and white ear (9.94%) damage was significantly low in SRI as compared to normal method (7.91 -24.05% DH & 18.46% WE). Gall midge damage was also significantly low in SRI (2.63 – 6.57% SS) than normal method (4.45 – 11.20% SS). Among the cultivars, stem borer damage was significantly high in cotton

dorasannalu variety (6.64% DH & 15.49% WE) than Arize 6444 hybrid (3.95% DH & 12.91% WE). Gall midge damage though not significant at 40 & 50 DAT, but at 60 DAT, hybrid (9.81% SS) recorded a significantly high damage as compared to variety (7.69%SS). Across the systems, maximum yield was obtained from SRI (5646 kg/ ha) and across the cultivars, hybrid (5605 kg/ ha) recorded higher yield than variety. Among the interactions, hybrid in SRI recorded highest yield (6092 kg/ ha) followed by hybrid under normal method (5200 kg/ ha).

At **Chinsurah**, KRH2 hybrid and IET 4094 variety was grown under normal and SRI methods of rice cultivation (Table 2.39). Stem borer, leaf folder, whorl maggot and rice bug damage was recorded. However, leaf folder and rice bug damage was low to draw valid conclusions. Among the cultivation systems, dead heart damage, though not statistically significant, was high in normal method at 40 & 80 DAT (13.68 % & 9.45%, respectively) but at 60 DAT, SRI (27.61%) had more damage than normal method (9.69%). Whorl maggot damage was high in normal method (21.18%) as compared to SRI (15.57%). Among the cultivars, KRH2 hybrid recorded maximum dead heart damage (14.67 – 24.20%) than variety (8.12 – 13.10%). Yield was not significantly different either among the cultivation systems or among the cultivars.

*Of the three locations in which IRCP was conducted during rabi 2010 under unprotected condition, dead heart and white ear damage was significantly low in SRI than normal method except at Chinsurah wherein dead heart damage was more in SRI (27.61%) as against normal method (9.69%). Similarly gall midge damage at Ragolu was low in SRI as compared to normal method. Contradicting reports were obtained with respect to whorl maggot wherein at Chinsurah, the damage was high in normal method (21.18%) while at Pattambi it was high in SRI (24.37%).*

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Table 2.37: 1 Influence of cultivation systems and cultivars on insect pest incidence at **Pattambi (IRCP), Rabi 2010**

Main plots	Sub- plots	%DH 40 DAT	%DH 50 DAT	%WE -	%WMDL 20 DAT	%WMDL 30 DAT	Yield kg/ha	Grain wt (g)
Normal	Hybrid	9.93(3.20)	5.45(2.37)	39.28(6.22)	12.98(3.46)	5.72(2.22)	3372	116
	Variety	13.95(3.71)	6.20(2.55)	37.12(6.13)	15.15(3.91)	6.51(2.45)	2244	125
SRI	Hybrid	2.29(1.61)	2.69(1.72)	16.06(4.04)	26.56(5.14)	12.52(3.49)	5412	650
	Variety	2.59(1.66)	3.20(1.87)	17.06(4.15)	22.17(4.66)	12.82(3.54)	8772	1214
LSD 0.05	M in S	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>1257</b>	<b>358</b>
	S in M	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>1171</b>	<b>339</b>
<b>Cultivation systems</b>								
	Normal	11.94(3.45)	5.83(2.46)	38.20(6.18)	14.06(3.69)	6.11(2.33)	2807	120
	SRI	2.44(1.63)	2.95(1.79)	16.56(4.09)	24.37(4.90)	12.67(3.51)	7091	932
LSD 0.05	Main	<b>0.52</b>	<b>0.53</b>	<b>0.67</b>	<b>0.78</b>	<b>0.78</b>	<b>1138</b>	<b>245</b>
	CV (%)	<b>22.11</b>	<b>26.98</b>	<b>14.14</b>	<b>19.67</b>	<b>28.9</b>	<b>27.86</b>	<b>50.39</b>
<b>Cultivars</b>								
	Hybrid	6.11(2.40)	4.07(2.05)	27.67(5.13)	19.77(4.30)	9.12(2.86)	4391	383
	Variety	8.27(2.68)	4.70(2.21)	27.09(5.14)	18.66(4.29)	9.67(2.99)	5507	670
LSD 0.05	Sub	<b>0.29</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>828</b>	<b>240</b>
	CV (%)	<b>29.53</b>	<b>23.3</b>	<b>13.03</b>	<b>24.18</b>	<b>20.01</b>	<b>22.75</b>	<b>55.3</b>

Figures in parentheses are square root transformed values

Hybrid = CORH3; Variety = Jyothi

Table 2.38: Influence of cultivation systems and cultivars on insect pest incidence at **Ragolu (IRCP), Rabi 2010**

Main plots	Sub- plots	%DH 40 DAT	%DH 50 DAT	% DH 60 DAT	%WE -	%SS 40 DAT	%SS 50 DAT	%SS 60 DAT	Yield kg/ha
<b>Normal</b>	<b>Hybrid</b>	5.10(2.19)	21.88(4.66)	27.28(5.13)	17.01(4.13)	3.70(1.90)	12.68(3.54)	13.11(3.62)	5118
	<b>Variety</b>	10.72(3.19)	22.99(4.77)	20.82(4.55)	19.92(4.46)	5.20(2.25)	9.72(3.11)	8.76(2.95)	4900
<b>SRI</b>	<b>Hybrid</b>	2.81(1.66)	8.72(2.92)	8.93(2.98)	8.82(2.97)	2.34(1.51)	5.12(2.22)	6.52(2.52)	6092
	<b>Variety</b>	2.57(1.58)	7.73(2.77)	9.47(3.07)	11.06(3.33)	2.91(1.68)	5.26(2.25)	6.63(2.56)	5200
<b>LSD 0.05</b>	<b>M in S</b>	<b>0.5</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>0.4</b>	<b>435</b>
	<b>S in M</b>	<b>0.47</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>0.38</b>	<b>425</b>
<b><u>Cultivation systems</u></b>									
	<b>Normal</b>	7.91(2.69)	22.43(4.72)	24.05(4.84)	18.46(4.30)	4.45(2.07)	11.20(3.32)	10.93(3.29)	5009
	<b>SRI</b>	2.69(1.62)	8.22(2.84)	9.20(3.02)	9.94(3.15)	2.63(1.60)	5.19(2.24)	6.57(2.54)	5646
<b>LSD 0.05</b>	<b>Main</b>	<b>0.43</b>	<b>0.33</b>	<b>0.5</b>	<b>1.94</b>	<b>0.27</b>	<b>0.54</b>	<b>0.27</b>	<b>163</b>
	<b>CV (%)</b>	<b>21.45</b>	<b>9.31</b>	<b>13.75</b>	<b>14.8</b>	<b>16.09</b>	<b>21.01</b>	<b>10.16</b>	<b>3.3</b>
<b><u>Cultivars</u></b>									
	<b>Hybrid</b>	3.95(1.92)	15.30(3.79)	18.11(4.05)	12.91(3.59)	3.02(1.70)	8.90(2.88)	9.81(3.07)	5605
	<b>Variety</b>	6.64(2.39)	15.36(3.77)	15.14(3.81)	15.49(3.94)	4.06(1.97)	7.49(2.68)	7.69(2.75)	5050
<b>LSD 0.05</b>	<b>Sub</b>	<b>0.33</b>	<b>NS</b>	<b>NS</b>	<b>1.89</b>	<b>NS</b>	<b>NS</b>	<b>0.27</b>	<b>300</b>
	<b>CV (%)</b>	<b>18.69</b>	<b>12.03</b>	<b>14.07</b>	<b>16.15</b>	<b>19.68</b>	<b>11.02</b>	<b>11.21</b>	<b>6.85</b>

Hybrid = Arize 6444; Variety = Cottondorasannalu  
 Figures in parentheses are square root transformed values

Table 2.39: Influence of cultivation systems and cultivars on insect pest incidence at **Chinsurah (IRCP), Rabi 2010**

Main plots	Sub- plots	%DH 40 DAT	%DH 60 DAT	%DH 80 DAT	%WMDL 20 DAT	Yield kg/ha
<b>Normal</b>	<b>Hybrid</b>	17.52(4.11)	12.47(3.45)	11.89(3.38)	20.20(4.48)	2080
	<b>Variety</b>	9.85(3.05)	6.91(2.53)	7.01(2.60)	22.17(4.70)	2259
<b>SRI</b>	<b>Hybrid</b>	11.82(3.33)	35.93(5.99)	5.19(2.26)	15.66(3.95)	2134
	<b>Variety</b>	6.38(2.40)	19.30(4.38)	10.38(3.16)	15.48(3.92)	2241
<b>LSD 0.05</b>	<b>M in S</b>	<b>NS</b>	<b>NS</b>	<b>0.53</b>	<b>NS</b>	<b>NS</b>
	<b>S in M</b>	<b>NS</b>	<b>NS</b>	<b>0.48</b>	<b>NS</b>	<b>NS</b>
<b>Cultivation systems</b>						
	<b>Normal</b>	13.68(3.58)	9.69(2.99)	9.45(2.99)	21.18(4.59)	2170
	<b>SRI</b>	9.10(2.86)	27.61(5.18)	7.78(2.71)	15.57(3.94)	2188
<b>LSD 0.05</b>	<b>Main</b>	<b>NS</b>	<b>0.5</b>	<b>NS</b>	<b>0.28</b>	<b>NS</b>
	<b>CV (%)</b>	<b>32.01</b>	<b>13.1</b>	<b>26.62</b>	<b>7.16</b>	<b>11.97</b>
<b>Cultivars</b>						
	<b>Hybrid</b>	14.67(3.72)	24.20(4.72)	8.54(2.82)	17.93(4.22)	2107
	<b>Variety</b>	8.12(2.72)	13.10(3.46)	8.70(2.88)	18.82(4.31)	2250
<b>LSD 0.05</b>	<b>Sub</b>	<b>0.59</b>	<b>0.61</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>
	<b>CV (%)</b>	<b>22.36</b>	<b>18.22</b>	<b>14.47</b>	<b>7.71</b>	<b>11.94</b>

Figures in parentheses are square root transformed values  
Hybrid = KRH2; Variety = IET 4094

## ii. Effect of organic manures on pest incidence (EOMP)

With the increase in the use of organic manures by the farmers, this trial was formulated mainly to evaluate the effect of organic manures on insect pest incidence and subsequently on grain yield. The trial was carried out in *rabi* 2010 at two locations *viz.*, Gangavathi and Rajendranagar. Similar to *kharif* season, the field trial consisted of six treatments and four replications in a randomized block design. Treatments include (1) Untreated control without application of organic manures or fertilizers, (2) 100 per cent recommended fertilizer dose (RFD), (3) Farm yard manure @ 10 tons per hectare, (4) Green manure – *Sesbania rostrata* or any other green manure - incorporation, (5) green manure as in T4 + 50 per cent recommended N as top dressing in two splits (GM + 50% N) and (6) application of vermicompost or poultry manure as per the local recommendation. No insecticide was applied in any of the treatments either in nursery or in main field. Insect pest incidence was recorded on ten randomly selected hills in each replication. Plot wise grain yield was also recorded to know the effect of organic manures.

### Results

At **Gangavathi**, stem borer and leaf folder incidence was observed during *rabi* season (Table 2.40). Stem borer damage was very high in all the treatments. At 30 DAT dead heart damage was significantly high in RFD (82.52%) as compared to other treatments (20.77 – 40.07%). At 50 DAT, significantly low dead heart damage was observed in vermicompost (31.31%) and was at par with GM (38.18%). White ear damage was also significantly low in VC (32.57%) and was at par with GM (42.11%) as compared to RFD (69.18%). The damage by leaf folder was significantly low in GM, GM + 50% and VC (2.39 – 3.98%) than RFD (5.91%). Maximum yield was obtained from VC (7484 kg/ ha) and was at par with GM + 50%N (6262 kg/ ha) and RFD (6671 kg/ ha). Untreated control recorded the lowest grain yield (3781 kg/ ha).

At **Rajendranagar**, stem borer, whorl maggot, hispa and thrips damage was observed (Table 2.41). Dead heart (<3%) and white ear (<5%) damage was low in different treatments to draw valid conclusions. Though, whorl maggot (9.33 – 21.33%) and thrips (11.00 – 21.00%) damage was high, differences among the treatments were not significant. Highest grain yield was obtained from GM + 50% N (4203 kg/ ha) and was at par with GM (4138 kg/ ha) and RFD (3801 kg/ha).

*Effect of organic manures on insect pest incidence trial was conducted at two locations during rabi season. Low dead heart (31.31%) and white ear (32.57%) damage was found in vermicompost treatment as against recommended fertilizer dose at Gangavathi. Whorl maggot and thrips damage recorded at Rajendranagar, though high, was not significant across the treatments. At both locations, GM + 50% N recorded higher grain yield (4203 - 6262 kg/ha) as compared to other treatments.*

Table 2.40: Effect of organic manures on insect pest incidence and grain yield at **Gangavathi (EOMP)**, Rabi 2010

Treatments	% DH 30 DAT	% DH 50 DAT	% WE Pre-harvest	% LFDL -	Yield kg /ha
Untreated control (UC)	39.98 (39.13)a	62.54(52.42)c	51.47(45.92)b	5.27(2.27)bc	3781b
Recommended Fertilizer Dose (RFD)	82.52 (71.59)b	56.28(48.72)c	69.18(57.26)c	5.91(2.41)c	6671a
Farm Yard Manure @ 10 t/ ha (FYM)	20.77 (26.47)a	50.35(45.21)bc	53.28(46.89)bc	3.23(1.75)ab	4546b
Green Manure (GM)	36.96 (37.14)a	38.18(37.99)ab	42.11(40.37)ab	2.39(1.53)a	4066b
GM + 50% N top dressing in 2 split doses	40.07 (39.23)a	50.84(45.52)bc	53.51(47.11)bc	3.70(1.92)abc	6262a
Vermicompost @ 2t/ ha (VC)	24.91 (29.89)a	31.31(33.97)a	32.57(34.77)a	3.98(1.97)abc	7484a
CV (%)	36.56	15.84	15.1	18.26	17.25

Means in a column followed by different letters are significantly different at  $p= 0.05$   
 Figures in parenthesis are square root transformed values

Table 2.41: Effect of organic manures on insect pest incidence and grain yield at **Rajendranagar, (EOMP)** Rabi 2010

Treatments	% DH 62 DAT	% WE Pre harvest	%WMDL 32 DAT	% ThDL 32 DAT	Yield kg/ ha
Untreated control (UC)	1.13(1.22)a	2.92(1.80)a	9.33(2.92)a	18.33(4.27)a	2420b
Recommended Fertilizer Dose (RFD)	1.86(1.42)a	5.03(2.35)a	21.33(4.62)a	14.33(3.74)a	3801a
Farm Yard Manure @ 10 t/ ha (FYM)	1.79(1.42)a	2.94(1.84)a	14.67(3.82)a	15.00(3.83)a	2040b
Green Manure (GM)	2.17(1.56)a	3.25(1.93)a	17.33(4.07)a	16.33(3.97)a	4138a
GM + 50% N top dressing in 2 split doses	0.91(1.17)a	1.77(1.51)a	17.33(4.07)a	21.00(4.56)a	4203a
Vermicompost @ 2t/ ha (VC)	3.09(1.74)a	2.74(1.73)a	13.00(3.58)a	11.00(3.21)a	2670b
CV (%)	41.29	20.28	19.53	20.19	17.71

Variety = Tellahamsa;

Means in a column followed by different letters are significantly different at  $p= 0.05$   
 Figures in parenthesis are square root transformed values

### iii. Trap crop for stem borer management (TCSB)

Yellow stem borer (YSB) is the dominant pest in rice ecosystem. Yellow stem borer being a monophagous pest, only a susceptible rice variety could be used as a trap crop. Research studies at DRR and FLDs taken up in farmers field proved that transplanting of one row of trap crop (Pusa basmati 1) as an inter crop for every 9 rows of main crop (2.5-3 m) in east-west direction would minimize stem borer damage in the main crop. Pusa Basmati 1, an aromatic fine grained rice variety had more stem borer damage than other varieties. The sowing time of the trap crop (Pusa Basmati) should be adjusted such that the trap crop flowers one week before flowering of the main crop.

This is the second season of the trial under coordinated programme. The trial was conducted at 3 centres *viz.*, Killikulam, Moncompu and Chinsurah with the objective to test the efficacy of growing Pusa Basmati 1 as trap crop in minimizing the damage by yellow stem borer (YSB) in the main crop by planting a susceptible variety as an inter (trap) crop. The main crop variety is a local popular variety. The experiment was laid out with the following treatments 1) main crop alone 2) main crop with trap crop 3) no insecticide treatment and 4) need based application of insecticide, with 4 replications in each treatment. Observations on total tillers and number of dead hearts were recorded at 30 and 50 DAT; panicle bearing tillers, and number of white ears at pre harvest from 25 hills per replication. If the dead heart damage exceeds 20% in the trap crop a spray of insecticide was recommended. Grain yield ( main crop yield and trap crop yield) was recorded from a uniform area of 3X3sq m. at two places in each replication. At the time of harvest 10 hills from each treatment were dissected out to estimate the stage of the insect in the trap crop variety. The information pertaining to all the management practices are summarized in Table 2.42 At all the locations a spray of insecticide was given. The results of this trial are discussed location wise:

**Chinsurah:** Main crop variety grown was Kshitish. The dead heart (2.0% at 30 DAT) damage was significantly low in Kshitish in the treatment where it was grown along with trap crop as compared to the treatment where it was grown as sole crop (5.8%). The other parameters like DH (%) at 50 DAT, white ear damage and grain yield were not statistically significant between the treatments.

**Moncompu:** Main crop variety grown was Jyothy. The dead heart damage in the main crop at 50 DAT was 11.5 % in the treatment where trap crop was grown as compared to treatment without trap crop (16.2 % DH) though statistically non significant. White ear damage and grain yield were not statistically significant between treatments.

Table 2.42: Management practices in various locations in **TCSB**, rabi 2010

I	1	Location	Thirupathisaram, Kanyakumari District	Rice Research station ,Chinsurah	Rice Research Station,Moncompu
	2	Main crop variety	TPS 3	KSHITISH	Jyothy
	3	Date of sowing the main crop	16.10.09	11.01.10	5
	4	Trap crop Variety	Pusa Basmati	Pusa Basmati -1	Pusa Basmati
	5	Date of sowing of trap crop	09.10.09	4.01.10	15/12/2009
		Date of transplanting	04.11.09		
	6	Treatment details (Give area under each traetment)	7x 11.5mt. /replication	8MX10M	5x4 m2
	7	No. of replications followed	Four	4	4
	8	No of trap crop rows sown in the field	Four rows /replication	5	2
	9	Whether experiment is taken up in farmers field/ reseach farm	Research farm	Research station	Research farm
<b>II</b>		<b>Agronomic practices</b>			
	1	How was main crop planted? a) In regular rows b)at Random	Regular rows	In regular rows	In regular rows
	2	Type of trap crop planting	Trap crop was planted after completing the planting of main crop	1 row after 9 rows	One row of trap crop for every 9 rows of main crop in east - west direction
	3	Difficulty faced while planting the trap crop	-	Slow transplanting	More labour requirement
	4	Fertilizers applied		30 KG IFFCO	Urea, Factomfos, Muriate of Potash
		a)Basal	50:60:30 Kg NPK /ha	8 kg Urea	
		b)Top dressing		8 kg Urea	Urea, Factomfos, Muriate of Potash
		First	50:00:15	8 kg Urea	
		Second	50:00:15		
	5	Herbicide application	No	4 kg Butachlor 3 days after planting	Yes Nominigold @ 120 ml/ acre 15 days after transplanting
	6	Pest incidence other than stem borer	Green leaf hopper	No	Leaf folder and Gall midge
	7	Details of insecticide application, if any			
		a.Name of the insecticide	Monocrotophos	Monocrotophos 35 EC	Fame (flubendiamide)
		b.Dosage	400ml/ha	2 ml /litre	20 ml/ acre
		c.Time of application	75 days after tranplanting		50 Dat in T3 and T4 treatments.

**Killikulam:** White ear (%) damage in the main crop ( var. TPS3) where trap crop was grown was 12.4 % as compared to treatment where no trap crop was grown (16.8%). The damage level was at par with the treatment where one insecticide spray was given in the main crop (14.6 %). No significant difference in yields was observed.

*This is the second season of the trial and was conducted at Killikulam, Moncompu and Chinsurah. The main crop varieties tested were Khitish (Chinsurah) Jyothy ( Moncompu ) and Killikulam ( TPS3). Growing of trap crop had significantly reduced dead heart damage at 30 DAT in Khitish, white ear damage in TPS3 and Jyothy (Fig. 2.11) though it did not increase the yields.*

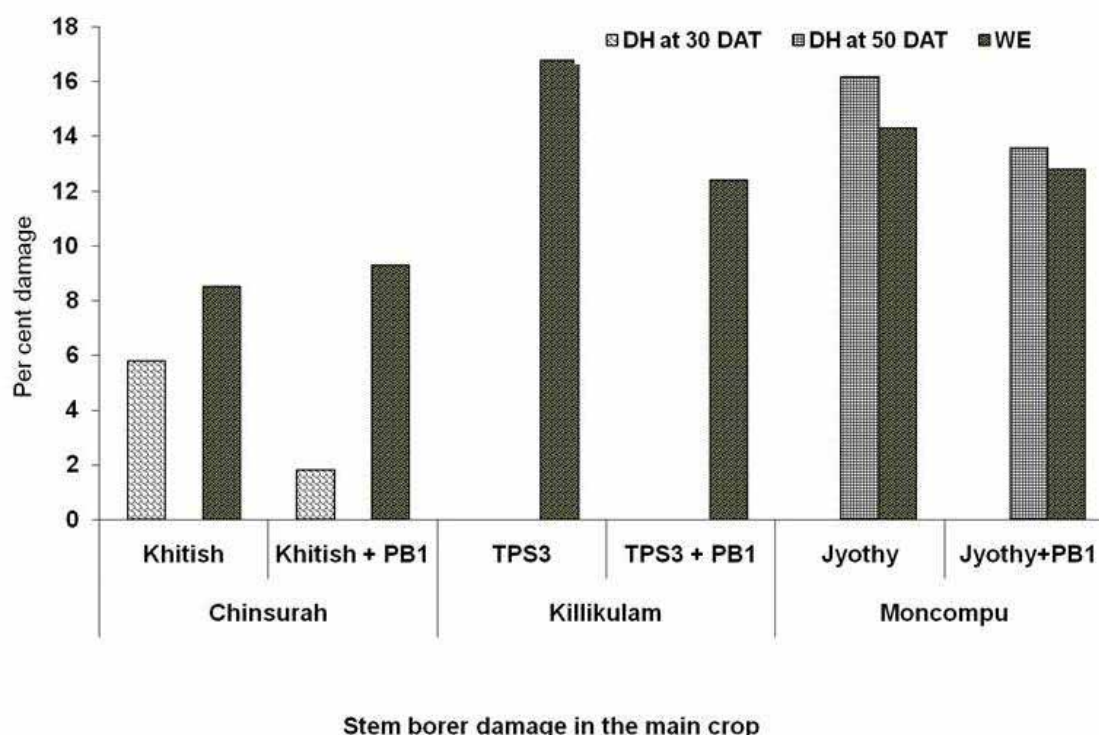


Fig. 2.11: Effect of trap crop on stem borer damage across locations

## 2.3 BIOCONTROL AND BIODIVERSITY STUDIES

### i. Monitoring of pests and their natural enemies (MPNE)

The trial was allotted to 9 centres and data was received from four centres *viz.*, Aduthurai, Karaikal, Pattambi and Rajendranagar.

#### Stem borer

**species composition:** The stem borer species composition was reported from Pattambi and Rajendranagar. At Pattambi, three species of stem borers were reported *viz.*, YSB *S. incertulus*, white stem borer *S. innotata* and pink stem borer *Sesamia inferens* (Fig 1). YSB which was present throughout the crop growth was dominant during the vegetative phase (78 %) but became less abundant in the reproductive phase (30%) when PSB became dominant (70.0%). Egg parasitisation was reported at this centre, only in the vegetative phase. At Rajendranagar the only species observed was YSB. At Aduthurai the YSB was dominant during vegetative phase accounting for 79% while WSB accounted for remaining 21%. But during reproductive phase PSB dominated (70%) followed by YSB (30%).

**Natural enemies:** The mean egg mass parasitisation at Pattambi was 40% and egg parasitisation was 50%. Three species of parasitoids were reported *Telenomus* sp. (58.59%), *Trichogramma* (31.31%), *Tetrastichus schoenobii* (10.1%). At Rajendranagar, the mean egg mass parasitisation was 57.14% and egg parasitisation was 19.29%. The parasitoids observed were *Trichogramma* (33.22%), *Telenomus* (59.14%) and *Tetrastichus* (7.64%). Hyper parasitisation by the pteromalid, *Trichomalopsis apanteloctena* on *Tetrastichus* was recorded up to 3 %. At Aduthurai the stem borer egg parasitisation was 50 per cent and the species composition of parasitoids were *Trichogramma* (31.31%), *Telenomus* (58.58%) and *Tetrastichus* (10.1%).

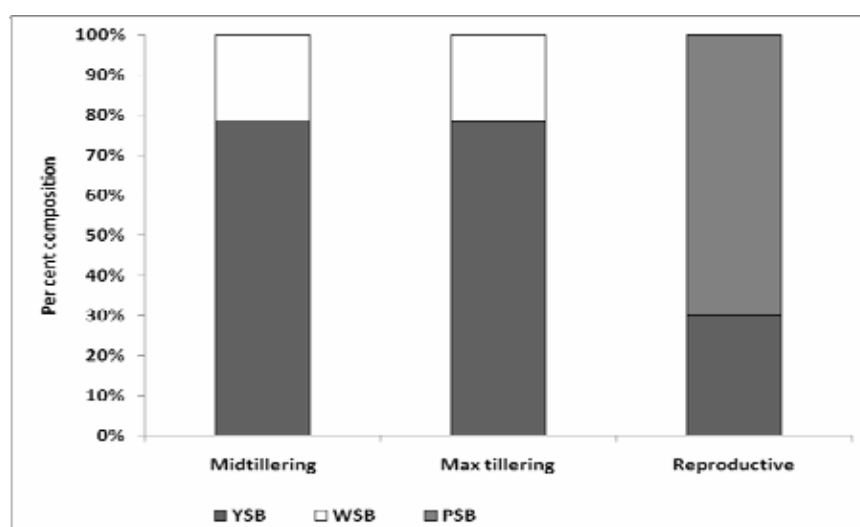


Fig 1. Stem borer species composition at Pattambi – Rabi 2010

## **Leaf folder**

**Species composition:** Information on the leaf folder species composition was reported from only Karaikal centre. The species composition based on larval characteristics was *Cnaphalocrocis medinalis* (65%) and *Marasmia* sp. (35%). Sweep net counts of adults and adults emerging from collected pupae were similar, with *C. medinalis* accounting for 52 % and *Marasmia* 48%. This indicated an equal abundance of the two species at this centre.

**Natural enemies:** The larval parasitoids observed were *Macrocentrus phillipenensis* and non gregarious *Apanteles* sp.

*Monitoring of pest species and their natural enemies (MPNE) trial carried out at 3 locations revealed that YSB was dominant in all centres during vegetative phase. The dominant egg parasitoids were Trichogramma and Telenomus sp.,*

## 2.4 INTEGRATED PEST MANAGEMENT

### i. On-Farm Integrated Pest Management (OIPM)

On farm integrated pest management trial was formulated with an objective to evaluate location specific IPM modules viz., 1) insecticide module (IPM I) wherein insect pests are controlled exclusively by chemicals, 2) non-insecticide module (IPM II) consisting of growing a resistant variety, use of pheromones for monitoring, mass trapping of yellow stem borer and augmentative release of bio-control agents, 3) a combination of insecticide and non-insecticide modules (IPM III) that has all the components of IPM II and need based chemical use and 4) farmers practices (FP).

In *rabi*, the trial was conducted at two locations, viz., Karjat and Pattambi. Pest management practices followed at each location under each module are given in Table 2.43. The area of each module was 2000 m<sup>2</sup> to 3000 m<sup>2</sup>, which was divided into six sub-plots, each representing a replication. Ten hills were randomly selected in each sub-plot to record insect pest incidence. Finally, grain yield was recorded from each replication and cost of cultivation was calculated to derive benefit cost ratio.

### Results

At **Karjat**, only stem borer damage was observed, however, both dead heart and white ear damage was too low across the IPM modules to draw valid conclusions. Due to low pest incidence there were no significant differences in grain yield across the modules (Table 2.44). BC ratio was high (9.27) in Farmers practices which was mainly due to low cost of cultivation.

At **Pattambi**, stem borer, gall midge, leaf folder, whorl maggot, case worm and blue beetle damage was observed (Table 2.45). However, the incidence of dead hearts, gall midge, case worm and blue beetle was too low to draw valid conclusions. Whorl maggot damage was significantly low in farmers' practices (1.0 – 2.8%) as compared to other IPM modules (2.1 – 6.4%). Leaf folder damage, though low (<5%), was significantly different across the modules with the lowest damage in IPM I module (0.6 – 1.8%). Maximum yield was obtained from IPM III (3280 kg/ ha) and was at par with IPM II (2933 kg/ ha). Benefit cost ratio was better in IPM III (2.79) followed by IPM II (2.57). Low BC ratio (1.19) was obtained in farmers practice due to low yield and high cost of cultivation.

*Assessment of IPM modules at Pattambi and Karjat during rabi 2010 revealed that the general pest incidence was low to draw valid conclusions. However, whorl maggot damage was low in farmers' practices as compared to other IPM modules. At Pattambi, higher grain yield was obtained from IPM III module as compared to farmers practices.*

Table 2.43: Pest management practices followed in different OIPM modules at various locations (OIPM), rabi 2010

Locations	IPM Module I (Insecticide based module)	IPM Module II (Non- insecticide based Module)	IPM Module III (Combination of IPM modules 1 & 2)	Farmers practice (FP)
<b>KARJAT</b>	Variety = Karjat -3  i) Summer ploughing ii) Clipping of leaf tips of seedlings before planting iii) Application of Carbofuran 3 G @ 16.5 Kg /ha two times iv) Fertilizer dose (NPK) : 100:50:50	Variety = Ratna  i) Summer ploughing ii) Clipping of leaf tips of seedlings before planting iii) Growing stem borer tolerant variety- Ratna iv) Fertilizer dose (NPK) : 100:50:50 v) Installation of 20 pheromone traps /ha. and changing the lure 3 times at 25 days interval starting from 15 DAT	Variety = Karjat -3  i) Summer ploughing ii) Clipping of leaf tips of seedlings before planting iii) Application of carbofuran 3 G @ 16.5 Kg /ha, two times iv) Fertilizer dose (NPK) : 100:50:50 v) Installation of 20 pheromone traps /ha. and changing the lure 3 times at 25 days interval starting from 15 DAT	Variety = Karjat -3  i) Summer ploughing ii) Growing high yielding variety- Karjat – 3 iii) Conventional farmers practices iv) Fertilizer dose (NPK) : 100:0:0
<b>PATTAMBI</b>	Variety = Uma  i) Fertilizer dose (NPK) : 90:45:45 ii) Application of carbofuran @ 1000g ai/ ha iii) Application of cartap hydrochloride 50 SP @ 5 kg/ acre at 75 DAT iv) Spray with Flubendiamide at 25, spray with Acephate at 55 and 65 DAT and Methylparathion at 85 DAT	Variety = Uma  i) Fertilizer dose (NPK) : 90:45:45 ii) Seed treatment with Pseudomonas iii) Spray with Eco-neem 1% at 25 DAT, 35, 45, 55, 65, 75 and 85 DAT iv) Six releases each with <i>T. japonicum</i> and <i>T. chilonis</i> against rice stem borer and leaf folder Pheromone traps for stem borer @ 8 traps / acre	Variety = Uma  i) Fertilizer dose (NPK) : 90:45:45 ii) Seed treatment with Pseudomonas iii) Application of carbofuran @ 1000g ai/ ha iv) Spray with Flubendiamide at 20, Eco-neem at 45 DAT, Acephate at 55 DAT, Delfin at 75 DAT and Methylparathion at 85 DAT v) Six releases each with <i>T. chilonis</i> against leaf folder Pheromone traps for stem borer @ 8 traps / acre	Variety = Uma  i) Fertilizer dose (NPK) : 70 kg Factomphos, 50 kg Urea and 15 kg Potash. ii) Application of carbofuran @ 1000g ai/ ha iii) Application of Furadan @ 7 kg/ acre at 25 and 75 DAT. iv) Spray with Lambdacyhalothrin at 25 and 45 DAT, Triazophos at 55 and 65 DAT, Quinalphos at 75 DAT and methylparathion at 85 DAT

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Table 2.44: Insect pest incidence, grain yield and benefit cost ratio in **OIPM** trial at **Karjat, Rabi 2010**

	<b>% DH 45 DAT</b>	<b>% WE Pre harvest</b>	<b>Yield kg/ha</b>	<b>Gross returns</b>	<b>Cost of cultivation</b>	<b>Net returns</b>	<b>BCR</b>
<b>IPM I</b>	0.1(0.8)a	0.3(0.9)ab	8580a	82368	12249	70119	<b>6.72</b>
<b>IPM II</b>	0.8(1.1)b	0.0(0.7)a	8720a	83712	11242	72470	<b>7.45</b>
<b>IPM III</b>	0.6(1.0)ab	1.1(1.2)bc	8853a	84989	13189	71800	<b>6.44</b>
<b>FP</b>	1.0(1.2)b	1.4(1.4)c	8427a	80899	8730	72169	<b>9.27</b>
<b>CV (%)</b>	15.27	19.71	7.80				

**Price of Paddy = Rs. 960/ q**

Figures in a column followed by different letters are statistically significant at p = 0.05

BCR = Benefit cost ratio (Gross returns / cost of cultivation)

Table 2.45: Insect pest incidence, grain yield and benefit cost ratio in **OIPM** trial at **Pattambi, Rabi 2010**

	<b>SB % WE Pre harvest</b>	<b>WHORL MAGGOT</b>			<b>LEAF FOLDER</b>		<b>Yield kg/ ha</b>	<b>Gross returns</b>	<b>Cost of cultivation</b>	<b>Net returns</b>	<b>BCR</b>
		<b>% DL</b>	<b>% DL</b>	<b>% DL</b>	<b>% DL</b>	<b>% DL</b>					
		<b>15 DAT</b>	<b>35 DAT</b>	<b>55 DAT</b>	<b>25 DAT</b>	<b>35 DAT</b>					
<b>IPM I</b>	18.6(4.3)b	6.4(2.6)c	2.8(1.8)a	3.2(1.9)b	1.8(1.4)a	0.6(1.0)a	2610b	36540	15200	21340	<b>2.4</b>
<b>IPM II</b>	19.4(4.4)b	5.4(2.4)bc	2.0(1.5)a	2.7(1.8)b	3.6(2.0)bc	3.1(1.9)bc	2933ab	41062	15980	25082	<b>2.57</b>
<b>IPM III</b>	11.1(3.4)a	3.7(2.0)ab	4.9(2.3)b	2.1(1.6)b	5.1(2.4)c	4.9(2.3)c	3280a	45920	16480	29440	<b>2.79</b>
<b>FP</b>	11.1(3.4)a	2.6(1.7)a	2.8(1.8)a	1.0(1.2)a	3.1(1.8)ab	1.8(1.5)b	1507c	21098	17750	3348	<b>1.19</b>
<b>CV (%)</b>	14.7	18.03	17.47	17.12	22.86	19.74	11.65				

**Price of Paddy = Rs. 1400/ q**

Figures in a column followed by different letters are statistically significant at p = 0.05

BCR = Benefit cost ratio (Gross returns / cost of cultivation)

**APPENDIX I**

**Scientists involved in coordinated programme**

**DRR headquarters, Hyderabad:** Drs. J. S. Bentur, G . Katti, V. Jhansi Lakshmi, N.Somasekhar, A. P. Padmakumari, Chitra Shanker & Ch.Padmavathi

**Cooperating centres:**

S. No.	State	Location	Code	Name of the cooperator, Designation
1.	Andhra Pradesh	Rajendranagar	RNR	Dr. N R G Varma Sr. Scientist (Rice)
2.		Maruteru	MTU	Dr. N.Mallikharjuna Rao. Scientist
3.		Nellore*	NLR	Dr. P.Raja Sekhar, Principal Scientist
4.		Ragolu	RGL	Dr. P. Visha Lakshmi, Principal Scientist and Head
5.		Warangal	WGL	Dr. R. sunitha Devi, Scientist
6.	Assam	Titabar	TTB	Dr. K.K. Shaw, Entomologist
7.		North Lakhimpur	NLP	Dr. Prabal Saikia, PS (Entomology)
8.	Bihar	Patna	PTN	Dr. R.B.P. Sinha, Sr. Entomologist
9.		Pusa	PUS	Dr. A. K. Misra, Sr. Scientist (Entomology)
10.	New Delhi	New Delhi*	NDL	Dr. Subhash Chander, Sr. Scientist (Ento.), IARI
11.	Jarkhand	Ranchi	RNC	Dr. Rabindra Prasad, Head, Dept. of Ent.
12.	Gujarat	Nawagam	NWG	Dr. V. J. Patel, Assoc. Res. Scientist (Ent.)
13.		Navsari	NVS	Dr. S. N Gajjar, Associ. Prof. (Entomology)
14.	Haryana	Kaul	KUL	Dr. Laxhi Ram, Entomologist
15.	H.P	Malan	MLN	Dr. A. Srivastava, Sr. Entomologist
16.	J & K	Chatha	CTA	Dr. Rajan Salalia, Asst. Prof.(Ento.)
17.		Khudwani	KUD	Dr. Afzal Bhat, Assoc. Professor (Ento.)
18.	Karnataka	Mandya	MND	Dr. D. K. Sidde Gowda, Entomologist (Rice)
19.		Gangavathi	GGV	Mr. Kiran Kumar, Jr. Entomologist
20.		Brahmavar	BMR	Dr. S. U. Patil, Jr. Entomologist
21.	Kerala	Moncompu	MNC	Dr. M.S. Nisha, Asst. Prof. of Ent.
22.		Pattambi	PTB	Mr. K. Karthikeyan, Asst. Prof. of Ent.
23.	Chattisgarh	Jagdapur	JDP	Dr. A. K. Gupta, Scientist (Ent.)
24.		Raipur	RPR	Dr. Sanjay Sharma, Assoc. Prof. Ent.
25.	M. P	Rewa	REW	Dr. M. R. Dhingra, Entomologist
26.	Maharashtra	Karjat	KJT	Dr. Nilesh Zende, Entomologist (Rice)
27.		Sakoli	SKL	Mr. P.W.Nemade, Jr. Entomologist
28.	Manipur	Iroisemba*	IRS	Dr. K.I.Singh, Professor (Ent.)
29.		Wangbal	WGB	Mr. L. Irabot Singh, Jr. Entomologist
30.	Meghalaya	Upper Shillong	USG	Mr.W.W.Marbaniang, Research Officer
31.	Orissa	Bhubaneswar*	BBN	Dr. S.K.Panda, Professor, Entomology
32.		Cuttack*	CTC	Dr. Mayabini Jena, Principal Scientist (Entomology)
33.		Sambalpur	SBP	Dr. L.K.Rath, Sr. Entomologist
34.	Punjab	Ludhiana	LDN	Dr. P. S. Sarao, Sr. Entomologist
35.	Rajasthan	Kota*	KOT	Dr. N. N. Tripathi, Asstt. Professor (Entomology)
36.	Tamil Nadu	Aduthurai	ADT	Dr. G. Ravi, Entomologist (AICRIP).
37.		Coimbatore	CBT	Dr. S. Suresh, Prof. of Entomology
38.		Madurai*	MDR	R.Nalini, Asst. Professor (Entomology)
39.		Annamalainagar*	ANM	Hari Prasad, Asst Professor (Entomology)
40.	Tripura	Arundhutinagar*	ADN	Dr. Farukul Islam, Asst. Director
41.	U. Territory	Karaikal*	KKL	Dr. D. Adiroubane, Dean & Prof. & Head Entomology
42.	U. Territory	Puducherry	PDC	Mr. J. Krishna Kumar, Jr. Entomologist
43.	Uttar Pradesh	Pantnagar	PNR	Dr. S. N. Tiwari, Prof. of Entomology
44.		Faizabad	FZB	Dr. R. A Singh, Entomologist
45.		Ghaghrahat	GGT	Dr. S. S. Prasad, Assoc. Prof. (Ento.)
46.	West Bengal	Chinsurah	CHN	Dr. C. Gangopadhyaya, Entomologist Dr. S. Islam, Asst. Entomologist
47.		Bankura*	BNK	Mr. Saurav Ghosh, Asst. Entomologist

\* - Voluntary Centre.

**PERFORMANCE OF ENTOMOLOGY CENTRES DURING 2010.**

State	Location	No. of Trials			
		Rabi 2010		Kharif 2010	
		Sent	Recd.	Sent	Recd.
<b>Funded co-operating centers</b>					
Andhra Pradesh	Maruteru	6	1	10	10
	Ragolu	4	3	7	7
	Rajendranagar	4	3	9	9
	Warangal			11	11
Assam	Titabar	3	0	8	5
Bihar	Patna			7	4
	Pusa			9	8
Gujarat	Nawagam			9	9
	Navsari			9	6
Haryana	Kaul			9	9
Himachal Pradesh	Malan			9	9
Jammu & Kashmir	Chatha (R.S.Pura)	2	2	6	5
	Khudwani			6	4
Jharkand	Ranchi			8	8
Karnataka	Mandya	2	0	11	11
	Gangavathi	5	4	8	8
	Brahmavar			8	6
Kerala	Moncompu	7	4	11	11
	Pattambi	8	5	9	9
Chattisgarh	Jagdapur			8	8
	Raipur			13	11
Madhya Pradesh	Rewa			9	7
11Maharashtra	Karjat	5	4	11	10
	Sakoli			8	6
Manipur	Wangbal			8	7
Meghalaya	Upper Shillong			5	2
Orissa	Sambalpur			12	11
Puducherry	Puducherry	2	2	9	8
Punjab	Ludhiana			13	10
Tamil Nadu	Aduthurai	4	0	10	7
	Coimbatore	4	4	11	7
Uttar Pradesh	Faizabad			7	6
	Ghaghrahat			8	8
Uttaranchal	Pantnagar			8	7
West Bengal	Bankura			7	4
	Chinsurah	7	5	10	10
	<b>Total</b>	<b>63</b>	<b>37</b>	<b>321</b>	<b>278</b>

<b>Voluntary centres</b>					
Andhra Pradesh	Nellore	5	1	9	7
Assam	Northlakhimpur			4	0
Manipur	Iroisemba			6	5
Orissa	Cuttack	3	0	4	3
	Bhubaneswar	3	3	7	6
Rajasthan	Kota			7	0
Delhi	New Delhi			4	2
Puducherry	Karaikal	3	2	4	4
Tamil Nadu	Madurai			5	5
	Annamalainagar			4	0
Tripura	Arundhuthinagar	3	3	4	3
	<b>Total</b>	<b>17</b>	<b>9</b>	<b>58</b>	<b>35</b>
<b>Total trials in funded coop. &amp; voluntary centres</b>		<b>80</b>	<b>46</b>	<b>379</b>	<b>313</b>
<b>% Receipt of data</b>		<b>57.5</b>		<b>82.6</b>	
<b>Grand totals for <i>kharif</i> &amp; <i>rabi</i></b>		<b>459</b>	<b>359</b>		
<b>% Receipt of data (overall)</b>		<b>78.2</b>			

**List of abbreviations**

<b>Pests</b>		
AW	:	Army worm
BB	:	Blue beetle
BPH	:	Brown planthopper
B+WBPH	:	Mixed populations of BPH and WBPH
CW	:	Case worm
Cocc.	:	Coccinellids
Cofan.	:	<i>Cofana spectra</i>
GB	:	Gundhi bug
GLH	:	Green leafhopper
GHC	:	Green horned caterpillar
GMB	:	Gall midge biotype
GRH	:	Grass hopper
LDP	:	Leaf damaging pests
LF	:	Leaf folder
MB	:	Mirid bug
MLB	:	Mealy bug
N.n	:	<i>Nephotettix nigropictus</i>
N.v	:	<i>Nephotettix virescens</i>
N.ve	:	<i>Nezara viridula</i>
OP	:	Other planthoppers
OSB	:	Other stem borers
PH	:	Planthoppers
SBDH	:	Stem borer dead heart stage
R.d	:	<i>Recilia dorsalis</i>
RH	:	Rice hispa
RT	:	Rice thrips
SBWE	:	Stem borer white ear stage
WB	:	Water bug
WBPH	:	Whitebacked planthopper
WLH	:	White leafhopper
WM	:	Whorl maggot
YSB	:	Yellow stem borer
PSB	:	Pink stem borer
<b>Units of damage etc.,</b>		
ADL	:	Average damaged leaves
a.i.	:	Active ingredient
Av.No./AN	:	Average number
BCR	:	Benefit cost ratio
CPP	:	Cost of plant protection
DG	:	Damaged grain
DH	:	Dead hearts
DL	:	Damaged leaves
DP	:	Damaged plants
DS	:	Damage score
DAT/DT	:	Days after transplanting
FR	:	Field reaction
GH	:	Greenhouse reaction
HB	:	Hopper burn
HBP	:	Hopper burned plants
IOC	:	Increase over control
No./10h	:	Number per 10 hills
NP	:	Net profit
NPT	:	Number of promising tests
NT	:	Not tested
PLD	:	Promising level of damage
PM	:	Pest management
RF	:	Rainfall
RH	:	Relative humidity
SS	:	Silver shoots
SSH	:	Sunshine hours
WE	:	White ears

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