2. ENTOMOLOGY

INTRODUCTION

Rice crop being the major food crop of India, any constraint or factor adversely affecting its yield and production has significant impact on the country's economy. Among the biotic stresses, insect pests continue to be the major factors influencing rice production across the diverse rice ecosystems in the country.

Real time pest incidence is being regularly monitored through Pest Survey Reports (PSR) generated at fortnightly interval from AICRIP centres. In 2014, severe incidence of stem borer was recorded at Karaikal and moderate to severe incidence of brown planthopper (BPH) was observed in Telangana region (Nalgonda dist.) during the first quarter (January to March). The stem borer incidence continued at Karaikal, while at Aduthurai, Coimbatore and Nellore moderate to severe leaf mite infestation was recorded during the second quarter (April to June). During the early period of *kharif* season coinciding with the third quarter (July to September), there were outbreaks of hispa in Malan (Himachal Pradesh) and black bug at Aduthurai. There was severe incidence of yellow stem borer and leaf folder at Pantnagar and Ludhiana, planthoppers at Nellore and Ludhiana, cutworm at Pattambi and swarming caterpillar at Raipur. In the last quarter of the year (October to December), planthopper outbreaks were observed at Gangavathi, Nellore, Mandya and Karaikal, while Coimbatore centre recorded outbreak of leaf folder pest. Severe planthopper damage was also reported from 6 centres across the country in southern (Maruteru, Ragolu, Warangal, Pattambi and Aduthurai), central (Jagdalpur) and north eastern region (Titabar). Severe incidence of yellow stem borer (Jagdalpur, Malan, Mandya, and Aduthurai), leaf folder (Chinsurah and Warangal), gall midge (Jagdalpur) as well as leaf & panicle mite (Rajendranagar) was also widespread.

These relentless pest infestations continue to pose challenges to the rice entomologists trying to find out ways and means to break these barriers for realizing potential yields through carrying out studies under the All India Coordinate Rice Improvement Programme (AICRIP). The major efforts of the entomologists at both DRR and its cooperating centres are directed towards holistically tackling the pest problems through a multi pronged approach involving mainly host plant resistance and other bio intensive strategies along with need based of insecticides as a last resort. Cost effectiveness and ease of adoption by the rice farmers continue to be the key yardsticks for consideration during development of the location specific IPM strategies.

Like in previous years, Coordinated Entomology programme maintained its focus on Host plant resistance screening programme with prime objective of identification of sources resistant to mainly gall midge and planthoppers. However, the programme also involved intensive multilocation screening of various nominated entries and germplasm accessions from different states to identify multiple pest resistant sources. The promising sources are being prioritized for further studies to incorporate their traits into other elite entries with higher yield potential under the breeding programme or for advanced genetic analysis.

Chemical control studies also merit attention because pesticides remain the most viable options for the farmer in case of pest outbreaks and they can also be cost effective if suitably integrated into the pest management framework. In the last few years newer chemicals with novel modes of action have been identified and in this year the trials targeted identification of chemicals which are most effective against group of pests and also their safety to natural enemies.

Ever since the climate change scenario has acquired global proportions, changes in cropping patterns and agronomic practices seem to have followed suit leading to newer ecological challenges in rice ecosystem. In this regard, ecological studies on insect pests have been initiated to understand the impact of changing rice cultivation techniques including planting time, method as well as other intercultivation practices on pest incidence. Assessment of crop losses due to major insect pests was also continued through field trials generating reliable data on quantifying yield losses in rice due to stem borer and leaf folder. Enhanced understanding of pest and natural enemy diversity is being attempted through regular monitoring of species composition across rice ecologies.

Ecological engineering has in recent times shown to be of promising and potential value within the confines of eco-friendly rice IPM. Hence, systematic evaluation of ecological engineering for planthopper management in field was continued particularly at centres located in planthopper endemic areas. Integrated pest management can be successful at farmers level if followed in a holistic way of addressing to multi pest problems through multi pronged approach. This requires multidisciplinary efforts of Entomology, Pathology and Agronomy researchers combined with on farm trials in farmers' participatory mode. Efforts were made to carry out multi location special IPM trials to validate location specific IPM practices *vis a vis* farmers practices.

Short and long term assessment of pest populations through light trap catches were also persisted with to generate relevant data base for pest forecasting in future. This year a new light trap was evaluated for its performance compared to the existing local light trap at different centres.

The following report summarizes the significant findings from the glass house evaluations and field trials carried out at DRR and its cooperating centres under AICRIP during 2014.

2.1 HOST PLANT RESISTANCE STUDIES

Identification and delineation of new sources of resistance to major insect pests is the prime objective of host plant resistance studies. These include glass house and multi location field trials to screen and evaluate the performance of germplasm accessions, breeding lines as well as characterization of insect pest populations from various hot spots. Six 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) Multiple Resistance Screening Trial (MRST) and vi) National Screening Nurseries (NSN) were constituted and conducted during *Kharif* 2014. In all, 1493 entries were evaluated at 41 locations against 14 pests and 51 entries (3.6%) were identified as promising. The detailed pest reaction of all the entries in each trial is presented in a separate volume **"Screening Nurseries: – Diseases & Insect Pests".**

i) Planthopper screening trial (PHS)

This trial was constituted with 95 entries comprising of 3 breeding lines developed at TNRRI, Aduthurai, TNAU, 10 breeding lines developed at RRU, Bapatla, ANGRAU, 13 breeding lines and 4 hybrids from Coimbatore, TNAU, 28 breeding lines developed at DRR, Hyderabad, 3 breeding lines of Moncompu, KAUM, 1 breeding line developed at CRRI, Cuttack, 7 breeding lines developed at APRRI, Maruteru, ANGRAU, 3 breeding lines from ARI, Rajendranagar, 1 introgression line from *O. rufipogon*, 11 germplasm accessions from North East region, along with two resistant checks PTB 33 (against BPH) and MO1 (against WBPH) and one susceptible check TN1. Of these, seven entries were under retesting. The entries were evaluated at 14 locations across the country against brown planthopper (BPH), whitebacked planthopper (WBPH) and mixed populations of planthoppers under both field and greenhouse conditions.

Evaluation of entries in 7 greenhouse and 2 field tests against brown planthopper, 2 greenhouse and two field tests against whitebacked planthopper and 3 field tests against mixed populations of planthoppers revealed that 7 breeding lines *viz.*, IR 65482-7-216-1-2-B, CR 2711-149, KAUM 179-1, KAUM 179-2, KAUM 182-1, RP 2068-18-3-5, RP 5707-432-4-6-8-1 and one germplasm accession Kushal as promising in 5-9 tests (**Table2.1**). The susceptible check TN1 recorded damage score in the range of 8.2-9.0 in these valid tests. Of these, six entries *viz.,* IR 65482-7-216-1-2-B, CR 2711-149, KAUM 179-1, KAUM 179-2, KAUM 182-1 and RP 2068-18-3-5, were under retesting and hence the resistance was confirmed during the second year of testing. The universal check PTB 33 performed well in 9 tests. The introgression line IR 65482-7-216-1-2-B from *Oryza australiensis* carrying *Bph 18* gene performed well in 5 tests at Cuttack, Mandya, Coimbatore (BPH and WBPH) and Ludhiana.

At Coimbatore, the entries were screened for their reaction to green leafhopper. The entries CR 2711-149, TRG 167, Kushal, Ratkhara were found promising with a damage score of 1.

Among the planthoppers, only BPH population was present throughout the crop season at Aduthurai, Rajendranagar, Raipur, whereas only WBPH population was prevalent at Kaul and Nawgam. Mixed population of planthoppers were recorded at Pantnagar, Gangavathi, Maruteru and Wangbal. At Maruteru, BPH and WBPH populations were present in equal ratio (1:1) at 68 days after transplanting, while at Gangavathi proportion of WBPH population was more (>1.4-1.6 times more than BPH) throughout the season. At Pantnagar, BPH population gradually prevailed over WBPH, whereas, at Wangbal WBPH was predominant over BPH (1.3:1.0).

*Evaluation of the entries against the two planthoppers BPH and WBPH in 9 greenhouse and 7 field tests indicated 8 entries as promising in 5-9 tests (***Table 2.2)***. Four breeding lines - CR 2711-149, KAUM 179-1, KAUM 179-2 and KAUM 182-1 showed consistent resistance reaction during second year of testing.*

ii) Gall midge screening trial (GMS)

The trial was constituted with 80 entries (73 breeding lines developed at 7 centres along with 5 checks) and evaluated at 13 locations.

Analysis of the data revealed that 18 lines had nil damage at both DRR and Jagdalpur (Biotype1). Six entries had nil damage at Ranchi and Jagtial where the population was designated as biotype 3. At Sakoli, 25 entries showed nil damage. JGL 19618 was promising at Warangal (biotype 4M). JGL 20171, JGL 20753, NP 3113-7 and RNR 17494 had nil damage at both Moncompu and Pattambi (biotype 5). At Iroisemba, 32 entries showed no damage.

*Overall, evaluation of 73 entries along with 7 checks at 9 locations in one greenhouse and 8 field tests against 6 designated biotypes helped in identification of six entries as promising in 6-7 tests (***Table 2.3***). Of these, 4 were under retesting. Another six entries were promising in 5 tests.*

Table 2.1 Promising entries against Panthoppers in PHS, kharif 2014

PHS No.	Designation	cross combination	Brown planthopper									Whitebacked planthopper				Planthoppers		
			Greenhouse reaction							Field reaction		Greenhouse reaction		Field reaction		Field reaction		
			DRR	ADT	CBT	CTC	LDN	MND	PNR	RNR 98DT	RPR 80DT	DRR	CBT	KUL 80DT	NWG 64DT	GGV 60DT	MTU 68DT	PNR 80DT
			DS	DS	DS	%DP	DS	DS	DS	DS	DS	DS	DS	No./5hills	No./10h	No./10h	DS	No./10h
29	CR 2711-149*	Tapaswini/Dhobanumberi	4.8	5.0	1.0	8.0	5.0	5.0	5	7	7	4.8	5.0	32	146	405	3.0	77
31	IR 65482-7-216-1-2-B*	IR 31917-45-3-2-2*3/*O.australiensis*	7.0	9.0	3.0	4.0	3.6	5.0	7	9	9	5.1	3.0	28	74	1812	9.0	66
32	KAUM 179-1*	Thavalakkannan/ Uma	5.0	9.0	5.0	0.0	5.1	5.0	5	9	7	7.2	9.0	31	32	381	3.0	72
33	KAUM 179-2*	Thavalakkannan/ Uma	4.7	9.0	5.0	0.0	5.0	5.0	1	9	7	7.8	9.0	20	28	197	3.0	58
34	KAUM 182-1*	Gouri/ Thavalakkannan	5.0	9.0	5.0	0.0	3.2	9.0	1	9	7	7.7	9.0	24	36	1554	7.0	59
47	RP 2068-18-3-5*	Swarnadhan/V. cheera	5.0	9.0	7.0	4.0	3.0	5.0	5	NT	7	6.5	7.0	44	42	507	5.0	49
60	PTB 33	Land race	1.7	5.0	3.0	88.0	NG	7.0	NT	5	3	5.5	5.0	NT	26	156	1.0	0
69	RP 5707-432-4-6-8-1	Sambamahsuri /CR1244-1246-1-605-1	9.0	9.0	5.0	100.0	9.0	5.0	9	9	3	5.0	3.0	55	26	379	5.0	59
91	VPB-231	Kushal	3.8	5.0	1.0	64.0	8.9	5.0	7	9	3	8.2	9.0	63	34	1546	9.0	64
Total tested			94	95	93	90	88	94	91	87	95	95	93	93	95	89	94	95
Max. in trial			9.0	9.0	9.0	100.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	74	174	2965	9.0	145
Min. in trial			1.4	5.0	1.0	0.0	3.0	3.0	1.0	3.0	1.0	1.7	1.0	16	20	27.0	1.0	0
Average damage in trial			7.9	8.5	6.5	77.7	7.9	7.1	8.3	8.1	6.4	7.2	7.2	48	67	980.0	7.2	66
Average damage in TN1			9.0	9.0	9.0	98.0	9.0	8.2	9.0	9.0	8.6	9.0	9.0	64	87	1942	9.0	70
Promising level			5	5	3	10	5	5.0	5	5	3	5	3	24	30	200	3	40
No. of Promising entries			7	6	16	12	8	6	7	12	16	8	5	12	15	14	13	7

* Entry under retesting.

Table 2.2 Performance of most promising entries against planthoppers in PHS Kharif 2014

PHS No.	Designation	Cross Combination	Number of promising tests (NPT) against					TOTAL NPT (16)
			BPH		WBPH		PH	
			GR (7)	FR (2)	GR (2)	FR (2)	FR (3)	
29	CR 2711-149*	Tapaswini / Dhobanumberi	7	0	1	0	1	9
31	IR 65482-7-216-1-2-B*	IR 31917-45-3-2-2*3/O.australiensis	4	0	1	0	0	5
32	KAUM 179-1*	Thavalakkannan/ Uma	4	0	0	0	1	5
33	KAUM 179-2*	Thavalakkannan/ Uma	5	0	0	2	2	9
34	KAUM 182-1*	Gouri/ Thavalakkannan	4	0	0	1	0	5
47	RP 2068-18-3-5*	Swarnadhan/V. cheera	5	0	0	0	0	5
60	PTB 33	Land race	3	2	0	1	3	9
69	RP 5707-432-4-6-8-1	Sambamahsuri /CR 1244-1246-1-605-1	1	1	2	1	0	5
91	VPB-231	Kushal	4	1	0	0	0	5

* Entry under retesting

iii) Gall midge special screening trial (GMSS)

The trial was constituted with 47 promising donors and eight checks and evaluated at 12 locations against 6 different biotypes of gall midge. COGR-2, ACC 4740, ACC 5403 and IC 578133 had nil damage for biotype 1 at both DRR and JDP. IC545441, IET 21842, IET22698 did not show any damage due to biotype 2 at Cuttack. At Ranchi 11 lines had nil damage but at Jagtial, 5 lines had nil damage against biotype3. IC 577224, Kavya, and IC 466408 showed no damage at Moncompu. IET 22698, W1263, Kavya, Madhuri L9 and COGR2 had <10% DP for biotype 5 at Pattambi. IC462336 and IET 22096 were promising at Sakoli apart from W1263 and Aganni. IC Nos 545528,462336,466408 and 578133 had <10% DP at Warangal for biotype 4M.

*Evaluation of donors in this trial against six different gall midge biotypes in 2 greenhouse and 7 field reactions helped in identification of IC 578133, COGR-2, and IET 22698 as promising in 3-4 tests (***Table 2.4***). IC 578133 is the new source of resistance identified this year.*

Table 2.3 Reaction of promising cultures against gall midge populations in GMS, *kharif* 2014

Entry No.	Designation	Cross	Per cent plant damage against									Overall NPT
			GMB1	GMB?	GMB3		GMB4	GMB4M	GMB5		GMB 6	
			DRR	JDP	RNC	JGL	SKL	WGL	MNC	PTB	IRS	
			GR	Field Reaction								
			-	50DT	50DT	50DT	50DT	49DT	50DT	30DT	50DT	9
72	KNM 637*	MTU 1010/JGL 3855	0.0	0.0	0.0	0.0	0.0	75.0	10.0	0.0	0.0	7
73	NP 3113-7*	NSPG 1833/NSPG 30	0.0	0.0	0.0	0.0	0.0	55.0	0.0	0.0	10.0	7
33	JGL 21062	MTU 1010/JGL 11470	0.0	0.0	15.0	0.0	0.0	50.0	0.0	19.1	0.0	6
65	KNM 113*	MTU 1010/JGL 13595	0.0	0.0	0.0	0.0	0.0	45.0	10.0	4.8	0.0	6
68	KNM 539*	JGL 11727/JGL 11470	0.0	0.0	25.0	0.0	0.0	80.0	0.0	14.3	0.0	6
77	RNR 17494	MTU 4870/JGL 1798	25.0	0.0	25.0	0.0	0.0	60.0	0.0	0.0	0.0	6
	Check											
50	AGANNI		0.0	0.0	0.0	0.0	0.0	0.0	10.0	38.1	20.0	6
10	KAVYA		100.0	0.0	0.0	0.0	0.0	85.0	10.0	15.8	0.0	5
Total tested			67	78	80	78	78	76	80	73	80	
Average damage in TN1			61.9	66.7	50.0	50.0	63.3	81.7	60.0	59.5	46.7	
Average damage in the trial			47.7	22.2	18.9	10.2	19.8	67.5	23.1	27.2	17.2	
Promising level			0	0	0	0	0	0	0	0	0	
No of Promising lines			27	41	15	33	26	2	21	7	33	

* Entry under retesting

Data from Sambalpur, Brahmavar, Maruteru and Ragolu were not considered for analysis due to low pest incidence

Table 2.4 Reaction of donors against gall midge populations in GMSS, kharif 2014

Entry No.	Designation	GMB1	GMB?	GMB2	GMB3		GMB5		GMB4	GMB4M	Overall NPT
		DRR	JDP	CTC	JGL	RNC	MNC	PTB	SKL	WGL	
		GR	FR	GR	Field Reaction						
		-	50DT	-	50DT	50DT	50DT	30DT	50DT	50DT	9
		%DP	%DP	% SS	%DP	%DP	%DP	%DP	%DP	%DP	
5	COGR-2	0.0	0.0	8.0	15.0	0.0	40.0	9.5	30.0	75.0	4
54	IC 578133	0.0	0.0	32.0	0.0	20.0	20.0	65.0	15.0	5.0	4
45	IET 22698	71.4	0.0	0.0	5.0	30.0	40.0	10.0	20.0	15.0	3
52	Aganni	0.0	0.0	0.0	0.0	0.0	40.0	NT	0.0	0.0	7
20	W1263	0.0	30.0	12.0	16.6	0.0	20.0	0.0	0.0	15.0	4
49	RP 2068-18-3-5	0.0	0.0	16.0	0.0	15.0	70.0	66.7	10.0	10.0	4
51	Abhaya	0.0	0.0	100.0	0.0	0.0	70.0	23.8	65.0	95.0	4
48	Kavya	0.0	0.0	84.0	0.0	0.0	0.0	4.8	15.0	95.0	6
11	Madhuri 9	0.0	10.0	24.0	16.6	0.0	60.0	9.5	15.0	75.0	3
Total tested		49	55	55	55	55	54	54	55	55	
Average damage in TN1		86.2	77.5	73.0	52.6	60.0	77.5	77.0	70.0	85.0	
Promising level		0	0	0	0	0	0	0	0	10	
No.promising		12	11	4	5	11	3	5	4	6	

Data from Ragolu and Brahmavar were not considered for analysis.

iv) Leaf folder Screening Trial (LFST)

The trial was constituted with 60 entries including W 1263 as resistant check and TN1 as susceptible check. During *Kharif* 2014, the trial was conducted at 17 locations across the country, of which, augmented field screening was done at 16 locations while at Malan, both field and net house screening was done with augmentation and at one location i.e., Ludhiana, only net house screening was done.

Data analysis from 9 valid field tests revealed that 8 entries were promising (**Table 2.5**). MTU 1162 and RP Bio 4918-24k were found promising in 4 out of 9 valid tests while 6 entries, *viz.,* IET 22222, IET 22155, JGL 21133, JGL 21828, MTU 1155 and MTU 1160 were found promising in 3 out of 9 valid field tests. The average damage in the trial ranged between 6.9 and 36.2% across locations. Net house screening data from Malan and Ludhiana revealed that 2 entries (IET 22155 and IET 22449) were promising in both the valid tests. IET 22155 was found promising in both field screening (3 out of 9 valid tests) and net house screening (2 out of 2 valid tests).

Evaluation of 60 entries against leaf folder in the field revealed that MTU 1162 and RP Bio 4918-24k were found promising in 4 of 9 valid field tests and 6 entries, viz., IET 22222, IET 22155, JGL 21133, JGL 21828, MTU 1155 and MTU 1160 were promising in 3 of 9 valid tests. IET 22155 was found promising in both field (3 of 9) and net house (2 of 2) valid tests.

Table 2.5 Promising entries identified against leaf folder in LFST, *kharif* 2014

LFST No.	DESIGNATION	Field screening									Field	Net house screening		Net house
		CHN	PDC	CHT	MLN	KUL	PTB	NWG	NVS	JDP		LDN	MLN	
		40 DAT	79 DAT	62 DAT	95 DAT	75 DAT	45 DAT	78 DAT	60 DAT	60 DAT	NPT 9	80 DAT	99 DAT	NPT 2
2	IET 22222	4.9	7.7	25.5	31.1	10.5	8.4	11.3	4.2	1.1	3	9.9	33.2	1
5	IET 22155	1.5	14.8	28	36	16.2	9.3	9.5	7	2.7	3	3	23.7	2
33	JGL 21133	9.1	4.8	26.7	23.5	29.8	15.3	29.6	3	3.5	3	100	41.5	0
36	JGL 21828	4.7	5.4	32.5	39.8	41.3	12.3	9.5	13.5	0.2	3	94	50.3	0
47	MTU 1155	5.8	6.6	26.2	36.8	21.8	11.6	9.9	4.3	4.3	3	100	44.6	0
51	MTU 1160	4.3	5.6	27.3	33.6	26.6	16.5	9.4	3.7	11.7	3	100	50.5	0
52	MTU 1162	6.2	7.2	24.9	36.3	20.5	7.3	8.8	3.5	0.2	4	19.1	81.6	0
56	RP Bio 4918-24K	6.7	7.5	23.4	25	16.2	4.9	18.6	3.1	1.6	4	40.2	41	0
11	IET 22449	8.3	16.6	27.9	56.4	23.0	5.8	14.1	6.7	14.4	0	5.8	22.1	2
Total Tested		59	60	60	59	59	59	60	59	60		59	59	
Avg. damage in TN 1		6	14.6	31.1	24.5	53.2	8.4	32.4	21.1	10.7		96.9	40.5	
Av. Damage in W 1263		5.3	13.9	28.9	21.3	11.1	7.2	15.8	3.4	3.7		23.6	26.1	
Promising level		5	5	25	20	10	5	10	5	5		10	25	
No. Promising		10	1	5	1	2	3	11	13	17		4	7	

Data from Aduthurai, Faizabad, Gangavathi, Karjat, Rajendranagar, Nellore and Pantnagar was not considered for analysis due to low pest pressure.
Data from Madurai could not be included for analysis due to late receipt.

v. Multiple pest resistance screening trial (MRST)

The trial was constituted with 35 entries (32 + 3 checks) and evaluated against various pests at 31 locations. The pest-wise reaction for each of the entries are given in a separate volume "Screening nurseries-diseases and Insect pests". The summary of the evaluation of this trial is discussed pest wise (**Table 2.6**) as under:

Brown planthopper: CR 3006-8-2 was the promising entry in 3 of the 6 valid tests. The check varieties PTB 33 and RP2068-18-3-5 were promising in 2 tests. In the replicated trial across locations, CR 3006-8-2 and RP 4918-228(S) had significantly low damage compared to other entries.

White backed planthopper: RP Bio 4918-50-13 was moderately tolerant to WBPH at DRR and resistant at CBT.

Mixed populations of BPH and WBPH: RP4918-228(S) was promising in the field evaluations at Maruteru and Gangavathi where the ratio of BPH to WBPH was 1:1 and 1: 2.5, respectively.

Green leafhopper : RP 5588-B-B-B-B-63, RP 5588-B-B-B-B-76 and RP Bio 4918-142 had a damage score (DS) of 1.0 at CBT. RP 5587, RP 5588-B-B-B-B-116, RP 5588-B-B-B-B-177-2, RP 5715-322-3-1-1, RP Bio 4918-24K, RP Bio 4918-50-13, RNT 14-1-1-2-2 and RTN 42-1-1-1 showed DS of 3.0.

Gall midge: JGL 19618 (biotype1, 2 & 3) and CR 1898-32-69-CN12-2 (biotype1 & 2) were promising in 2-3 tests of the 6 tests against 5 biotypes.

Stem borer: RP 5587-B-B-B-258-1, RP 5588-B-B-B-B-32, RP 5588-B-B-B-B-63, were promising in 3-5 of the 6 tests out of 21 valid tests for stem borer at both vegetative and reproductive phase of plant growth.

In the replicated trial across locations, the dead heart damage in Suraksha and, RP5715-322-3-1 was <10% DH though they were statistically not significantly different from other entries except TN1. RP Bio 4918-268, RP Bio 4918-268, CR 1898-32-69-CN 12-2 had <10% damage, however there were no significant differences between these and 10 other test entries.

Leaf folder: RP 5588-B-B-B-B-76 was promising in 2 tests of the 6 valid tests against leaf folder at 50 DAT. In a replicated trial conducted across two locations, RP5588-BBBB177-2 and RNT 42-1-1-1 had <10 % DL.

Whorl maggot: RP 5587-B-B-B-267-1 had <5% damage for whorl maggot at Chinsurah.

Case worm: The leaf area damage by case worm across entries in the trial varied from 17-73.3 % at Brahmavar at 28DT.

Other pests: None of the entries were promising for gundhi bug (10-30 %DG) or leaf damaging pests.

Table 2.6 Performance of most promising cultures against insect pests in MRST, *Kharif* 2014

Entry No.	Designation	Cross	Number of promising tests against												No of promising		MRI	PPR
			BPH	WBPH	BPH+WBPH	GLH	GM	SBDH	SBWE	LF	WM	LDP	CW	GB	Tests	Pests		
			6	2	2	1	6	9	12	6	3	2	1	1	51	10	510	
1	CR 1898-32-69-CN 12-2	Selection	0	0	1	0	2	1	1	1	0	0	0	0	**6**	5	30	5.9
3	CR 3006-8-2*	Pusa 44/Salkathi	3	0	0	1	1	1	0	0	0	0	0	0	**6**	5	30	5.9
24	RP Bio 4918-142	Swarna/*O. nivara*	0	0	1	1	0	1	1	1	0	0	0	0	**5**	5	25	4.9
7	RP 4918-228(S)*	Swarna/*O. nivara*	1	0	2	0	1	0	0	1	0	0	0	0	**5**	4	20	3.9
5	JGL 19618*	JGL 11609/Abhaya	0	0	0	0	3	1	1	0	0	0	0	0	**5**	3	15	2.9
21	RP 5588-B-B-B-B-63	IR64 X IR75870-5-8-5-B-1-B	0	0	0	1	0	2	2	0	0	0	0	0	**5**	3	15	2.9
13	RP 5587-B-B-B-258-1	IR64 X IR75870-5-8-5-B-2-B	0	0	0	0	0	2	3	0	0	0	0	0	**5**	2	10	2.0
	Checks																	
34	W 1263 (CBT)	-	1	0	0	0	2	2	2	1	0	0	1	0	**9**	6	54	10.6
20	RP2068-18-3-5		2	0	1	0	1	1	1	1	0	0	0	0	**7**	6	42	8.2

* Entry under retesting

$ LDP- leaf damaging pests (LF +WM & LF +GRH)

Data on BPH from NVS, WBPH from KUL, gall midge from RGL, MDR, CBT,ADT, BRM, ; SBDH from NVS, CBT, PDC, PUS, RGL, RNC, RPR, SKL, WGL, RNR, MDR; white ear data from PDC, ADT, GGV, RNC , BMR, LDN. RNR and WGL; leaf folder damage from CHN, ADT, GGV, JDP, NLR, NVS, PDC, PNR, PUS, RGL, RPR; GLH data from JDP was not considered for analysis for want of sufficient pest pressure.

Overall, evaluation of 35 entries in 9 greenhouse and 42 field reactions in 51 valid tests across 31 locations against 10 pests helped in identification of 7 entries which were promising in 5-6 tests against 2-5 pests. The multiple pest resistance index varied from 10-30 with a PPR of 2.0 to 5.09. CR3006-8-2, RP 4918-228(S) and JGL 19618 were promising in this second year of testing.

vi) National Screening Nurseries (NSN)

National screening Nurseries (NSN) comprises of 4 trials, NSN1, NSN2, NSN hills and NHSN. NSN1 was constituted with 254 entries (231 breeding lines+ 23 checks) and evaluated in 20 locations. NSN2 trial was constituted with 652 entries (629 from IVT +23 checks) and evaluated at 12 locations. NSN hills consisted of 89 entries along with 23 checks and evaluation was done at 8 locations against 9 pests. NHSN trial was constituted with 150 entries (130 hybrids and 20 checks) and carried out at 20 locations. The details of the pest reaction for all the entries are given in a separate volume “Screening Nurseries- Diseases and Insect pests”. The trials are discussed pest wise.

Brown planthopper:
NSN1: IET 23739(NSN1-51) was promising in 3 of the 5 tests against BPH.
NSN2: All the test entries were susceptible.
NSN hills: IET 24180, 24184 and 24230 had DS of 3.0 at Coimbatore but they were highly susceptible at both DRR and LDN.
NHSN: None of the entries were promising across locations.

White- backed planthopper
NSN1: IET 22989 had a DS of 3.0 at Coimbatore.
NSN2: All the test entries were susceptible.
NSN hills: IET 24216, 24179, 24230, 23540 and 23524 showed a DS of 3.0 at CBT but were susceptible at DRR.
NHSN: All the test entries were susceptible.

Mixed population of hoppers
NSN1: IET 23081, IET 23052, IET 22055, IET 22302 and IET 22648 had a DS of 3.0 at Maruteru where the ratio of BPH: WBPH was 1:1.
NSN2: IET Nos 23150, 24452, 23918, 24485, 24490, 24493, 24503, 23906, 23929, 24424, 24537, 24367, 24393, 24629, 24714 exhibited field tolerance to a mixed population of planthoppers at both Maruteru (1BPH:1WBPH) and Gangavathi (1BPH: 1.89 WBPH) and had a DS of ≤3.0.
NSN hills: Swarnadhan exhibited a DS of 3.0 at Maruteru.
NHSN: All the entries were susceptible in field test at Maruteru

Green leafhopper:

NSN Hills: IET Nos 24216,24179,24188,24189 and VL Dhan 65 had a DS of 3.0 at CBT.

NHSN: IET Nos 24789, 24804, IHRT-E-20, IHRT-ME-11, IHRT-ME-20, 24832, 24833, 24840, 24841, 24855, 24857, IHRT-M-15, 24871, 24896 showed a DS ≤3.0.

Gall midge

NSN1: IET 23194 (NSN1-93) had nil damage for biotype1, 4 and 5 in 3 of the 5 tests.

NSN2: IET Nos 24237, 24320 and 24667 had nil damage in 3 of the 5 field tests against gall midge.

NSN hills: IET 23536 had nil damage for biotype 1 at DRR.

NHSN: IET Nos 24822 and 24896 had nil damage for biotype 1 at DRR but across locations none of the entries were promising except for Aganni the resistant check.

Stem borer

NSN1: Out of 6 valid tests, seven entries showed nil dead heart damage in only one test. IET 23642, 23053, 23596 and 23413 had nil white ear damage in 4 tests out of 12 valid tests.

NSN2: IET 24272 had nil damage in 2 of the 4 tests against stem borer at vegetative phase. At reproductive phase, one entry IET 24601 had nil damage in 4 of the 6 tests. Evaluation of entries at both the phases identified IET Nos 24601 and IET Nos 24673 as promising in 4 of the 10 tests conducted.

NSN hills: None of the entries were promising.

NHSN: IHRT 06, IHRT M-7 and HRT MS16 (IET 24894) were promising in 3 of the 11 tests.

However, the reaction in all the promising entries needs confirmation to disprove it as due to pest escape.

Leaf folder

NSN1: IET 24059 and IET 22770 had <5% damage at one location each out of 6 valid tests. The reaction needs to be confirmed again.

NSN2: IET 23738, 24241 and 24246 had nil damage for leaf folder in 2 of the 5 tests.

Other pests

Whorl maggot: In NSN2 trial at Jagdalpur, 14 entries had nil damage at 50 DAT.

Case worm : All NSN1 entries were susceptible at Brahmavar.

Blue beetle: The damage by blue beetle at Pattambi in NHSN entries varied from 9.8-50% at 50 DT.

Leaf damaging pests: In NSN1trial at Faizabad, IET Nos 23341, 24571 and IR64 had nil damage for whorl maggot and leaffolder.

Rice hispa

Evaluation of NSN hill entries at Malan for rice hispa in polyhouse identified 10 entries with <10 % DL where the leaf area damage varied from 0.5-7.8%. The damage in NHSN varied from 0-60% with nil damage in Kavya.

Grasshoppers: In NSN hills trial at Khudwani, IET24203 had only 6.7 % DL.

Gundhi bug: The gundhi bug damage varied from 2-81% DG across entries in NHSN trial at Rewa.

Overall reaction

NSN1*: Evaluation of entries in 9 greenhouse and 31 field tests helped in identification of eight entries as promising in 4-5 tests against 2-3 pests (*** **Table 2.7).**

NSN2*: Evaluation of NSN 2 entries across 12 locations in 4 greenhouse and 23 field reactions against 6 pests identified 11 entries as promising in 4-6 tests of the 27 tests against 2-4 pests (*** **Table 2.8***).*

NSN hills*: Evaluation of NSN hill entries across 8 locations in 8 greenhouse and 5 field reactions against 8 pests identified 4 entries as promising in 2-3 tests of the 13 tests against 2-3 pests (*** **Table 2.9***).*

NHSN*: Evaluation of NHSN across 20 locations in 10 greenhouse and 24 field reactions helped in identification of 4 promising entries in 3-4 tests out of 34 tests. (*** **Table 2.10*)***

Table 2.7 Performance of the most promising entries against insect pests in NSN 1, *kharif* 2014

Entry No.	IET No.	Designation	Cross Combination	Number of promising tests													No of promising		MRI	PPR
				BPH	WBPH	GLH	BPH + WBPH	Gall Midge Biotype				Stem Borer		LF	LDP	CW	Tests	Pests		
								1	4	4M	5	DH	WE							
				5	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**6**	**12**	**6**	**1**	**1**	**40**	**8**	**320**	
86	22989	CR 2081-147-1-1	Samsom polo/ NDGR 421	1	1	0	0	0	0	0	0	0	3	0	0	0	**5**	3	15	4.7
118	24049	CRR 595-9-1	Kalinga III/ RR166-645	0	0	0	0	0	0	0	1	0	2	1	0	0	**4**	3	12	3.8
220		IR-64		1	0	0	0	0	0	0	0	0	2	0	1	0	**4**	3	12	3.8
79	23599	CR 2682-1-1-5-1-1	CRLC 899/ AC.38606	0	0	0	0	0	0	0	1	0	3	0	0	0	**4**	2	8	2.5
93	23194	NLR 40054	MTU 7029/ NLR 19994	0	0	0	0	1	1	0	1	0	1	0	0	0	**4**	2	8	2.5
158	23429	CN 1756-3-3-1-MLD 17	IR 50/ ADT 41	1	0	0	0	0	0	0	0	0	3	0	0	0	**4**	2	8	2.5
175	23341	CR 3692-1-1	IR 55419-04/ Way Rarem	0	0	0	0	0	0	0	0	1	2	0	1	0	**4**	2	8	2.5
1	23088	NP 9381	PRN 6565/ PRN 3941	0	0	0	0	1	0	0	0	0	3	0	0	0	**4**	2	8	2.5
		Checks																		
246		Aganni		0	0	0	1	2	1	1	0	0	2	0	0	0	**7**	2	14	4.4
249		PTB-33		3	0	0	0	0	1	0	1	0	2	0	0	0	**7**	3	21	6.6

PPR= (MRI of test entry/total MRI) X 100

Data from Brahmavar for gall midge, Pantnagar for WBPH; Karjat, Coimbatore, Navsari, Puducherry, Warangal and Sakoli for SBDH; Karjat and Rajendranagar for SBWE; Moncompu, Navsari and Rajendranagar for leaf folder RH from RNR were not considered for analysis due to low pest incidence.

Table 2.8 Performance of promising cultures against insect pests in NSN2, *kharif* 2014.

Entry No.	IET No.	Designation	Cross combination	Number of Promising Tests (NPT)								No. of promising		MRI
				BPH	Bph+Wbph	WBPH	GM	SBDH	SBWE	LF	WM	Tests	Pests	
				3	2	1	5	4	6	5	1	27	6	162
7	23738	MTU 1162	MTU 1075/BM 71	0	1	0	1	0	2	2	0	6	3	18
117	24474	OR 2330-1-1	OR 1530-1 / NDR 8003	0	0	0	2	0	2	0	1	5	3	15
138	24490	OR 2436-11	Indravati/ Nsamsagui-19	0	2	0	1	0	2	0	0	5	2	10
240	23930	MTU 1169	PLA 1100/CR 1009	0	1	0	2	0	2	0	0	5	2	10
256	24587	NP-973-8	NP-36/T. Basmati	0	0	0	2	1	2	0	0	5	2	10
24	24247	CBMAS 14065	Improved White Ponni/APO	0	0	0	1	0	1	1	1	4	4	16
1	23757	MTU 1163	MTU 1075/Samba Mahsuri	0	1	0	1	1	0	1	0	4	3	12
6	23742	Culture KAU MK 157	Mahsuri/Kuthiru	0	1	0	1	1	0	1	0	4	3	12
73	24295	RNR 15227	MTU 4870/ JGL 1798	0	1	0	1	0	0	1	1	4	3	12
288	24423	TR 2013-001	ADT 43/FL 478///ADT 43	0	0	0	2	0	1	1	0	4	3	12
629	24561	RP 5884- GSR IR 1-5-S10-D1-D1 (HHZ 5-SAL 10-DT1-DT1)	Huang-Hua-Zhan// Huang-Hua-Zhan/OM 1723	0	1	0	1	1	0	1	0	4	3	12
		Checks												
647		PTB-33		1	1	0	1	0	3	0	0	6	3	18
645		Kavya		1	0	0	2	0	1	0	0	4	3	12
38		NDR 359	-	0	1	0	1	0	1	1	0	4	3	12

Data on BPH from JDP and RGL, gall midge from RGL, dead heart damage from PDC, RGL, MNC and leaf folder damage from GGV, JDP and PDC were not considered for analysis due to low pest incidence.

Table 2.9 Performance of promising cultures against insect pests in NSN hills, *kharif* 2014

Entry No	IET	Designation	Cross Combination	Number of promising tests (NPT) against						Overall NPT
				Plant hopper	GM	SB	LF	RH	GRH	
				7	1	1	2	1	1	**13**
22	24181	HPR 2750	HS/T23/IR 66295-36-2	2	0	0	0	1	0	**3**
49	-	Rasi	-	2	1	0	0	0	0	**3**
93	24228	RCPL-1-82	Bali (local collection)/ IRAT 141	2	0	0	0	1	0	**3**
3	24200	RCM-30	KD-2-6-3/Akhanphou	2	0	0	0	0	0	**2**
		Checks								
107	-	PTB-33	Land race	3	0	0	0	0	0	**3**
109	-	RP 2068-18-3-5	Swarnadhan/V. Cheera	2	1	0	0	0	0	**3**
112	-	W-1263	-	1	1	0	0	0	0	**2**

* Planthoppers include BPH , WBPH and GLH

Data from Upper Shillong and rice skipper damage from Khudwani were not considered for analysis.

Table 2.10 Reaction of the most promising hybrids against insect pests in NHSN, *kharif* 2014

NHSN No.	IET No.	Designation	Number of promising tests (NPT)														Overall NPT
			BPH	WBPH	GLH	BPH+ WBPH	Gall Midge Biotype			Stem Borer		LF	RH	WM	BB	GB	
							1	5	4M	DH	WE						
			5	**2**	**1**	**1**	**1**	**2**	**1**	**5**	**6**	**6**	**1**	**1**	**1**	**1**	**34**
130	24896	SPH-6159	0	0	1	0	1	0	0	1	1	0	0	0	0	0	**4**
6	-	PA-6129 (NCH)	0	0	0	0	0	0	0	2	1	0	0	0	0	0	**3**
106	-	LCV	0	0	0	0	0	0	0	2	1	0	0	0	0	0	**3**
128	24894	NK-17358	0	0	0	0	0	0	0	1	2	0	0	0	0	0	**3**
		Checks															
142		Aganni	0	0	1	0	1	0	1	2	1	0	0	0	0	0	**6**
145		PTB-33	2	1	0	0	0	0	0	0	1	0	0	0	0	0	**4**
147		RP 2068-18-3-5	2	0	0	0	1	0	0	0	1	0	0	0	0	0	**4**

Data on BPH from Warangal, Pantnagar; WBPH from Pantnagar and Kaul; Gall midge data from Brahmavar; SBDH from Pattambi: SBDH and SBWE data from Karjat, Ludhiana, Warangal and Rajendranagar; leaffolder damage from Pattambi, Raipur, Chinsurah, Malan and Pantnagar were not considered for analysis due to low pest incidence.

2.2. INSECT BIOTYPE STUDIES

Monitoring variations in pest populations is essential to understand evolution of biotypes and their consequent effect on stability of host plant resistance as a viable component of IPM. Hence, in the context of earlier research efforts in identification of biotypes in case of gall midge, variations in the populations of gall midge were monitored through a set of differentials in endemic locations by conducting two trials *viz*; i) Gall Midge Biotype Trial (GMBT) and ii) Gall Midge Population Monitoring trial (GMPM). Also, since the last few years, Planthopper Special Screening trial (PHSS) is being carried out to study BPH populations in terms of virulence against a set of gene differentials.

i) Gall midge biotype trial (GMBT)

Gall midge biotype trial was constituted with a set of gene differentials which are categorized into 5 groups and evaluated at 16 locations. The results of the evaluation are summarized in **Table 2.11** and discussed as under.

Biotype 1: The reaction of differentials to populations at DRR and Sambalpur conform to the typical pattern of biotype1 (R-R-R-R-S) except slight variation in the performance of one or two differentials in the groups.

Biotype 2: At Cuttack, this year susceptibility of the group 2, 3 and 4 differentials was observed except for ARC 5984 (*Gm5*), Aganni and INRC 3021 (*Gm8*) which were resistant.

Biotype 3: This year also the reaction of the gall midge populations at Jagtial and Ranchi conformed to the typical pattern of R-S-R-R-S for biotype 3.

Biotype 4: At Sakoli, except for RP2068-18-3-5 (*gm3*), Aganni (*Gm8*) and RP23333-156-8 (*Gm*7) which had low damage all the differentials were susceptible.

Biotype 4M: W1263 (*Gm1*), RP2068-18-3-5 (*gm3*) and Aganni (*Gm8*) had nil damage when evaluated against biotype 4M at Warangal.

Biotype 5: This year most of the differentials were susceptible at both Moncompu and Pattambi except for W1263 and ARC6605 which recorded <10% DP.

Biotype 6: Reaction pattern of population at Iroisemba conformed to the typical pattern of biotype 6 *ie*., RSSSS.

Other populations: At Jagdalpur, all the differentials were resistant except Abhaya, Phalguna and BG380-2. The reaction of Nellore population was similar to that of biotype1.

Evaluation of gene differentials against seven identified biotypes and two populations of gall midge at 12 locations in one greenhouse and 11 field reactions revealed that W1263, ARC6605, Aganni and INRC3021 were promising in 8-9 tests. The results also indicate that Gm1 and Gm8 were promising at 8-9 locations out of 12 locations tested.

ii) Gall midge population monitoring (GMPM)

In order to monitor the virulence pattern of the gall midge populations, progeny testing of a single gall midge female was designed and allotted to 6 centres. Data from Cuttack, Moncompu, Brahmavar, Ragolu and Warangal was not received.

The trial at Sakoli was conducted with three differentials, W1263 (*Gm1*), RP2068-18-3-5 (*gm3*) and Abhaya (*Gm4*) along with Purple variety. 250 gall midge females were released singly in each pot planted with all the 4 varieties. The pots were observed for the gall development and emergence of insects from the gall. The sex of the insect was also recorded. Results revealed 17.2% plant damage on Abhaya, 6% on RP2068-18-3-5, 3.2% on purple and no damage on W1263. The sex ratio was highly favourable on Abhaya (2:1) and RP2068-18-3-5 (2.5:1). The population was avirulent on W 1263. The results are similar to that recorded in GMBT trial.

Table 2.11 Reaction differential rice varieties against gall midge populations, GMBT, *Kharif* 2014

Group	Entry No.	Differential	Gene	GMB 1		GMB 2	GMB 3		GMB 4	GMB 4M	GMB 5		GMB 6	GMB ?		Overall NPT
				DRR	SBP	CTC	RNC	JGT	SKL	WGL	MNC	PTB	IRS	JDP	NLR	
				GR	FR	GR	FR	FR	FR	FR	FR	FR	FR	FR	FR	
				-	50 DT	-	50 DT	50 DT	50 DT	50 DT	50 DT	30 DT	50 DT	50 DT	50 DT	
				%DP	%DP	% SS	%DP	%DP	%DP	%DP	%DP	%DP	%DP	%DP	%DP	12
I	1	KAVYA	*Gm 1*	0.0	0.0	88.0	0.0	0.0	0.00	75.0	40.0	19.1	5.0	0.0	15.0	**7**
	2	W 1263	*Gm 1*	0.0	0.0	20.0	0.0	0.0	0.00	0.0	40.0	9.5	0.0	0.0	NT	**9**
	3	ARC 6605	*(?)*	10.0	10.0	32.0	0.0	0.0	5.00	60.0	20.0	4.8	10.0	0.0	0.0	**9**
II	4	PHALGUNA	*Gm 2*	50.0	10.0	96.0	20.0	50.0	70.00	95.0	50.0	55.0	60.0	70.0	25.0	**1**
	5	ARC 5984	*Gm 5*	0.0	0.0	8.0	60.0	20.0	20.00	30.0	30.0	42.9	5.0	10.0	5.0	**6**
	6	DUKONG 1	*Gm 6*	22.2	10.0	80.0	0.0	35.0	35.00	80.0	40.0	19.1	30.0	20.0	10.0	**3**
	7	RP 2333-156-8	*Gm 7*	7.7	0.0	40.0	30.0	25.0	0.00	55.0	90.0	61.9	35.0	10.0	10.0	**5**
	8	MADHURI L 9	*Gm 9*	0.0	0.0	84.0	0.0	30.0	26.32	85.0	60.0	19.1	5.0	0.0	0.0	**6**
	9	BG 380-2	*Gm 10*	28.6	30.0	92.0	0.0	45.0	55.00	80.0	80.0	85.0	25.0	60.0	50.0	**1**
III	10	MR 1523	*Gm 11*	0.0	20.0	80.0	0.0	0.0	35.00	60.0	100.0	71.4	60.0	0.0	NT	**4**
IV	11	RP 2068-18-3-5	*gm 3*	0.0	0.0	24.0	30.0	0.0	10.00	15.0	90.0	76.2	80.0	10.0	15.0	**5**
	12	ABHAYA	*Gm 4*	0.0	80.0	96.0	0.0	0.0	45.00	70.0	70.0	61.9	45.0	20.0	NT	**3**
	13	INRC 3021	*Gm8*	0.0	0.0	0.0	0.0	0.0	15.00	10.0	60.0	61.9	10.0	0.0	10.0	**9**
	14	AGANNI	*Gm8*	0.0	0.0	0.0	0.0	0.0	10.00	0.0	70.0	61.9	35.0	0.0	NT	**8**
	15	INRC 15888	*(?)*	33.3	0.0	84.0	20.0	0.0	20.00	40.0	60.0	14.3	10.0	10.0	0.0	**5**
V	16	B 95-1	*none*	25.0	30.0	76.0	45.0	NT	30.00	95.0	80.0	81.0	45.0	50.0	40.0	
	17	TN1	*none*	80.00	100.0	88.0	70.0	55.0	84.21	90.0	70.0	85.7	50.0	90.0	25.0	

Data from Raipur, Wangbal, Ragolu, and Brahmavar were not considered for analysis due to low pest pressure.

iii) Planthopper Special Screening Trial (PHSS)

A set of 16 primary sources of BPH resistance with some sources having known resistance gene(s) was evaluated against BPH at ten locations *viz.*, DRR, Raipur, New Delhi, Ludhiana, Cuttack, Coimbatore, Aduthurai, Rajendranagar, Mandya and Maruteru in greenhouse in standard seedbox screening test (SSST) with 2-3 replications. At DRR, the differentials were also screened against WBPH. At Maruteru, nymphal survival on the differentials was also observed and honeydew excreted by the insect was measured in terms of area.

Results presented in **Table 2.12** showed that two gene differentials *viz.,* T 12 (ACC 56989) with *bph7* gene and RP 2068-18-3-5 with unidentified genes were promising in 7 out of 11 tests with a damage score of <5. Rathu Heenati with *Bph3+Bph17* genes was promising in 6 out of 11 tests with a damage score of <5. PTB 33 with *bph2+Bph3*+unknown factors was promising in 5 out of 11 tests with a damage score of <5 and at Aduthurai and Rajendranagar, it scored higher damage score of 7.3 to 7.7. The next most promising entries were IR 64 with *Bph1*+ unknown factors and OM 4498 with unknown genetics which performed better in 4 centres each. Two differentials - Swarnalatha (ACC 33964) with *Bph 6* gene and IR71033-121-15 with BPH20/21 gene registered promising reaction at three locations each *viz*., Coimbatore, Ludhiana and Maruteru (Swarnalatha), Ludhiana, Raipur and Maruteru (IR71033-121-15). Four gene differentials viz., Babawee with *bph4* (Rajendranagar, Raipur), Pokkali with *bph9* (DRR, New Delhi), IR 65482-7-216-1-2-B with Bph18 (Coimbatore and Maruteru), IR 36 with *bph2* (Raipur and Maruteru) performed better at two locations each with a damage score of < 5 except IR 36 which recorded a damage score of < 3. Four gene differentials viz., ASD 7 with *bph 2*, Chinsaba with *bph 8*, Milyang 63 and MUT NS 1 with unknown genetics were not effective at any of the test locations. Pokkali was promising against WBPH at DRR with a damage score of 1.9.

Highest nymphal survival was recorded on MUT NS 1 whereas lowest nymphal survival was recorded on RP 2068-18-3-5. Highest honeydew excretion was recorded on Milyang 63 whereas lowest honeydew excretion was observed on Rathu heenati.

Table 2.12 Reaction of most promising gene differentials in PHSS, *kharif* 2014

PHSS No.	Designation	R Gene	BPH	WBPH	Brown Planthopper									NPT
					Greenhouse reaction (Damage Score) at									
			DRR		ADT	CBT	CTC	LDN	MND	MTU	NDL	RNR	RPR	11
2	Rathu Heenati (ACC11730)	*Bph3+Bph17*	4.1	6.3	7.7	5	9	NG	3.0	3.2	5.4	3.8	3	6
7	T 12 (ACC56989)	*bph7*	7.4	8.3	8.3	5	7.7	3.0	5.0	4	4.6	4.5	3.1	7
11	IR 64	*Bph1+$*	6.4	7.3	7	3	8.3	5.5	3.0	2.8	6.5	5.8	2.1	4
16	OM 4498	-	8.7	7.2	8.3	5	5.7	3.5	9.0	4	6.2	5.8	1.9	4
17	RP 2068-18-3-5	-	4.5	5.9	6.3	3.0	3.0	3.0	3.0	1.0	5.5	5.1	1.2	7
18	Ptb33	*bph2+Bph3+$*	1.6	6.0	7.7	NG	0.7	NG	5.0	NG	5.0	7.3	1.3	5

$-other factors

2.3 CHEMICAL CONTROL STUDIES

Insecticides play an important role as one of the key components of rice pest management. They remain the most viable and popular option for the farmer to manage pests because they are curative, efficient and even cost effective if well integrated into pest management. In the last few years very effective insecticides have come into the fore for their targeted action against multiple pests such as stem borer, leaf folder and planthoppers. Earlier efforts under AICRIP were directed to evaluate their efficacy to combat the insect pests singly rather than test their efficacy against combination of pests or compare their performance *vis a vis* one another in addition to conventionally recommended insecticides. Hence, this year, efforts were made to assess the relative field efficacy of newer insecticides which have been found effective against major insect pests of rice in the last few years.

Farmers prefer to optimize the cost of intercultural operations including plant protection as much as possible depending on their limited resources. In the present context of resource scarcity, farmers need to effectively save agricultural labour and optimize their time utilization too. Also, in rice crop at any given time during different crop growth stages, more than one pest or disease is prevalent and most of the times the situation may have to be dealt by using insecticide-fungicide mixture to take care of pests as well as diseases. Farmers generally resort to physical mixing of pesticides through tank mixtures in such situations. Thus, pesticide compatibility study is essential to know the impact of tank mixing of promising newer insecticides and fungicides on their efficacy against both insect pests and diseases so that farmers are given the right information on the efficacy of mixtures. In this context, chemical control studies consisting of Insecticide Evaluation Trial (IET) and Pesticide Compatibility Trial (PCT) were continued, during *kharif* 2014.

i) Insecticide Evaluation Trial (IET)

In this trial, during *kharif* 2014, four newer insecticides were evaluated *vis a vis* recommended insecticides *viz.,* acephate (Acephate 75 SP), buprofezin (Applaud 25 SC) and monocrotophos (Suphos 36 WSC) at specified dosages for their efficacy to assess their relative efficacy against insect pests, across at 34 locations.

Treatments:

Four newer insecticides *viz*., acephate 95% SG (Acephate)., @ 500 g a.i./ha, flubendiamide 4% plus buprofezin 20% SC(RIL-IS-109) @ 1000 g a.i./ha supplied by Rallis India Ltd, dinotefuran 20 SC (Token) supplied by Indofil Chemicals @ 40 g a.i./ha each, imidacloprid plus ethiprole (Glamore 80 SG) @ 100 g a.i./ha, supplied by Bayer Crop Science Ltd., were evaluated. These treatments were compared with the three recommended insecticides – acephate 75 SP (Starthene), buprofezin 25 SC (Applaud) and monocrotophos 36 WSC (Suphos) and untreated control treatment without any insecticide application. These eight treatments were replicated thrice each and laid out in Randomized Complete Block Design (RCBD). At all the locations, a basal application of fipronil 0.3G (Regent) @ 25 kg/hawas made once at 25 DAT in all treatments except untreated control. Subsequently applications of individual treatments were done based on pest incidence exceeding the economic threshold level guidelines. The insecticides were applied as high volume sprays @ 500 litres of spray fluid/ha.

Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
Aduthurai	28/7/14	20/8/14	29/12/14	2	15 & 48
Brahmavar	15/07/14	07/08/14	07/11/14	3	23,35 & 50
Cuttack	18/06/13	18/07/13	-	3	15, 52 & 63 DATI
Faizabad	28/06/14	20/08/14	28/11/14	3	36,40 & 61 DAT
Gangavathi	18/07/14	25/08/14	29/12/14	3	43,60 & 65 DAT
Ghaghraghat	16/06/14	15/07/14	17/11/14	4	25,35,50&60 DAT
Iroisemba	13/07/14	08/08/14	04/12/14	1	25 DAT
Jagdalpur	08/07/14	06/08/14	10/12/14	2	25 & 35 DAT
Karjat	02/07/14	01/08/14	-	1	33 DAT
Karaikal	11/12/13	11/0114	-	2	60 & 79 DAT
Kaul	18/06/14	18/07/14	18/11/14	2	24 & 59 DAT
Khudwani	10/05/13	16/06/13	04/10/13	1	25 DAT
Ludhiana	-	30/06/14	25/10/14	3	15,51 & 71 DAT
Malan	19/06/14	11/07/14	01/11/14	3	42,56 & 75 DAT
Mandya	04/08/14	26/08/14	15/12/14	3	34,58 & 77 DAT
Maruteru	05/07/14	05/08/14	24/11/14	3	25,48 & 71 DAT
Moncompu	-	11/06/14	10/10/14	3	30,50 & 65 DAT
Navsari	25/06/14	30/07/14	10/11/14	2	12 & 45 DAT
Nawagam	17/07/14	02/09/14	13/12/14	2	28 & 42 DAT
New Delhi	23/06/14	21/07/14	30/10/14	3	33,47 & 62 DAT
Nellore	16/09/14	17/10/14	-	3	30,45 & 60 DAT
Pantnagar	18/06/14	20/07/14	13/11/14	3	25,35 & 65 DAT
Pattambi	25/07/14	04/08/14	30/10/14	3	10,30 & 60 DAT
Puducherry	12/07/14	21/08/14	20/11/14	-	-
Pusa	24/06/14	17/07/14	23/11/14	2	30 & 48 DAT
Ragolu	15/07/14	16/08/14	17/12/14	3	15,55 & 85 DAT
Raipur	28/06/14	04/08/14	09/12/14	4	25,35,50 & 65 DAT
Rajendranagar	23/06/14	23/07/14	08/12/14	4	40,65,91 & 125 DAT
Ranchi	01/07/14	22/07/14	05/12/14	4	25,35,50 & 60 DAT
Rewa	07/07/14	02/08/14	14/11/14	1	60 DAT
Sakoli	07/07/14	28/07/14	01/12/14	3	38,53 & 72 DAT
Sambalpur	07/08/14	08/09/14	07/01/15	3	35,50 & 65 DAT
Titabar	18/07/14	20/08/14	25/11/14	4	25,35,50 & 65 DAT
Warangal	19/06/14	18/07/14	20/11/14	4	25,38,55 & 82 DAT

Standard observation procedures were followed to record insect pest incidence at regular intervals throughout the crop growth period. To assess stem borer and gall midge damage, observations were recorded on total tillers

(TT), dead hearts (DH) and silver shoots (SS) at 30 and 50 DAT, while stem borer damage at heading stage was expressed as per cent white ears based on counts of panicle bearing tillers (PBT) and white ear heads (WE). In case of sucking pests such as brown planthopper (BPH), whitebacked planthopper (WBPH), green leafhopper (GLH) and natural enemies, number of insects were recorded on ten randomly selected hills. The damage due to foliage feeders such as leaf folder, whorl maggot, hispa, etc., was assessed based on counts of damaged leaves/10 hills. At the time of harvest, the grain yield from net plot leaving 2 border rows on all sides was collected and expressed as kg/ha.

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

Results

Pest Infestation (Table 2.13):

Stem borer infestation during vegetative stage ranged from 0.1 to 14.4% DH in the insecticide treatments across 17 locations with minimum damage exceeding 5% DH in untreated control, during 30 to 88 DAT. There were significant differences among the treatments at 16 locations. The insecticide treatments showed mean infestation between 4.7 and 6.1% DH across the locations compared to 12.4% DH in untreated control. All the insecticide treatments were significantly superior to control. More than 5% white ears(WE) were recorded at heading stage at 23 centres and differences among the treatments were significant at 16 locations. At Nawagam and Faizabad, incidence was recorded upto 46.3 and 49.1% respectively, in control. However, mean infestation ranged from 6.2 to 8.8% WE in insecticide treatments significantly higher than 15.7% recorded in untreated control. However, there were no significant differences among the insecticide treatments at both vegetative and reproductive stages. Overall, among the insecticide treatments, flubendiamide plus buprofezin treatment was the best in reducing stem borer incidence at both vegetative and reproductive phases.

Gall midge infestation was high at Jagdalpur, ranging from 14.2 to 38.2% SS across treatments including control, during 30-50 DAT. At other locations, the incidence was varied between 0.7 and 23.6% SS. There were significant differences among the treatments at most of the locations. However, mean infestation over 8 locations was at par in all the treatments including control (7.3 to 13.3 % SS).

Leaf folder damage was recorded at 7 locations, however it was low to moderate ranging from 0.3 to 30.7 in insecticide treatments compared to 2.4 to 39.6% in untreated control during 30 to 80 DAT. The mean infestation ranged from 6.7 to 8.5% LFDL in the insecticide treatments compared to 14.3 in untreated control. All the treatments were significantly superior to control. At Ranchi, the leaf folder damaged leaves were significantly reduced in insecticide treatments (13.3 to 40.0 leaves per 10 hills) compared to control (63.3 LFDL per 10 hills) ten days after application at 60 DAT. Overall, among the insecticide treatments flubendiamide plus buprofezin treatment was superior to the remaining treatments.

Very severe incidence of **brown planthopper** was observed in the endemic areas of Maruteru (maximum up to 3767.8 hoppers/ 10 hills), high at Gangavathi (upto 541.3 hoppers/ 10 hills) and moderate at Warangal and Ragolu (up to 176.0 hoppers/10 hills). Across the locations, dinotefuran treatment (67.5 hoppers/10 hills) followed by imidachlorid plus ethiprole (93.8 hoppers/10 hills) were the best treatments while acephate (159.4 and 165.8 hoppers/10 hills, respectively) and buprofezin (172.6 hoppers/10 hills) were the next best treatments being on par. All the insecticide treatments were significantly superior to control.

Whitebacked planthopper infestation was observed at 4 locations ranging from 1.3 to 450.3 hoppers/10 hills and the mean infestation across locations varied between 49.5 and 142.3 hoppers/10 hills. Imidacloprid plus ethiprole, dinotefuran, acephate and flubendiamide plus buprofezin were the best treatments being on par (49.5 to 57.7 hoppers/10 hills). However all the insecticide treatments were superior to control(142.3 hoppers/10 hills).

Green leafhopper populations were moderate at Ranchi and Gangavathi (66.7 to 88.0 hoppers/10 hills) during 40-48 DAT, however there was drastic decline in their numbers at Ranchi after four days following insecticide application (8.0 to 21.3 hoppers/10 hills) while at Gangavathi, the population in insecticide treatments got reduced to 9.0 to 52.0 hoppers/10 hills at 100 DAT. All the insecticide treatments were at par showing mean population range of 23.1 to 28.0 hoppers per 10 hills significantly lower than that of control (46.1 hoppers/10 hills). Overall dinotefuran showed relatively better performance than the remaining insecticide treatments across locations.

Gundhi bug pest incidence was recorded at three locations ranging from 1.0 to 25.0 bugs per 10 hills across treatments. At Rewa, there was significant reduction in the bug population from 17.7 to 25.0 bugs per 10 hills to 2.7 to 3.0 and 6.7 to 8.7 bugs per 10 hills after three and 10 days following insecticide treatment application. In the control treatment there was increase of the bug population from 17.7 to 20.0 bugs/10 hills during the same period. Across locations, all the insecticide treatments were on par (6.9 to 8.9 bugs/10 hills) and significantly superior to control (15.0 bugs/10 hills).

Among the other foliage feeders, **hispa** damage was recorded upto 64.5% DL at 40 DAT at Malan. There was significant reduction in damage in all the insecticide treatments (4.8 to 9.9 %DL) after application compared to control (19.4 %DL) at 50 DAT. At Ranchi also, insecticide treatment was significant resulting in significantly low hispa damage (18.0 to 21.7% DL) compared to the pre treatment damage of 32.3 to 60.5% HDL, while in control the damage increased from 47.0% HDL to 50.0 % DL.

Data on populations of **natural enemies** *viz*., mirid bugs and spiders recorded at Gangavathi and Maruteru showed that the insecticide treatments showed significantly less population of mirid bugs (49.4 to 84.9 bugs/10 hills) compared to control(105.3 bugs/10 hills). Among the treatments monocrotophos was the safest showing 84.9 bugs per 10 hills followed by flubendiamide plus buprofezin treatments (66.4 to 78.1 bugs/10 hills). The spider numbers remained within a narrow range of 15.9 to 18.4 numbers/10 hills across insecticide treatments being at par with one another however, significantly less than that of control (26.2 spiders/10 hills).

Grain Yield (Table2.14):

There were significant differences in grain yield among the treatments at 22 locations. Based on mean yield of these locations, flubendiamide plus buprofezin treatment yielded the highest of 4591 kg/ha with an increase of 25.5% over control (3420 kg/ha) and was at par with dinotefuran (4521 kg/ha and 24.3% IOC) as well as the two acephate treatments (4484 and 4447 kgs/ha with 23.7 and 23.1 % IOC, respectively). Buprofezin (4382 kg/ha with 23.7% IOC) was the next best treatment followed by imidacloprid plus ethiprole (4304 kg/ha with 20.5% IOC) and monocrotophos treatments showing yield of 4286 kg/ha with 20.5 and 20.3% IOC, respectively.

Insecticide evaluation trial was carried out at 34 locations to evaluate the efficacy of four newer insecticides viz., acephate, flubendiamide plus buprofezin, imidacloprid plus ethiprole and dinotefuran along with four recommended insecticides against major insect pests of rice and consequent impact on grain yield during kharif 2014. Based on the performance of the insecticide treatments for their efficacy in reducing pest infestation and their impact on grain yield across locations, it was evident that flubendiamide plus buprofezin treatment performed well against stem borer and leaf folder, while against gall midge all the treatments were at par. Dinotefuran followed by imidacloprid plus ethiprole were effective against planthoppers and leafhoppers. Flubendiamide plus buprofezin treatment yielded the highest and was on par with dinotefuran and acephate treatments.

Table 2.13 Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formu-lation	Dose of formulation or product/ha	Stem borer damage(% Dead hearts)															
				ADT		FZB		KJT		LDN	MNC		MND		NAV		PNR		
				30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	-	30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	46 DAT	53 DAT	60 DAT
Acephate	Acephate 95 SG	95	526 g	5.9a	5.0a	13.8a	5.7b	5.6a	3.3b	1.1a	4.4a	1.5a	3.6a	3.6b	5.7c	6.5b	5.1a	12.5b	10.6b
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	6.8a	8.2a	9.6a	2.5a	5.7a	1.0a	1.2a	5.4a	2.4b	1.4a	1.8ab	3.5a	4.5a	3.3a	5.8ab	8.3ab
Buprofezin	Applaud	25 SC	1000 g	3.7a	3.4a	11.2a	4.4a	5.3a	4.8b	4.9b	10.1b	5.0c	3.7a	3.5b	8.5e	10.3d	4.3a	4.6a	4.3a
Dinotefuran	Token	36	200 g	5.8a	4.9a	11.9a	4.6a	6.1a	4.2b	5.3b	12.8b	3.6bc	4.6a	3.2ab	4.5b	5.7b	3.7a	9.5ab	7.0ab
Imidacloprid + Ethiprole	Glamore	80	125 g	6.5a	5.0a	12.7a	5.0a	6.1a	4.7b	5.2b	5.0a	2.2ab	3.1a	3.0ab	11.5f	12.8e	6.6a	9.4ab	12.4b
Acephate	Acephate	75	667 g	6.5a	5.8a	9.3a	8.2b	5.3a	2.5a	1.3a	5.8a	2.7b	1.5a	1.4a	9.3e	11.4e	3.8a	12.8v	6.2ab
Monocrotophos	Suphos	36	1390 ml	5.2a	6.2a	7.9a	2.5a	5.2a	4.6b	1.4a	4.2a	0.9a	2.6a	3.1a	6.8d	7.5c	2.3a	5.7ab	5.8ab
Untreated Control	Water	-		8.4a	6.0a	28.8b	40.0c	5.6a	8.1c	5.9b	15.9b	6.1c	7.7b	12.8c	14.7g	17.7f	5.1a	8.5ab	6.9ab

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formu-lation	Dose of formulation or product/ha	Stem borer damage(% Dead hearts)													Mean
				PTB		PUS		RGL	RNC	RNR	RPR	SBP		SKL		WGL	
				30 DAT	50 DAT	30 DAT	50 DAT	50 DAT	-	68 DAT	50 DAT	56 DAT	76 DAT	53 DAT	68 DAT	88 DAT	
Acephate	Acephate 95 SG	95	526 g	1.2ab	2.8a	8.7b	9.4b	7.9ab	3.7ab	0.1a	3.1b	5.2c	2.1ab	6.5a	12.9a	8.7ab	**5.7a**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	1.7ab	3.7a	6.7ab	9.1b	7.0a	2.7a	1.3a	1.2a	3.7b	1.7ab	6.3a	13.4a	7.0ab	**4.7a**
Buprofezin	Applaud	25 SC	1000 g	5.0b	3.0a	9.8b	10.8b	9.9ab	8.8c	4.8b	5.6c	7.2d	5.4c	7.2a	13.2a	11.5b	**6.7a**
Dinotefuran	Token	36	200 g	7.0bc	4.0a	7.4b	9.2b	6.5a	5.8bc	1.4a	7.7d	4.1b	4.2c	7.2a	14.4a	9.1ab	**6.4a**
Imidacloprid + Ethiprole	Glamore	80	125 g	2.2a	3.8a	4.0a	1.7a	11.0b	2.2a	3.9ab	5.5c	2.6a	1.3a	8.1a	14.2a	5.9a	**6.1a**
Acephate	Acephate	75	667 g	0.9a	2.9a	10.0b	10.5b	8.7ab	4.9b	0.5a	1.9a	6.2cd	3.3bc	5.1a	13.6a	8.1ab	**5.9a**
Monocrotophos	Suphos	36	1390 ml	3.2a	1.8a	9.3b	11.5b	9.2ab	7.5c	1.1a	5.8c	5.4c	2.9b	6.9a	13.6a	9.8ab	**5.5a**
Untreated Control	Water	-		9.7b	5.3a	17.8c	17.0c	11.1b	17.7d	6.0b	12.5e	11.6e	14.5d	9.8b	18.3b	8.7ab	**12.4b**

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Stem Borer Damage (%White ears)											
				ADT	CTC	FZB	GGT	GGV	KJT	LDN	MNC	MND	MTU	NAV	NWG
Acephate	Acephate 95 SG	95	526 g	3.6b	11.7ab	14.9c	3.3a	2.2b	1.9b	1.3a	3.1ab	2.5a	22.5b	7.5b	15.0a
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	2.1a	15.3bc	3.6a	4.7b	0.8a	0.4a	1.8a	3.4ab	3.6a	13.6ab	5.5a	15.2a
Buprofezin	Applaud	25 SC	1000 g	2.2a	17.2bc	6.7b	5.3bc	4.8b	3.0b	5.3b	6.3b	3.5a	19.9b	10.9d	11.9a
Dinotefuran	Token	36	200 g	2.6a	10.7ab	6.7b	3.7ab	5.2b	2.4b	5.1b	5.4b	3.2a	12.8ab	6.6b	11.8a
Imidacloprid + Ethiprole	Glamore	80	125 g	2.9b	8.1a	8.8b	4.6ab	3.4b	2.3b	5.1b	3.3ab	3.0a	10.1a	13.6d	14.3a
Acephate	Acephate	75	667 g	1.8a	12.2b	15.6c	4.5ab	2.2b	1.7b	1.9a	5.6b	1.4a	15.8ab	12.6d	14.4a
Monocrotophos	Suphos	36	1390 ml	2.1a	18.6c	3.7a	6.1c	3.3b	2.2b	2.4a	2.6a	3.1a	22.5b	8.9c	13.2a
Untreated Control	Water	-	-	7.3c	22.1c	49.1d	10.1d	8.1c	9.5c	7.1c	7.4b	12.8b	20.7b	19.3e	46.3b

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Stem Borer Damage (%White ears)											Mean
				PNR	PTB	PUS	RGL	RNC	RNR	RPR	SBP	SKL	TTB	WGL	
Acephate	Acephate 95 SG	95	526 g	18.7a	7.3a	9.0b	8.5a	2.9a	1.7a	12.0a	4.7b	11.2a	1.2a	3.3a	**7.4a**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	17.8a	7.6a	8.1b	8.4a	1.7a	1.2a	11.7a	2.5a	7.0a	0.2a	5.7a	**6.2a**
Buprofezin	Applaud	25 SC	1000 g	22.2a	9.0a	12.7b	10.9a	6.4b	5.7a	16.7b	6.2b	8.4a	0.8a	5.6a	**8.8a**
Dinotefuran	Token	36	200 g	17.0a	10.5a	10.5b	10.5a	3.5a	2.6a	19.5bc	5.3b	10.6a	1.7a	4.8a	**7.5a**
Imidacloprid + Ethiprole	Glamore	80	125 g	21.0a	12.2a	1.1a	10.2a	1.8a	3.2a	18.0b	1.2a	12.0a	1.9a	5.3a	**7.3a**
Acephate	Acephate	75	667 g	17.8a	5.1a	11.1b	7.1a	2.2a	1.7a	19.7b	5.1b	9.2a	1.6a	3.3a	**7.5a**
Monocrotophos	Suphos	36	1390 ml	16.0a	10.5a	12.0b	6.2a	2.3a	2.2a	18.3b	5.1b	8.6a	1.9a	3.6a	**7.6a**
Untreated Control	Water	-	-	17.3a	8.0a	20.4c	14.5a	10.8c	3.6a	23.4c	16.8c	16.4a	5.2a	5.8a	**15.7b**

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Gall Midge Damage (%Silver Shoots)															
				ADT		BMR	IRS		JDP		MNC		MTU	SBP		SKL			Mean
				30 DAT	50 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	30 DAT	50 DAT	50 DAT	30 DAT	50 DAT	38 DAT	53 DAT	72 DAT	
Acephate	Acephate 95 SG	95	526 g	2.9ab	2.2a	2.6a	4.6a	7.8a	34.1c	24.6b	1.7a	1.2a	6.3a	5.0a	3.4a	17.4a	12.4a	5.6a	**9.2**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	2.1a	0.7a	4.7a	4.2a	7.3a	18.1a	16.9a	7.2c	4.3b	5.5a	3.3a	2.1a	20.1a	12.7a	5.1a	**8**
Buprofezin	Applaud	25 SC	1000 g	4.0b	1.8a	5.1a	3.4a	6.9a	21.1ab	18.3a	5.8bc	4.1b	6.8a	4.4a	3.8b	19.1a	12.2a	4.9a	**8.4**
Dinotefuran	Token	36	200 g	3.2ab	1.7a	6.7a	3.1a	6.2a	15.4a	14.2a	9.6c	5.2b	4.0a	5.5a	5.3b	17.3a	12.8a	4.8a	**7.9**
Imidacloprid + Ethiprole	Glamore	80	125 g	3.4ab	2.4a	5.8a	3.3a	6.6a	17.6a	15.2a	3.9b	2.5a	4.9a	3.6a	1.5a	18.5a	11.6a	5.1a	**7.3**
Acephate	Acephate	75	667 g	3.9ab	2.1a	4.4a	4.4a	7.3a	28.4bc	21.3b	4.4b	3.3ab	3.4a	6.6a	3.9b	17.2a	13.6a	6.0a	**9**
Monocrotophos	Suphos	36	1390 ml	3.9ab	2.7a	5.1a	4.4a	6.0a	23.7b	17.8a	2.2a	1.6a	7.1a	3.7a	2.9a	17.6a	10.0a	4.5a	**7.8**
Untreated Control	Water	-	-	10.8c	2.3a	6.4a	5.4a	7.5a	38.2c	30.9b	10.6c	7.0c	4.1a	13.1b	14.5c	23.6a	15.2a	7.9a	**13.3**

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Leaf folder damaged leaves (% LFDL)										
				ADT		BMR			FZB		JDP		LDN	
				30DAT	50DAT	Before Spray	After Spray		30DAT	50DAT	65DAT	70DAT	71DAT	
						48DAT	50DAT	53DAT					BT	AT
Acephate	Acephate 95 SG	95	526 g	4.7a	2.7a	28.7a	27.9a	15.3a	2.1a	1.1b	4.2b	3.4a	6.3b	3.0a
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	5.1a	2.3a	31.4a	30.6a	15.8a	2.7a	0.5a	0.5a	3.0a	5.6b	3.0a
Buprofezin	Applaud	25 SC	1000 g	5.2a	1.7a	27.7a	29.0a	16.8a	4.9bc	2.9c	6.8c	6.8b	7.5c	6.0b
Dinotefuran	Token	36	200 g	7.5a	1.9a	28.9a	26.5a	15.5a	2.1a	1.0b	8.6c	5.1b	8.1c	6.0b
Imidacloprid + Ethiprole	Glamore	80	125 g	4.7a	1.8a	25.0a	27.5a	16.1a	3.4b	1.8b	8.2c	4.9b	6.7b	6.0b
Acephate	Acephate	75	667 g	4.5a	2.4a	29.4a	28.9a	15.9a	4.0bc	1.9b	5.8b	3.7a	3.5a	2.0a
Monocrotophos	Suphos	36	1390 ml	5.4a	2.5a	30.7a	28.6a	18.0a	2.1a	0.3a	5.7b	3.0a	3.5a	2.0a
Untreated Control	Water	-	-	2.4a	7.0b	33.6a	31.9a	26.0b	5.3c	6.5d	10.5d	9.3c	10.9d	13.0c

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formulation	Dose of formulation or product/ha	Leaf folder damaged leaves (% LFDL)									Mean	LFDL/10 hills	
				MLN	MND		NWG		PTB	RPR	SKL			RNC	
				90DAT	30DAT	50DAT	70DAT	80DAT	60DAT	DAT	72DAT (BT)	72DAT (AT)		60DAT BT	70DAT AT
Acephate	Acephate 95 SG	95	526 g	8.0b	4.8b	2.0a	8.8a	5.9a	9.2b	2.9a	5.3a	4.2a	7.2a	63.0a	23.3bc
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	7.2ab	2.3a	1.5a	10.3ab	6.7a	3.0a	1.9a	3.3a	3.6a	6.7a	66.3a	13.3a
Buprofezin	Applaud	25 SC	1000 g	5.7a	3.8ab	2.2a	16.9b	9.7a	10.2b	3.6b	5.2a	3.9a	8.5a	67.3a	40.0d
Dinotefuran	Token	36	200 g	5.8a	4.1ab	2.0a	16.2b	7.0a	8.3b	3.1a	4.2a	3.8a	8.1a	68.3a	26.7c
Imidacloprid + Ethiprole	Glamore	80	125 g	6.5ab	4.2b	2.5a	14.7b	9.5a	10.4b	6.3c	6.7a	4.1a	8.2a	54.7a	16.3a
Acephate	Acephate	75	667 g	7.4ab	4.0ab	2.4a	13.3b	7.6a	6.0a	2.9a	4.9a	3.4a	7.4a	55.3a	21.3bc
Monocrotophos	Suphos	36	1390 ml	7.2ab	4.5b	2.2a	11.9a	7.1a	7.4ab	3.5b	4.3a	4.4a	7.4a	54.7a	19.3b
Untreated Control	Water	-	-	10.9c	15.0c	11.8b	26.6c	39.6b	12.4b	8.2c	7.3a	6.3a	14.3	61.0a	63.3e

Table2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Brown Planthopper (No./10 hills)										
				ADT	GGV				JDP			MNC	MND	
				80DAT	40DAT	60DAT	80DAT	100DAT	50DAT	72DAT	80DAT	65DAT	77DAT(BT)	80DAT(AT)
Acephate	Acephate 95 SG	95	526 g	18.7a	155.7a	85.0b	77.7b	47.7c	6.0a	7.7a	5.7a	19.0bc	58.3a	43.3bc
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175	875 ml	24.0a	169.3a	91.3b	87.3b	51.0c	4.7a	9.0a	7.3ab	20.7bc	79.0a	50.0bc
Buprofezin	Applaud	25 SC	1000 g	20.7a	162.3a	93.7b	89.0b	58.0c	4.7a	11.0a	7.0ab	6.0a	55.0a	46.7bc
Dinotefuran	Token	36	200 g	19.3a	170.3a	68.3b	54.3a	30.7b	4.3a	9.3a	9.3b	9.3a	58.3a	9.7a
Imidacloprid + Ethiprole	Glamore	80	125 g	21.7a	170.3a	35.0a	27.0a	6.3a	5.0a	4.3a	8.3a	15.3b	80.0a	5.7a
Acephate	Acephate	75	667 g	19.0a	157.0a	89.0b	81.7b	54.7c	3.0a	11.7a	6.3ab	24.0bc	78.3a	31.7b
Monocrotophos	Suphos	36	1390 ml	11.7a	168.7a	153.3c	159.7c	94.7d	2.0a	9.7a	10.3b	23.0bc	73.3a	53.3bc
Untreated Control	Water	-	-	23.3a	167.7a	323.3d	522.7d	541.3e	12.7a	15.7a	13.3b	28.0c	80.0a	70.0c

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formula-tion or product/ha	Brown Planthopper (No./10 hills)										
				MTU					PNR				RGL	SBP
				50DAT	60DAT	70DAT	76DAT	83DAT	46DAT	53DAT	60DAT	90DAT	45DAT	-
Acephate	Acephate 95 G	95	526 g	138.8a	127.8a	383.3b	1684.7ab	1868.7b	15.7a	13.0a	25.3a	169.8ab	122.7a	4.7b
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+ 175g	875 ml	88.5a	199.7a	630.0b	1722.8ab	3789.2b	5.0a	10.0a	18.7a	359.2b	117.3a	2.5a
Buprofezin	Applaud	25 SC	1000 g	48.0a	125.3a	367.8ab	1188.0ab	2688.5b	7.0a	10.0a	14.0a	324.2b	128.7a	6.2b
Dinotefuran	Token	36	200 g	65.2a	49.0a	171.2a	656.5a	316.2a	2.0a	12.3a	16.3a	87.2a	122.0a	5.3b
Imidacloprid + Ethiprole	Glamore	80	125 g	66.7a	77.5a	126.5a	934.3a	954.7ab	3.3a	11.0a	10.3a	137.2ab	132.7a	1.2a
Acephate	Acephate	75	667 g	59.3a	112.8a	433.0b	1380.3a	2070.8ab	6.3a	13.7a	16.7a	193.3ab	122.0a	5.1b
Monocrotophos	Suphos	36	1390 ml	101.5a	173.8a	718.3b	2311.7b	4769.2c	11.0a	12.3a	19.3a	1010.0c	136.7a	5.1b
Untreated Control	Water	-	-	131.8a	992.8b	1347.7c	3202.5b	3767.8b	8.0a	8.0a	21.7a	522.7b	126.0a	16.8c

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Brown Planthopper (No./10 hills)								
				SKL					WGL			
				41DAT	53DAT	56DAT	71DAT	75DAT	92DAT	99DAT	104DAT	Mean
Acephate	Acephate 95 SG	95	526 g	16.0a	16.0a	12.7a	24.7a	29.3ab	90.3b	168.0bc	131.3b	**185.6b**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175	875 ml	17.0a	14.0a	14.3a	25.3a	26.0a	56.3a	125.3bc	176.0b	**266.4c**
Buprofezin	Applaud	25 SC	1000 g	16.0a	14.7a	14.7a	29.0a	26.3a	80.7b	72.3a	78.7ab	**193.1b**
Dinotefuran	Token	36	200 g	14.7a	15.7a	13.7a	29.7a	24.3a	35.3a	68.7a	78.0ab	**74.2a**
Imidacloprid + Ethiprole	Glamore	80	125 g	18.3a	16.7a	14.0a	28.0a	29.3ab	40.7a	73.0a	60.3a	**103.8a**
Acephate	Acephate	75	667 g	17.7a	15.0a	14.7ab	32.7a	25.3a	46.0a	108.7a	120.7b	**178.3b**
Monocrotophos	Suphos	36	1390 ml	16.3a	13.7a	15.0ab	31.7a	28.7a	116.3b	186.3c	157.7b	**353.1c**
Untreated Control	Water	-	-	19.3a	23.7b	18.0b	28.3a	34.0b	517.7c	309.7d	226.3c	**437.4d**

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Whitebacked Planthopper(No./10 hills) GGV				NVS		PNR	SKL						Mean
				40 DAT	60 DAT	80 DAT	100 DAT	45 DAT	55 DAT	65 DAT	37 DAT	40 DAT	53 DAT	56 DAT	71 DAT	75 DAT	
Acephate	Acephate 95 SG	95	526 g	361.7a	78.3a	63.3b	31.7b	9.3a	2.3a	6.3a	12.0a	17.0a	22.0a	19.0a	30.7a	48.0a	**54.0a**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	367.7a	92.7a	74.0b	39.7b	13.3a	1.3a	10.0a	11.0a	16.7a	22.7a	21.3a	34.3a	46.0a	**57.7a**
Buprofezin	Applaud	25 SC	1000 g	382.0a	97.0a	76.7b	42.0bc	14.7a	5.3b	9.0a	13.7a	17.0a	24.3a	19.7a	37.0a	46.3a	**60.4ab**
Dinotefuran	Token	36	200 g	400.3a	71.7a	34.0a	14.3a	14.7a	1.7a	8.3a	12.3a	17.7a	26.0a	18.7a	34.3a	44.0a	**53.7a**
Imidacloprid + Ethiprole	Glamore	80	125 g	386.3a	47.0a	21.0a	4.7a	14.0a	9.3b	7.7a	12.7a	16.7a	26.3a	19.0a	31.7a	47.0a	**49.5a**
Acephate	Acephate	75	667 g	381.0a	85.7a	68.0b	34.3b	14.3a	7.7b	6.0a	12.7a	15.7a	23.7a	18.7a	35.3a	44.3a	**57.5a**
Monocrotophos	Suphos	36	1390 ml	370.0a	156.0b	137.3c	69.7c	15.0a	5.0b	8.0a	13.3a	18.0a	26.3a	21.0a	33.0a	50.0a	**71.0b**
Untreated Control	Water	-		390.3a	441.7c	450.3d	343.7d	16.0a	18.0c	5.0a	11.7a	25.0b	24.3a	26.3b	37.7a	59.3b	**142.3c**

Table: 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Green Leafhopper(No./10 hills) GGV			JDP			NAV		RNC		SKL			Mean
				40 DAT	60 DAT	100 DAT	50 DAT	72 DAT	80 DAT	58 DAT	68 DAT	48 DAT	52 DAT	51 DAT	71 DAT	75 DAT	
Acephate	Acephate 95 SG	95	526 g	88.0a	34.7a	22.7b	9.7a	25.3a	17.3a	12.0a	3.3a	66.7a	19.7d	6.0a	22.3a	14.7a	**26.3a**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	86.3a	47.7b	28.3b	12.7ab	30.0a	19.3a	11.7a	2.0a	68.7a	8.0a	5.0a	19.3a	12.7a	**27.1a**
Buprofezin	Applaud	25 SC	1000 g	77.3a	53.3b	31.3b	15.3ab	29.3a	18.3a	11.3a	7.7b	68.7a	11.7b	7.3a	18.7a	14.7a	**28.1a**
Dinotefuran	Token	36	200 g	74.7a	21.7a	5.3a	11.0ab	27.7a	16.0a	10.0a	2.0a	72.0a	21.3d	6.7a	19.7a	11.7a	**23.1a**
Imidacloprid + Ethiprole	Glamore	80	125 g	78.3a	27.7a	9.0a	11.3a	27.3a	16.7a	11.7a	11.0b	68.3a	14.7bc	8.0a	19.0a	14.0a	**24.4a**
Acephate	Acephate	75	667 g	76.3a	40.0ab	27.0b	8.7a	35.7a	21.7a	13.0a	9.0b	70.0a	17.7c	7.3a	23.3a	14.7a	**28.0a**
Monocrotophos	Suphos	36	1390 ml	85.0a	64.7b	52.0c	12.7a	35.7a	23.3a	12.3a	5.0a	70.7a	20.3d	5.0a	22.0a	12.3a	**32.4a**
Untreated Control	Water	-	-	80.7a	102.0c	89.7d	21.0b	40.3a	33.3b	13.3a	18.7c	72.3a	75.3e	7.3a	22.7a	22.0b	**46.1b**

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

Table: 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formulation	Dose of formulation or product/ha	Gundhi bugs(No./10 hills)						Mean
				NVS		REW			TTB	
				BS	AS	59 DAT	62 DAT	70 DAT	65 DAT	
Acephate	Acephate 95 SG	95	526 g	9.7a	3.0b	18.7a	3.0a	7.3a	1.7b	**7.2a**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	9.0a	1.7a	20.7a	2.0a	7.7a	0.3a	**6.9a**
Buprofezin	Applaud	25 SC	1000 g	9.3a	5.3c	21.7a	2.7a	7.7a	1.7b	**8.1a**
Dinotefuran	Token	36	200 g	9.7a	3.3b	20.3a	2.3a	6.7a	2.7b	**7.5a**
Imidacloprid + Ethiprole	Glamore	80	125 g	9.3a	9.0d	19.7a	2.7a	6.3a	2.7b	**8.3a**
Acephate	Acephate	75	667 g	9.3a	5.0b	25.0a	3.0a	8.7a	2.3b	**8.9a**
Monocrotophos	Suphos	36	1390 ml	9.3a	6.3c	20.0a	2.7a	7.3a	2.3b	**8.0a**
Untreated Control	Water	-	-	10.0a	13.3e	17.7a	19.7b	20.3b	9.0c	**15.0b**

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formulation	Dose of formulation or product/ha	Hispa damaged leaves(%HDL)				HDL/10 hills	
				MLN				RNC	
				40 DAT	50 DAT	90 DAT	Mean	34 BT	40 AT
Acephate	Acephate 95 SG	95	526 g	40.7a	5.0a	4.0a	16.6a	45.7a	18.0a
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	60.5a	5.9a	3.8a	23.4ab	50.0a	19.7a
Buprofezin	Applaud	25 SC	1000 g	32.3a	6.7a	2.4a	13.8a	45.3a	28.7b
Dinotefuran	Token	36	200 g	42.1a	9.9a	5.5a	19.2a	48.3a	26.7b
Imidacloprid + Ethiprole	Glamore	80	125 g	46.6a	5.2a	5.5a	19.1a	40.0a	16.0a
Acephate	Acephate	75	667 g	40.2a	4.8a	6.1a	17.1a	39.3a	18.3a
Monocrotophos	Suphos	36	1390 ml	56.4a	5.2a	6.0a	22.5ab	42.7a	21.7ab
Untreated Control	Water	-	-	64.5a	19.4b	8.0b	30.6b	47.0a	50.0c

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Caseworm Damage (%CWDL) BMR 35DAT BT	Caseworm Damage (%CWDL) BMR 35DAT AT	Caseworm Damage (%CWDL) BMR Mean	Whorl Maggot Damage (%WMDL) PTB
Acephate	Acephate 95 SG	95	526 g	41.2a	29.0bc	35.1	17.4ab
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	44.8a	25.7ab	35.2	20.8b
Buprofezin	Applaud	25 SC	1000 g	34.4a	28.3b	31.4	21.6b
Dinotefuran	Token	36	200 g	46.0a	26.7ab	36.3	15.3a
Imidacloprid + Ethiprole	Glamore	80	125 g	46.9a	19.3a	33.1	12.4a
Acephate	Acephate	75	667 g	46.9a	25.7ab	36.3	21.3b
Monocrotophos	Suphos	36	1390 ml	57.4a	24.6a	41	17.0a
Untreated Control	Water	-	-	50.9a	35.1c	43	23.0b

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Mirid bugs(No./10 hills) GGV 40DAT	GGV 70DAT	GGV 76DAT	GGV 100DAT	GGV 83DAT	MTU 90DAT	MTU 99DAT	MTU 104DAT	Mean
Acephate	Acephate 95 SG	95	526 g	193.3a	16.7b	51.7ab	80.7bc	83.3b	89.8bc	7.0a	8.3a	**66.4c**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	188.0a	26.5ab	60.7a	68.0bc	132.2a	130.8ab	7.0a	11.3a	**78.1c**
Buprofezin	Applaud	25 SC	1000 g	186.7a	16.8b	52.3ab	98.3b	125.2a	124.5b	5.3a	9.7a	**77.4c**
Dinotefuran	Token	36	200 g	187.3a	9.2b	27.5b	85.7bc	32.3c	39.3d	5.3a	8.3a	**49.4d**
Imidacloprid + Ethiprole	Glamore	80	125 g	182.7a	11.5b	41.5a	58.7c	58.2bc	74.3d	5.7a	7.3a	**55.0d**
Acephate	Acephate	75	667 g	186.3a	12.7b	47.0a	49.0c	94.0a	84.3c	5.3a	10.7a	**61.2c**
Monocrotophos	Suphos	36	1390 ml	195.7a	22.2a	57.7a	32.7c	159.7a	191.7a	6.7a	12.7a	**84.9b**
Untreated Control	Water	-	-	192.0a	29.0a	70.2a	217.0a	159.2a	154.0ab	11.0a	10.3a	**105.3a**

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

Table 2.13 (contd…) Insect Pest incidence in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formu-lation	Dose of formulation or product/ ha	Spiders (No./10 hills) GGV 40 DAT	GGV 100 DAT	KUL 63 DAT	KUL 69 DATAT	KUL 72 DATAT	KUL 83 DATAT	MTU 30 DAT	MTU 50 DAT	MTU 60 DAT	MTU 70 DAT	MTU 76 DAT	SKL 10 DAT2	SKL 10 DAT 3	WGL 92 DAT	WGL 99 DAT	WGL 104 DAT	Mean
Acephate	Acephate 95 SG	95	526 g	57.0a	29.0b	53.3a	5.0c	5.3b	5.7b	3.5a	5.5a	6.0bc	8.3a	9.5a	5.3a	8.7a	23.3a	29.3a	27.0a	**17.6a**
Flubendiamide 4%+ Buprofezin 20% SC	RIL-IS-109	35g+175g	875 ml	51.7a	18.3c	56.0a	6.0c	4.0c	5.0b	4.8a	5.0a	6.5b	7.8a	11.3a	5.3a	7.0a	22.3a	31.0a	26.3a	**16.8a**
Buprofezin	Applaud	25 SC	1000 g	55.0a	44.0b	56.7a	8.3c	4.7bc	6.0b	3.0a	3.7a	4.8c	7.3a	8.5a	6.0a	9.3a	25.3a	27.3a	24.3a	**18.4a**
Dinotefuran	Token	36	200 g	54.3a	33.7bc	51.0a	6.0c	3.3c	7.0b	3.5a	4.0a	4.8c	5.8a	6.2a	5.7a	8.0a	23.3a	25.0a	23.7a	**16.6a**
Imidacloprid + Ethiprole	Glamore	80	125 g	52.7a	15.7c	56.3a	7.7c	5.7b	5.7b	3.3a	5.8a	5.7bc	5.3a	7.7a	5.7a	8.7a	23.0a	21.0a	24.7a	**15.9a**
Acephate	Acephate	75	667 g	53.7a	12.7c	52.0a	5.0c	6.3b	6.0b	3.0a	5.7a	7.0b	5.8a	8.7a	5.7a	9.0a	24.3a	30.7a	24.3a	**16.2a**
Monocrotophos	Suphos	36	1390 ml	50.3a	8.7c	52.3a	10.0b	4.3b	5.3b	3.8a	6.2a	7.2b	6.5a	10.0a	6.3a	7.7a	21.3a	34.3a	26.0a	**16.3a**
Untreated Control	Water	-	-	48.7a	79.7a	59.3a	42.0a	35.0a	13.0a	3.3a	6.3a	9.3a	7.5a	14.0a	8.0a	11.7a	24.7a	29.7a	26.3a	**26.2b**

Table 2.14 Grain yield in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. form-ula-tion	Dose of formulation or product/ ha	Yield (kg/ha) ADT	BMR	CTC	FZB	GGT	GGV	IRS	JDP	KJT	KUL	LDN	MLN	MND	MTU	NVS
Acephate	Acephate 95 SG	95	526 g	10000a	2477a	4256b	2908d	3201a	5933a	3688b	3197c	6076a	3960a	7064a	4395a	5421a	2935c	5378b
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+ 175g	875 ml	9000b	2326a	3905bc	3405a	2620b	6293a	4600a	3733b	6619a	4133a	5452b	4148a	5592a	3188b	5966a
Buprofezin	Applaud	25 SC	1000 g	10000a	2265a	3853bc	3312b	2648b	5333a	4650a	3700b	5245bc	4160a	5599b	4864a	5405a	3629b	5329b
Dinotefuran	Token	36	200 g	10000a	2958a	4759ab	3250c	3054a	6480a	3925ab	4110a	4680c	4207a	5409b	4198a	5542a	4455a	5415b
Imidacloprid + Ethiprole	Glamore	80	125 g	8167b	2258b	5188a	3238c	2591b	6547a	3550bc	3777b	5483bc	4040a	5420b	4099a	5656a	3698b	5102b
Acephate	Acephate	75	667 g	9000b	2246b	5133a	2535e	2738b	5773a	3313bc	3350c	6322a	4067a	6868a	4444a	5550a	3485bc	5170b
Monocrotophos	Suphos	36	1390 ml	10833a	2188b	3541bc	3362b	2453b	3880b	2975c	3667b	5758ab	3960a	6730a	4123a	5299a	2511c	5362b
Untreated Control	Water	-	-	6333c	1503c	3229c	2117f	1946c	2120c	3650bc	2900c	4398c	4000a	4631c	3111b	4694a	2342c	4083c

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

Table 2.14 Grain yield in different treatments, IET, *Kharif* 2014

Treatment	Trade Name	% a.i. formula-tion	Dose of formulation or product/ha	Yield (kg/ha)															Mean	% IOC
				NDL	NWG	PDC	PNR	PTB	PUS	REW	RGL	RNC	RNR	RPR	SBP	SKL	TTB	WGL		
Acephate	Acephate 95 SG	95	526 g	4633a	3905a	4892a	3245bc	2229c	7722ab	3248a	5836a	2889b	3872a	7150a	3294b	1642a	4028b	5045ab	**4484ab**	**23.7**
Flubendiamide 4% + Buprofezin 20% SC	RIL-IS-109	35g+ 175g	875 ml	5267a	4026a	4983a	4188a	3361a	7681ab	2850ab	6186a	3311a	3966a	7033a	3588a	1425a	4570a	4306ab	**4591a**	**25.5**
Buprofezin	Applaud	25 SC	1000 g	4883a	2893a	5267a	3225bc	2966a	7361b	2244c	6022a	2711b	3779a	6233b	2961c	1800a	4292ab	4819ab	**4382b**	**21.9**
Dinotefuran	Token	36	200 g	4933a	2343a	5033a	3477b	2555bc	8181a	3098ab	6314a	3067a	4175a	6275b	3353b	1525a	3907b	4960ab	**4521a**	**24.3**
Imidacloprid + Ethiprole	Glamore	80	125 g	5100a	2321a	4867a	3013c	2366bc	7431b	2821b	6069a	3178a	3729a	5967b	3745a	1483a	3815bc	4418ab	**4304b**	**20.5**
Acephate	Acephate	75	667 g	5167a	2655a	5217a	3173bc	2581bc	7778ab	2821b	6544a	3311a	3902a	6725a	3157b	1600a	3575c	5195a	**4447ab**	**23.1**
Monocrotophos	Suphos	36	1390 ml	4667a	2985a	4358a	3412b	2829a	8056a	2863ab	5881a	3302a	4043a	6567ab	3333b	1600a	3777bc	4265b	**4286a**	**25.3**
Untreated Control	Water	-	-	4750a	1530a	4367a	3143c	2641bc	5764c	1795c	5900a	2444c	3565a	5875b	1980d	1350a	3253d	3179c	**3420c**	**-**

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

i) Pesticide Compatibility Trial (PCT)

The compatibility of two newer insecticides belonging to different groups *viz*., rynaxypyr (chlorantraniliprole) – Coragen 20 SC supplied by Dupont India Limited and dinotefuran (Token 20 SG), a product of Indofil Chemicals Ltd. with fungicides was evaluated based on their efficacy when applied as tank-mix in the field. The fungicides consisted of carbendazim plus mancozeb and validamycin supplied by Krishi Rasayan Exports Pvt. Ltd. During Kharif 2014, the trial was carried out at 19 locations *viz.*, Aduthurai, Chinsurah, Cuttack, Faizabad, Gangavathi, Iroisemba, Ghaghraghat, Jagdalpur, Ludhiana, Navsari, Nellore, Puducherry, Pattambi, Raipur, Rewa, Ranchi, Sakoli, Sambalpur and Titabar.

Treatments

The trial consisted of nine treatments consisting of the rynaxypyr@ 0.3 ml/litre, dinotefuran @ 0.4 ml/litre, carbendazim plus mancozeb @ 2.0 g/litre and validamycin @ 2.5 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 nine treatments with three replications were laid out in Randomized Complete Block Design (RCBD).

Observations were recorded on ten randomly selected hills to assess stem borer damage at vegetative and heading stages and expressed as per cent dead hearts or white ears. Similarly, counts of leaf folder damaged leaves were taken on 10 randomly selected hills per plot and the percentage damaged leaves were calculated. Planthopper populations were counted on ten randomly selected hills per plot before and after application of treatments. For assessing the severity of blast, sheath blight and bacterial leaf 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.

Results

Insect pest infestation (Table 2.15)

The **stem borer** infestation at vegetative stage across 11 locations was recorded up to a maximum of 26.5% DH, while mean infestation ranged from 4.2 to 12.1% DH across treatments including control. There were significant differences among the pesticide treatments at all locations. The infestation in insecticides alone and combination treatments (4.2 to 6.5% DH) was lower than that in fungicide alone treatments (7.4 and 8.0% DH %) and control (12.1% DH). The differences in efficacy between the two insecticides and their combinations with fungicides were not significant. At heading stage, there were significant differences among the treatments at 11 locations. The white ear incidence was significantly lower in rynaxypyr treatment and its combinations (11.5 to 13.2% WE), while dinotefuran treatment alone and in combination fared on par with fungicide treatments and control (16.7 to 24.2% WE). Overall, against stem borer, the performance of rynaxypyr was superior to that of dinotefuran, when applied alone or in combination with fungicides.

The **gall midge** incidence was recorded up to 55.8% SS across 4 locations. All the pesticide treatments were at par (11.9 to 18.8% SS) while fungicide treatments were also at par with control (25.5% SS) control.

Leaf folder incidence was recorded upto a maximum of 17.9% DL at Jagdalpur, while in the remaining locations, the damage ranged between 1.0 and 11.0% DL. The mean infestation across locations varied from 3.3 to 8.9% DL and there were no discernible differences among the treatments including control.

Brown planthopper populations were recorded at 6 locations and maximum infestation was recorded up to 537.0 hopper/10 hills at Gangavathi. The mean infestation across locations ranged from 26.8 to 103.9 hoppers per 10 hills. The hopper population was significantly lower in dinotefuran treatment alone as well as in combination with fungicides (26.8 to 28.8 hoppers/10 hills) compared to rynaxypyr treatments (46.4 to 50.5 hoppers/10 hills). The fungicides alone treatments showed significantly higher hopper populations on par with control (91.8 to 103.9 hoppers/10 hills). The efficacy of dinotefuran when applied individually was at par in combination with fungicides also. The white backed planthopper population was also high and recorded upto 515.0 hoppers/10 hills at Gangavathi. As observed in the case of BPH, application of dinotefuran individually as well as in combination with fungicides showed significantly lower mean WBPH population (47.8 to 51.0 hoppers/10 hills) than rynaxypyr treatments (89.0 to 92.4 hoppers/10 hills). The fungicides applied alone (141.5 and 141.9 hoppers/10 hills) were at par with untreated control (150.3 hoppers/10 hills).

Disease incidence

Blast disease was recorded at seven locations. At Jagdalpur disease severity was recorded upto 68.5% and there were significant differences among treatments including control after the application of pesticide treatments. The blast severity was significantly lower in the fungicide applications applied alone as well as in combination with insecticides (12.3 to 26.7%) compared to insecticide treatments (32.6 and 46.0%) as well as control (68.5%). Among the two fungicides there were no significant differences in performance when used alone or in combination with insecticide. At Gangavathi and Ghaghraghat, as well as across locations there were no significant differences among the treatments because of low to moderate disease incidence.

Sheath blight incidence was observed at 3 locations and at Faizabad, the incidence was recorded up to an extent of 56.1%. At this location there were significant differences among the treatments including control. The fungicide treatments showed significantly lower disease incidence (18.3 to 29.7%) compared to insecticide treatments (30.9 to 45.5%) and control (38.6 to 56.1%). varied from 14.6 to 18.2% in pesticide treatments and 19.2 to 27.7% in control. In the remaining two locations there were no significant differences among treatments including control. Across locations, efficacy of fungicide treatments whether applied alone or in combination with insecticides was at par.

Grain yield (Table 2.16)

There were significant differences in grain yield among different treatments at 12 locations. The mean grain yield data across the locations revealed that application of rynaxypyr alone was the best treatment showing the highest yield of 5663 kg/ha with an increase of 23.2% over control (IOC) which was on par with the treatment rynaxypyr applied alongwith combination formulation carbendazim plus mancozeb with the next highest yield of 5594 kg/ha and 22.2% IOC. Dinotefuran applied alone also yielded high (5531 kg/ha with 21.3% IOC) on par with its combination along with carbendazim plus mancozeb (5423 kg/ha with 19.8% IOC). The next best treatments were rynaxypyr applied with validamycin yielding 5298 kg/ha with an IOC of 17.9%, dinotefuran plus validamycin (5271 kg/ha with 17.5 % IOC) and carbendazim plus mancozeb treatment applied alone (5252 kg/ha and 17.2 % IOC). Validamycin treatment yielded 5152 kg/ha with IOC of 15.2%.

Pesticide compatibility trial was carried out 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, at 19 centres during kharif 2014. There were no significant differences in the performance of the two newer insecticide formulations dinotefuran and rynaxypyr in their proven efficacy when applied alone or in combination with fungicides. Yield point of view the treatments of rynaxypyr applied alone and its combination with fungicides were superior to dinotefuran alone and its combination with fungicides. However, the results revealed that there was no adverse impact on the efficacy of either of the insecticides when applied with fungicides or vice versa confirming the compatibility of the chemicals when used as tank mix in the field.

Table 2.15 (Contd…) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formula-tion	g or ml per litre of spray fluid	Stem Borer damage (%Deadhearts)									
				ADT		CHN		FZB		LDN		NVS	
				30DAT	50DAT	30DAT	50DAT	30DAT	50DAT	BS	15DAS	30DAT	50DAT
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	6.3a	6.7a	0.0a	1.3a	2.4a	4.7a	4.8a	1.2a	6.4ab	7.3ab
Token	Dinotefuran	20	0.4	4.6a	3.7a	1.9a	9.5b	10.3b	7.0b	4.6a	4.2b	8.4b	9.4b
CM 75	Carbendazim+Mancozeb	50	2	5.8a	5.5a	3.7a	12.0b	13.2b	6.7b	4.6a	4.1b	7.4b	8.5b
V-3	Validamycin	3	2.5	4.8a	5.2a	2.7a	13.2b	12.1b	8.9b	5.1a	4.0b	9.5bc	10.4bc
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	6.0a	5.2a	0.0a	1.0a	9.7b	2.9	5.0a	1.5a	3.6a	3.9a
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	6.6a	5.1a	0.4a	1.8a	7.2b	2.1a	5.1a	1.7a	2.5a	3.0a
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	5.2a	6.1a	3.0a	10.8b	8.6b	3.1a	4.4a	2.6a	5.3ab	5.7ab
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	7.0ab	7.1ab	2.3a	10.0b	8.4b	3.2a	5.1a	2.3a	8.4b	8.7b
Untreated Control	Water spray	-		14.3b	11.0b	4.0a	16.6c	26.5c	26.3c	4.9a	5.9b	11.4c	13.4c

Table 2.15 (Contd…) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formula-tion	g or ml per litre of spray fluid	Stem Borer damage (%Deadhearts)										
				PTB		RNC	RPR		SBP		SKL			
				30DAT	50DAT	30DAT	30DAT	50DAT	56DAT	76DAT	19DAT	26DAT	52DAT	Mean
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	3.9a	2.8a	3.9a	2.6a	4.0a	3.3a	1.0a	1.9a	2.3a	9.7a	**4.4a**
Token	Dinotefuran	20	0.4	3.5a	12.3	4.4a	4.8ab	8.6b	7.5b	4.6b	2.0a	1.5a	10.7a	**6.5ab**
CM 75	Carbendazim+Mancozeb	50	2	4.5a	12.7b	9.2b	5.8b	10.5b	7.7b	5.5b	2.7a	4.6a	10.6a	**7.4b**
V-3	Validamycin	3	2.5	5.3a	15.0b	11.2b	6.5b	11.5b	5.9b	3.8a	4.0ab	4.6a	13.0a	**8.0b**
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	5.7a	1.5a	4.3a	2.5a	3.7a	1.8a	0.6a	3.1a	1.4a	8.0a	**4.2a**
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	3.4a	1.8a	3.6a	2.0a	6.3ab	3.1a	1.4a	4.5ab	2.8a	9.9a	**4.3a**
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	4.1a	2.0a	4.6a	3.9a	9.4b	6.8b	2.7a	2.8a	2.1a	10.0a	**5.5ab**
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	2.2a	3.8a	4.8a	4.7ab	10.8b	4.9ab	3.7a	5.7b	4.1a	10.6a	**6.1ab**
Unntreated Control	Water spray	-		7.0a	13.3b	14.4c	8.0b	14.5c	12.9c	16.8c	7.3b	6.4a	10.4a	**12.1c**

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

Table 2.15 (Contd…) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Stem Borer damage (%White ears)												Mean
				ADT	CHN	FZB	GGT	GGV	LDN	NVS	PTB	RNC	RPR	SBP	SKL	
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	2.6a	0.7a	3.3a	3.9a	1.0a	1.1a	8.3c	5.0a	3.3a	12.5ab	1.2a	4.8a	**11.5**
Token	Dinotefuran	20	0.4	3.1a	4.1b	6.9c	4.0a	2.9b	3.5b	10.2c	10.0b	3.5a	16.7b	3.6a	10.7b	**16.7**
CM 75	Carbendazim+Mancozeb	50	2	2.9a	16.8c	12.7d	9.2b	4.8b	4.1b	9.5c	11.8b	7.9b	21.0c	7.4b	6.8a	**22**
V-3	Validamycin	3	2.5	2.2a	12.0c	14.2d	9.3b	4.5b	4.1b	11.4c	11.1a	6.7b	19.1b	4.3ab	9.5b	**21.8**
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	2.7a	2.5a	5.3b	3.4a	0.6a	1.6a	4.6a	4.7a	3.1a	11.7a	0.9a	5.9a	**12.9**
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	2.6a	2.0a	4.4a	3.7a	0.9a	2.1a	4.3a	3.3a	3.1a	14.8b	2.2a	6.3a	**13.2**
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	2.3a	5.0b	6.9c	3.6a	2.7b	4.2b	7.0b	5.9a	2.7a	15.9b	4.0ab	7.2b	**18.1**
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	2.3a	8.3bc	7.0c	3.6a	3.0b	4.1b	10.1c	5.1a	3.5a	15.5b	3.1a	2.6a	**19.3**
Untreated Control	Water spray	-		6.6a	18.3c	28.8e	10.1b	7.8c	7.2c	15.6d	8.0b	10.2b	21.7c	12.2c	15.8c	**24.2**

Table 2.15 (Contd…) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Brown Planthopper (No./10 hills)									
				GGV						JDP			
				44 DAT		66 DAT		91 DAT		60 DAT		70 DAT	
				BT	AT	BT	AT	BT	AT	BT	AT	BT	AT
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	173.0a	130.3b	259.0a	196.3b	216.7b	152.3b	13.3b	0.7a	8.0ab	4.3a
Token	Dinotefuran	20	0.4	183.3a	70.3a	125.7a	63.3a	94.7a	29.3a	13.0b	1.7a	4.7a	3.0a
CM 75	Carbendazim+Mancozeb	50	2	179.3a	211.3c	382.3a	487.7c	490.3c	465.3c	6.3a	4.7a	9.3ab	8.0a
V-3	Validamycin	3	2.5	183.0a	220.3c	358.3a	492.3c	477.3c	458.7bc	7.3a	6.7a	10.0b	5.3a
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	195.0a	117.3b	202.7a	171.3b	191.0b	143.7a	12.7b	3.7a	6.7a	4.7a
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	194.0a	123.0b	245.7a	181.3b	199.7b	140.7b	10.3ab	0.7a	9.0ab	3.7a
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	188.0a	62.7a	139.3a	49.7a	85.7a	23.0a	10.7ab	1.0a	5.3a	1.7a
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	179.3a	66.7a	148.7ab	57.0a	94.7a	24.7a	9.3a	0.3a	4.3a	8.0ab
Untreated Control	Water spray	-	-	195.3b	243.0d	396.0b	537.0c	524.0c	502.3c	18.0b	20.0b	14.7b	19.3b

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

Table 2.15 (Contd...) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formu-lation	g or ml per litre of spray fluid	Brown Planthopper (No./10 hills)						Mean
				LDN		NVS				
				-		50 DAT		80 DAT		
				BT	AT	BT	AT	BT	AT	
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	8.7a	6.7bc	9.0a	3.0a	12.3a	5.0b	**50.5**
Token	Dinotefuran	20	0.4	7.0a	3.0a	9.0a	5.3b	13.0a	6.0b	**28.8**
CM 75	Carbendazim+Mancozeb	50	2	7.0a	5.7b	8.7a	3.7ab	13.0a	5.0b	**93.0**
V-3	Validamycin	3	2.5	6.7a	6.0b	8.3a	5.7b	11.7a	6.7b	**91.8**
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	6.3a	4.7a	8.7a	1.7a	13.0a	3.3b	**46.4**
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	7.3a	5.7b	9.0a	1.0a	12.7a	1.7a	**48.9**
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	6.3a	3.3a	8.3a	2.7a	13.3a	4.7b	**27.6**
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	7.0a	3.0a	9.7a	4.7b	14.0a	7.0b	**26.8**
Untreated Control	Water spray	-	-	6.7a	9.0c	10.3a	11.3c	15.0a	18.0c	**103.9**

Table 2.15 (Contd...) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formu-lation	g or ml per litre of spray fluid	Whitebacked Planthopper (No./10 hills)								
				GGV						Mean	LDN	
				44DAT		66DAT		91DAT			-	
				BT	AT	BT	AT	AT	BT		BT	AT
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	429.7a	286.0b	352.7b	225.7b	193.7b	140.3b	271.3b	7.3b	8.7a
Token	Dinotefuran	20	0.4	439.0a	79.7a	183.3a	66.7a	83.3a	16.3a	144.7a	3.0a	8.7a
CM 75	Carbendazim+Mancozeb	50	2	443.0a	429.0c	486.0c	455.0c	410.7c	374.0c	432.9c	7.0b	8.7a
V-3	Validamycin	3	2.5	437.3a	436.3c	475.3c	462.7c	402.3c	381.7c	432.6c	8.7b	10.3a
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	456.0a	274.0b	322.7b	205.0b	172.0b	125.7b	259.2b	8.0b	9.3a
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	458.0a	295.7b	331.7b	215.7b	179.0b	131.3b	268.6b	7.7b	8.0a
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	445.7a	69.0a	153.3a	54.3a	68.0a	10.7a	133.5a	4.7a	7.7a
Token+Validamycin	Dinotefuran+Validamycin	-	0.4+2.5	440.7a	75.7a	170.3a	60.7a	75.7a	12.7a	139.3a	4.0a	8.7a
Untreated Control	Water spray	-	-	422.0a	445.0c	515.0c	502.0c	435.0c	390.3c	451.6c	11.7c	8.3a

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

Table 2.15 (Contd...) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formu-lation	g or ml per litre of spray fluid	Whitebacked Planthopper (No./10 hills)											Mean
				NVS				SKL							
				50 DAT		80 DAT		25 DAT	36 DAT	52 DAT	70 DAT	42 DAT	57 DAT	76 DAT	
				BT	AT	BT	AT								
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	9.0a	3.0a	14.7a	7.7a	6.3a	7.7a	16.7a	38	23	22.7	52.3	**92.4**
Token	Dinotefuran	20	0.4	9.0a	5.3a	15.0a	10.3a	4.7a	6.7a	17.3a	34.7	21.7	22	53.7	**54.3**
CM 75	Carbendazim+Mancozeb	50	2	8.7a	3.7a	14.7a	8.3a	9.0b	6.7a	21.0a	39.3	22.3	24	53.3	**141.5**
V-3	Validamycin	3	2.5	8.3a	5.7a	15.3a	11.7a	11.3b	7.3a	21.3a	37.3	25	20.7	53	**141.9**
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	8.7a	1.7a	16.3a	5.7a	6.7a	7.3a	19.0a	41.7	21.3	20	52.7	**89.0**
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	9.0a	1.0a	14.0a	5.0a	4.3a	7.0a	19.3a	38.7	23	20.3	55.3	**91.4**
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	8.3a	2.7a	14.0a	7.3a	5.0a	6.3a	19.7a	38.7	23.7	20.3	56	**51.0**
Token+Validamycin	Dinotefuran+Validamycin	-	0.4+2.5	9.7a	4.7a	15.7a	9.3a	4.0a	7.3a	20.0a	40	18.7	17	55.3	**47.8**
Untreated Control	Water spray	-	-	10.7a	11.7b	17.0a	22.3b	15.7c	7.7a	18.7a	36	33	27.7	65	**150.3**

Table 2.15 (Contd...) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formula-tion	g or ml per litre of spray fluid	Blast (% Sev/10hills)								
				GGT		SBP			RNC			
				87DAT BT	87DAT AT	66DAT	67DAT	76DAT	59 DAT	65 DAT	90DAT BT	100DAT AT
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	15.8a	15.3b	2.6b	2.7b	1.3b	10.5a	11.5c	7.6a	8.6c
Token	Dinotefuran	20	0.4	14.9a	14.9b	2.7b	2.7b	1.7b	10.5a	11.5c	7.7a	7.7a
CM 75	Carbendazim+Mancozeb	50	2	15.5a	4.5a	1.7a	1.2a	1.3b	9.8a	1.3a	7.7a	7.7a
V-3	Validamycin	3	2.5	15.6a	4.5a	1.9a	1.8b	1.3b	10.2a	5.7b	6.7a	6.7a
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	14.8a	4.2a	1.3a	0.8a	1.3b	10.8a	2.2a	6.7a	6.7a
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	16.3a	5.4a	2.5b	1.8b	1.4b	10.7a	5.9b	6.7a	6.7a
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	15.4a	4.1a	2.4b	2.0b	1.4b	10.9a	1.8a	6.7a	6.7a
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	15.6a	4.4a	3.1b	2.8b	0.0a	9.8a	5.5b	6.5a	6.5a
Unntreated Control	Water spray	-	-	15.2a	16.5b	4.2c	4.6c	2.2c	10.2a	12.1c	6.7a	6.7a

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

Table 2.15 (Contd...) Insect pest incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formu lation	g or ml per litre of spray fluid	Blast (%Sev/10hills)								
				GGV		JDP		NVS				
				BT	AT	45DAT BT	45DAT AT	80DAT AT	80DAT BT	50DAT AT	50DAT BT	Mean
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	20.4a	23.0a	15.6a	32.6b	3.7a	1.7b	1.7a	1.0a	**9.8**
Token	Dinotefuran	20	0.4	19.6a	20.7a	24.1a	46.0b	4.0a	2.0b	2.0a	1.7b	**11**
CM 75	Carbendazim+Mancozeb	50	2	21.5a	24.1a	29.6a	26.7ab	4.0a	1.7b	1.7a	1.0a	**8.7**
V-3	Validamycin	3	2.5	24.1a	23.3a	56.7c	20.3a	4.7a	2.3b	2.0a	1.0a	**10.3**
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	24.4a	24.1a	59.6c	26.7ab	4.0a	1.0a	1.0a	0.7a	**10.3**
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	23.0a	22.6a	38.5bc	12.3a	4.3a	0.7a	1.3a	0.3a	**8.8**
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	24.1a	21.9a	25.9a	21.5ab	4.0a	1.3a	2.0a	0.7a	**8.3**
Token+Validamycin	Dinotefuran+ Validamycin	-	0.4+2.5	25.9a	26.7a	38.1b	17.4ab	4.0a	1.7b	1.3a	1.3b	**9.3**
Untreated Control	Water spray	-		22.6a	26.3a	43.3b	68.5c	4.7a	5.7c	2.3a	3.7c	**14.3**

Table 2.15 (Contd...) Disease incidence in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. for-mula-tion	g or ml per litre of spray fluid	Sheath Blight (%Sev/10hills)									Mean
				FZB			NVS				SKL		
				51DAT		68DAT	50 DAT		80DAT		52DAT	62DAT	
				BT	AT	AT	BT	AT	BT	AT	-	-	
Coragen	Rynaxypyr(Chloran-traniliprole)	20	0.3	17.0a	30.9b	41.8c	10.3a	3.3b	7.7a	6.7b	7.7a	8.0a	**14.3**
Token	Dinotefuran	20	0.4	19.1a	34.4b	45.5c	10.3a	5.3b	3.3a	9.7b	3.3a	8.7a	**15.5**
CM 75	Carbendazim+Mancozeb	50	2	16.1a	20.9a	29.7b	10.7a	3.7b	5.3a	7.3b	5.3a	7.7a	**11.6**
V-3	Validamycin	3	2.5	17.9a	18.3a	22.1a	10.3a	6.0b	7.0a	10.7b	7.0a	8.7a	**11.6**
Coragen+CM 75	Rynaxypyr+Carbendazim+ Mancozeb	-	0.3+2.0	18.7a	23.7ab	28.1b	11.0a	2.0a	8.3a	5.3a	8.3a	8.0a	**12.1**
Coragen+ Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	16.9a	17.3a	20.0a	10.0a	1.3a	6.7a	4.3a	6.7a	9.3a	**9.9**
Token+CM 75	Dinotefuran+Carbendazim+ Mancozeb	-	0.4+2.0	18.3a	22.1ab	29.5b	11.0a	2.3a	7.3a	5.7a	7.3a	9.3a	**12.1**
Token+Validamycin	Dinotefuran+Validamycin	-	0.4+2.5	17.4a	22.5ab	25.5b	11.0a	4.7b	7.7a	9.3b	7.7a	9.3a	**12.3**
Untreated Control	Water spray	-	-	18.8a	38.6c	56.1d	13.0a	14.0c	6.0a	27.3c	6.0a	15.0b	**21.4**

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

Table 2.16 (Contd...) Grain yield in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formu-lation	g or ml per litre of spray fluid	Yield(Kg/ha)								
				ADT	CHN	FZB	GGT	GGV	JDP	NVS	PDC	PTB
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	9833a	4778a	3042b	2837a	5040b	2267c	5484b	5642a	3114ab
Token	Dinotefuran	20	0.4	9000a	4489a	2933b	2752a	6680a	2008c	5617b	5075a	2696b
CM 75	Carbendazim+Mancozeb	50	2	10167a	5422a	2900b	2226b	3467cd	2483b	5441c	5133a	2703b
V-3	Validamycin	3	2.5	9333a	6044a	2967b	2197b	3493c	2607b	5159d	5317a	2300b
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	6000a	5600a	3117b	2939a	5107b	2458bc	5480b	5333a	3420a
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	9667a	5378a	3400a	3073a	5173b	2898a	5809a	5275a	3554a
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	9667a	4667a	3017b	2904a	6893a	2583b	5572b	5117a	2778b
Token+Validamycin	Dinotefuran+Validamycin	-	0.4+2.5	9167a	4867a	3250ab	2985a	6813a	2800a	5419c	5008a	2808b
Untreated Control	Water spray	-	-	6167a	4356a	2158c	1950b	2000d	1555d	4091e	4825a	2778b

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

Table 2.16 (Contd...) Grain yield in different treatments, PCT, *Kharif* 2014

Trade Name	Common Name	% a.i. formu-lation	g or ml per litre of spray fluid	Yield(Kg/ha)						Mean	% IOC
				REW	RNC	RPR	SBP	SKL	TTB		
Coragen	Rynaxypyr(Chlorantraniliprole)	20	0.3	2083a	3200ab	7500a	3584ab	2325b	4138b	**5663**	**23.2**
Token	Dinotefuran	20	0.4	2124a	3044ab	7333a	3212b	2208b	4070b	**5531**	**21.3**
CM 75	Carbendazim+Mancozeb	50	2	1266b	2911b	6953b	3153b	2167b	3816c	**5252**	**17.2**
V-3	Validamycin	3	2.5	1225b	2756b	6717b	3369b	2250b	4179b	**5152**	**15.2**
Coragen+CM 75	Rynaxypyr+Carbendazim+Mancozeb	-	0.3+2.0	2056a	3378a	7446a	3917a	2767a	4560a	**5594**	**22.2**
Coragen+Validamycin	Rynaxypyr+Validamycin	-	0.3+2.5	2029a	3044ab	6579b	3623a	2558a	4758a	**5298**	**17.9**
Token+CM 75	Dinotefuran+Carbendazim+Mancozeb	-	0.4+2.0	2097a	3422a	6933b	3192b	2508a	4271b	**5423**	**19.8**
Token+Validamycin	Dinotefuran+Validamycin	-	0.4+2.5	2042a	2927a	6829b	3310b	2067b	4270b	**5271**	**17.5**
Untreated Control	Water spray	-	-	1198b	2511b	5992c	1978c	1800c	3251d	**4350**	**-**

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

2.4 ECOLOGICAL STUDIES

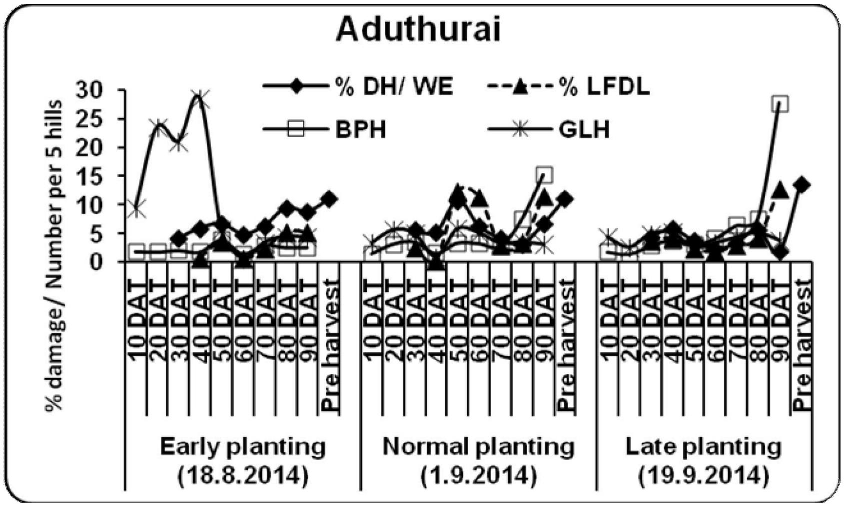
There have been increasing concerns associated with alterations in pest populations both in terms of diversity and number due to changes in global climatic scenario particularly in recent past. Now, it has become essential to study and understand the impact of shift in cropping systems, patterns and types of cultivation systems on pest scenario across rice ecosystems. Keeping this in view, ecological studies were continued in *Kharif* 2014 and included trials related to i) Effect of Planting Date on Pest Incidence (EPDP) and ii) Pest incidence in Selective Mechanization Trial (PISMT). The results of these trials are presented below:

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

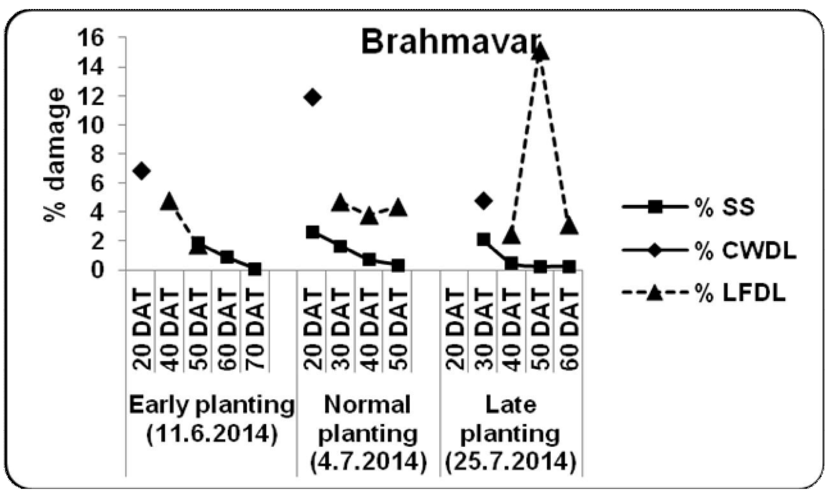
Climate change impacts resulting in delayed monsoon and subsequent release of water from canals is forcing farmers to plant rice at different dates. These changes in sowing and planting dates have profound influence on the incidence of insect pests. Hence, it is imperative to have the knowledge about seasonal incidence of insect pests and their population dynamics in relation to the crop growth stage to devise efficient pest management strategies. Keeping this in view, the present trial was formulated with an objective to know the effect of date of planting on insect pest incidence.

During *Kharif* 2014, delayed monsoon and variability in the distribution pattern of rainfall compelled farmers to go for planting rice at different dates depending on the situation. This trial was conducted at 19 locations during *Kharif* 2014. At each location, most popular variety of that region was planted at three dates *viz.*, Normal planting - as per the recommended package of practices of that region, Early planting - 15 days earlier to normal planting, and Late planting - 15 days later than the normal planting. Each time nursery sowings and later plantings were done separately in 500 sq. m area. Observations on insect pest incidence were recorded at 10 day interval starting from the first appearance of the pest. Location wise pest incidence at different dates of planting is reported:

Aduthurai: Incidence of stem borer, gall midge, leaf folder, whorl maggot, BPH, WBPH and GLH was observed in all the plantings on CR 1009 variety grown in this trial. Moderate infestation of stem borer (11.02- 13.70% WE) and leaf folder (0.22 – 12.69% DL) was recorded. Populations of BPH (0.28 – 5.54/ hill) and GLH (0.6-5.7/ hill) were low across the plantings. Low WBPH incidence was found only in early planting (0.38 – 1.11/ hill).

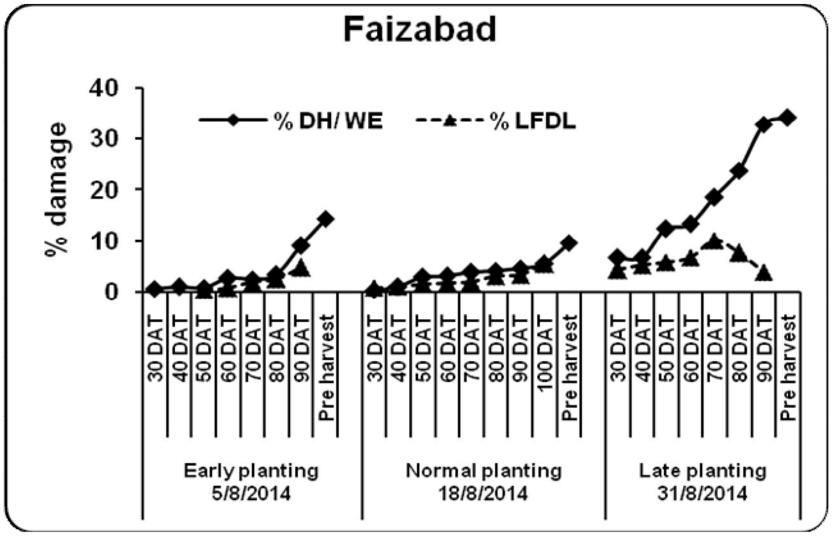


Brahmavar: Jyothi variety was grown in this trial. Low incidence of gall midge (0.11 – 2.67%SS), moderate incidence of leaf folder (1.78 – 15.14%DL) and case worm (4.83 – 11.96%DL) was observed in all the planting dates. Case worm damage was observed only at 20 DAT in early & normal plantings and at 30 DAT in late planting. Grain yield of 45.64, 38.68 and 29.66 q/ ha was obtained from early, normal and late plantings, respectively.

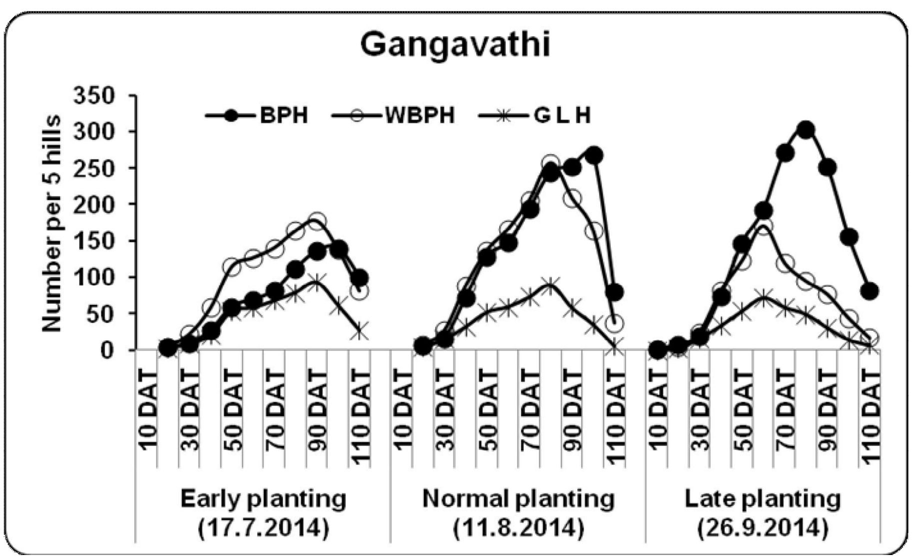


Chinsurah: Low incidence of stem borer (0.49-9.61%), whorl maggot (0.36-6.33% DL) and very low incidence of leaf folder and hispa (<1%DL), green leafhopper, white leafhopper and rice bug (<1 per hill) was reported on Swarna (MTU 7029) variety grown in this trial. Grain yield of 57.5,55 and 50 q/ ha was recorded in early, normal and late plantings, respectively.

Faizabad: High incidence of stem borer was observed in late planting (16.26% DH and 34.14% WE) in Pusa Basmati-1 variety, while leaf folder incidence was low in different plantings (0.4 – 10.06%DL). Grain yield of 60.8 q/ha was obtained from normal planting while yields were relatively lower (53.2 and 24.4 q/ha, respectively) in early and late planting mainly due to white ear damage.

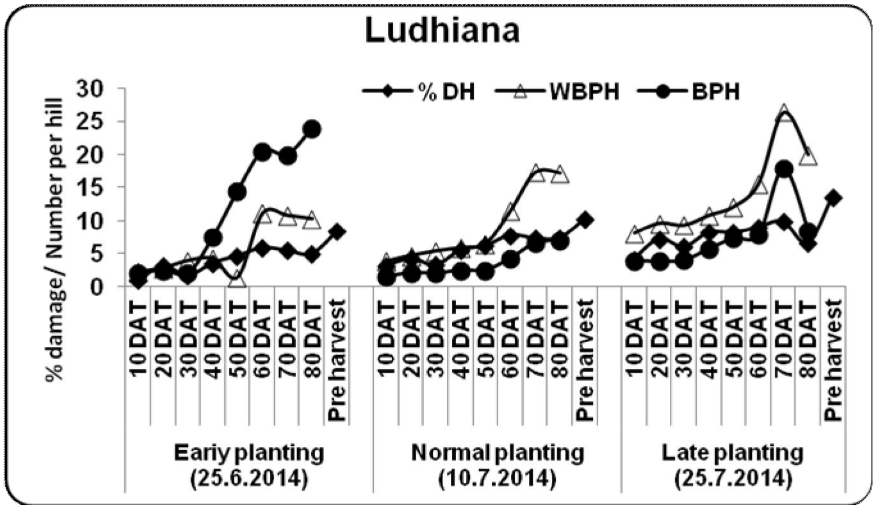


Gangavathi: Most popular variety *i.e.,* BPT 5204 was grown at this location. High population of brown planthopper (61), white backed planthopper (51) and green leafhopper (19) was recorded from each hill in different dates of planting. Low incidence of stem borer (<10%) and leaf folder (<5%) was also reported. However severe rat damage was observed only in early planting (>90%) resulting in drastic yield reduction. Grain yield of 5.73, 23.23 and 20.91 q/ ha was recorded in early, normal and late plantings, respectively.

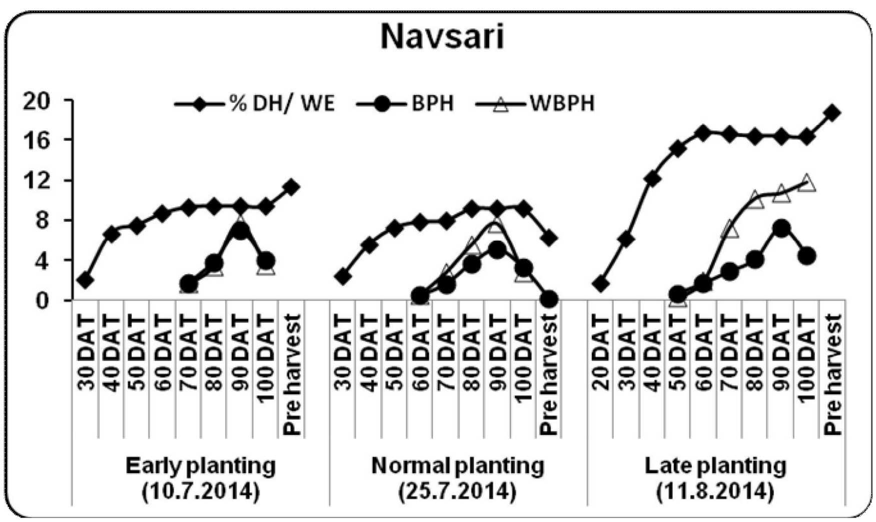


Ghaghraghat: Incidence of whorl maggot, green leafhopper and stem borer (4.38-6.16% WE) was very low in all the plantings in NDGR 201 variety grown in this trial. Grain yield of 56, 53.2 and 50.4 q/ ha was recorded in early, normal and late plantings, respectively.

Ludhiana: Punjab Mehak 1 was grown in this trial. Low incidence of whorl maggot (0.88 – 7.11% DL) and stem borer (1.01-13.56%) was reported whereas the incidence of brown planthopper (1.50 -24.0) and white backed planthopper (1.39-26.40) was high. BPH incidence was high in early planting (11.63/hill) while WBPH incidence was high in late planting (13.99/ hill). Grain yield of 44.35, 42.75 and 37.25 q/ ha was recorded for early, normal and late plantings.



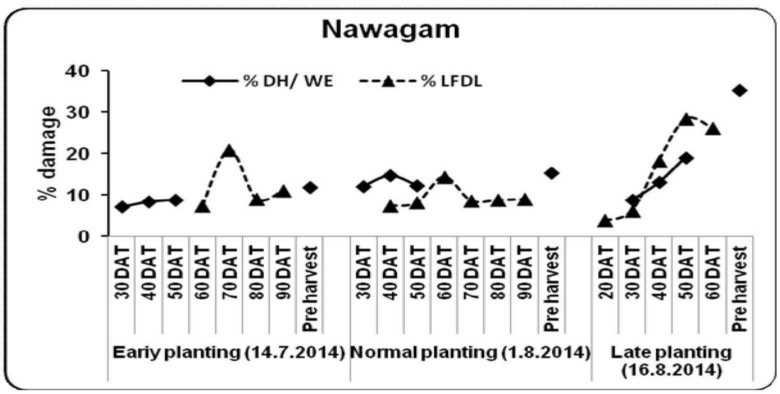
Navsari: Incidence of stem borer, leaf folder, hispa, BPH, WBPH and GLH was low in all the plantings on GR 11 variety grown in this trial. However, dead heart and white ear damage of 13.13 and 18.80% respectively was reported in late planting. Grain yield ranged between 46.75 and 54.50 q/ ha in all the three plantings.



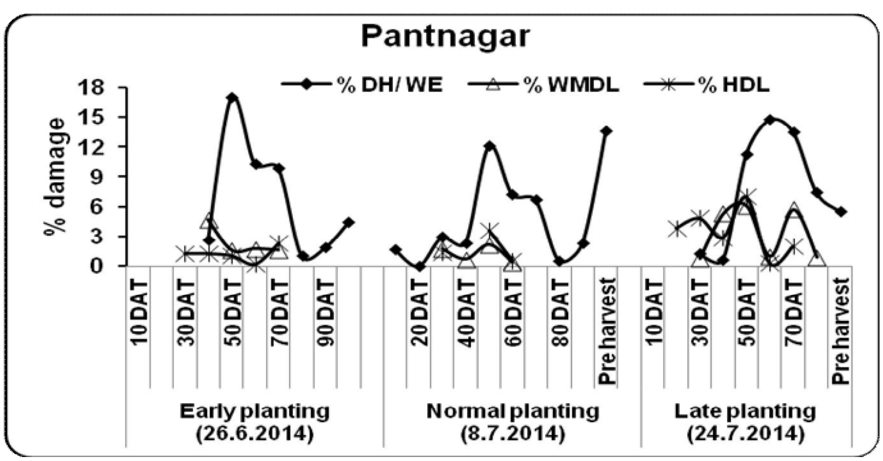
Khudwani: Low incidence of grasshopper (6.3 – 16.2% DL) and rice skipper (0.94-3.14%DL) was reported in all the plantings on Jhelum variety with grain yield of 42.4 - 46.8 q/ ha in different plantings.

New Delhi: Pusa 2511 (Pusa sugandh -5) was grown in this trial. Very low incidence of whorl maggot (0.06-2.72%), leaf folder (0.01-4.31%) and WBPH (0-3/hill) was observed at this location.

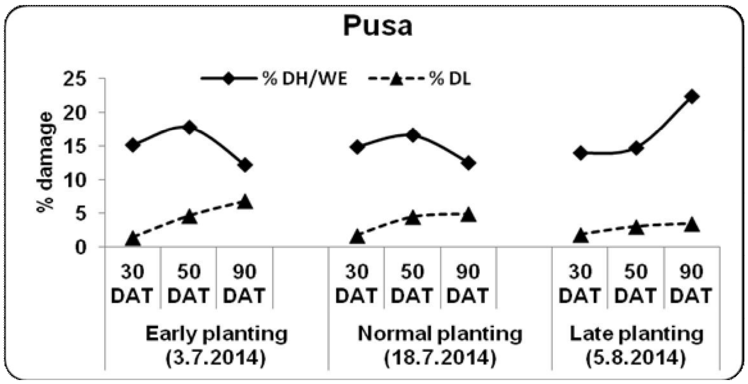
Nawagam: Most popular GR 11 variety was grown in this trial. Incidence of stem borer and leaf folder was observed in all the plantings. Dead heart damage exceeded economic threshold level (ETL) in normal (13.00%) and late (13.62%) plantings while white ear damage was very high in late planting (35.40%). Early and late plantings recorded relatively high leaf folder damage (12.13 – 16.52%) as compared to normal planting (9.40%). Grain yield was high in early planting (42.18q/ ha) followed by normal (35.03 q/ ha) and late plantings (30.76 q/ ha).



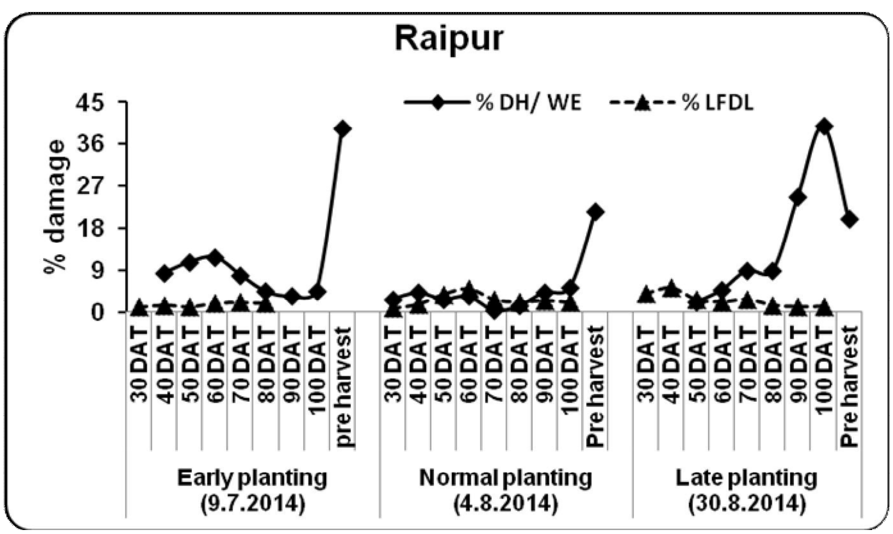
Pantnagar: Incidence of stem borer, leaf folder, whorl maggot, hispa, BPH and WBPH was observed in all the plantings on HKR 47 grown in this trial. Low damage by leaf folder (0.08-3.26%), whorl maggot (0.35 – 6.05%) and hispa (0.21-6.99%) was recorded in all the plantings. Dead heart damage was high in early planting at 50 DAT (17%) while white ears were high in normal planting (13.63%). BPH population was very low across the plantings (0.1 – 3.85/ hill) while WBPH was observed only in late planting at 70 DAT (0.3/hill). Grain yield of 58.7, 51.46 and 49.14 q/ ha was recorded in early, normal and late plantings, respectively.



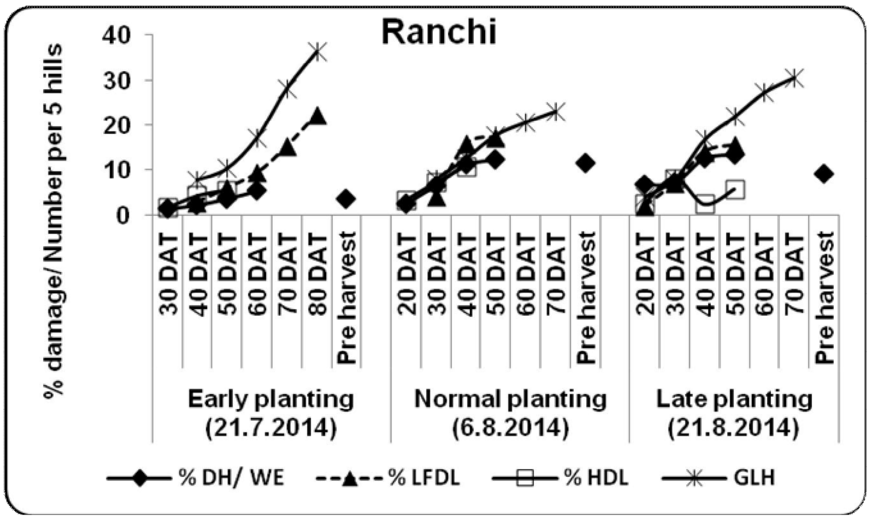
Pusa: Incidence of stem borer and leaf folder was observed in Rajendra Mansuri variety grown in this trial. Low damaged leaves (1.49-6.8%) were observed in all the plantings while moderate dead heart damage (14.39-16.52%) and white ears (12.22 – 22.36%) were recorded across the plantings. Though there were not much difference in dead heart damage across the plantings but white ears were high in late planting (22.36%).



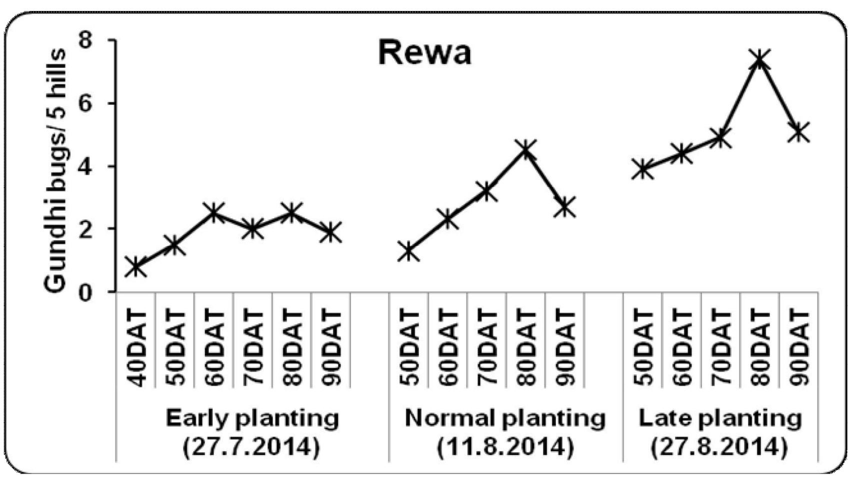
Raipur: Swarna variety was grown in this trial. Low incidence (<5% DL) of leaf folder, hispa and case worm while high incidence of white ears (20.09-39.36%) was observed across the plantings with maximum white ears in early planting. Dead heart damage varied between 3.07 and 14.90% in all the plantings with maximum damage in late planting. Highest grain yield of 61.6 q/ ha was recorded in normal planting followed by early planting (57.6 q/ ha) and late planting (21.7 q/ ha).



Ranchi: Incidence of stem borer, leaf folder, gall midge, hispa and green leafhopper was observed in all the plantings on Sahbhagi variety grown in this trial. Low to moderate incidence of stem borer (1.37-13.42%) was recorded in all the plantings with maximum of 10.01% dead hearts in late planting and 11.55% white ears in normal planting. Moderate incidence of leaf folder (2.03 – 22.37% DL) and green leafhopper (4 – 36.4 per 5 hills) was recorded. Low incidence of gall midge (0.98-7.58% SS) and hispa (1.61 – 10.85%) was reported across the plantings. Grain yield of 40.57, 33.13 and 30.83 q/ ha was recorded in early, normal and late plantings, respectively.

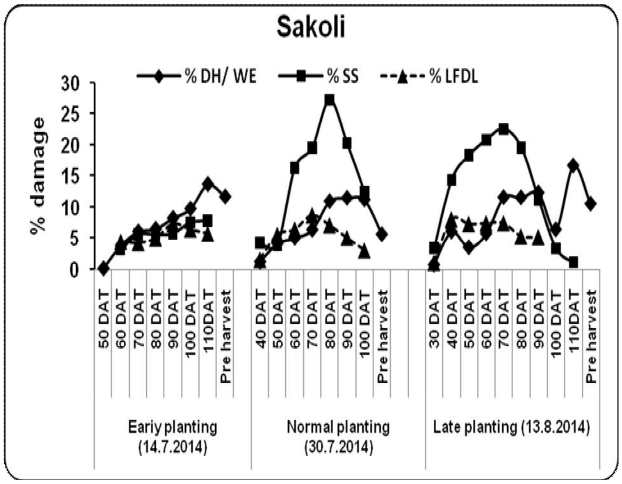


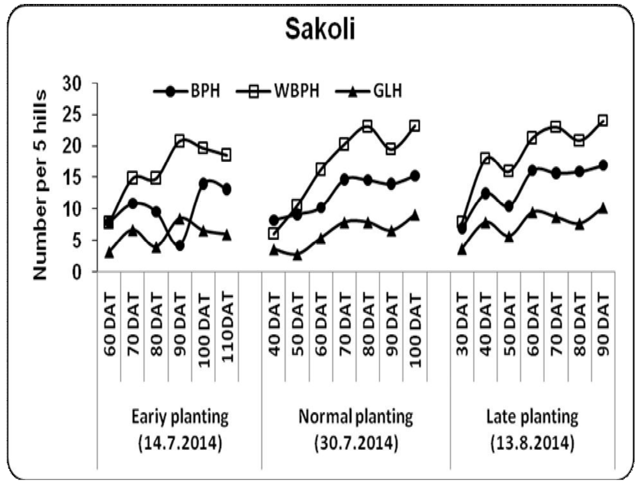
Rewa: Low incidence of gundhi bug (0.16-1.48 bugs/ hill) was observed across the plantings in PS III variety grown in this trial. Grain yield was high in early planting (43.9 q/ ha) followed by normal (37.02) and late plantings (25.84).



Sakoli: Incidence of stem borer, gall midge, leaf folder, BPH, WBPH and GLH was recorded in all the plantings on PKV HMT grown in this trial. High incidence of gall midge (1.22 – 27.22% SS) was observed with maximum damage in normal planting. Low incidence of leaf folder (1.09 - 8.77% DL), dead hearts (0.2 - 8.32%), white ears (5.68 – 11.71%), BPH (0.84 – 3.36/ hill), WBPH (1.22 –

4.78/ hill) and GLH (0.56 – 2.04/ hill) were recorded in different plantings. Grain yield of 19.38, 27.1 and 15.9 q/ ha was recorded from early, normal and late plantings, respectively.





Sambalpur: Low incidence of stem borer (0.25 – 7.16%), gall midge (0.31 – 8.94% SS), leaf folder (0.15 – 8.18% DL) and BPH (0.18 – 3.04/ hill) was observed in all the plantings in Jaya variety grown in this trial. Grain yield of 34q/ha was recorded from early planting followed by 32.48q/ha from normal planting and 31.72q/ha from late planting.

Titabar: Ranjit variety was grown in this trial. Very low incidence of stem borer (0.7-7.98%), gall midge (0.33 – 4.53% SS), leaf folder (0.18 – 2.94% DL), whorl maggot (0.09 – 1.06% DL) and GLH (0.2 – 4.6) was observed across the plantings. Grain yield of 81.84, 75 and 70 q/ ha was recorded from early, normal and late plantings, respectively

Overall, the mean insect pest incidence across locations was low in different dates of planting during *Kharif* 2014. There was not much difference in insect pest incidence/ damage in different dates of planting with respect to gall midge and leaf damaging insects such as leaf folder, whorl maggot, hispa, rice skipper and gundhi bug **(Fig.2.1)**. However, dead hearts and white ears caused by stem borer were relatively high in late planting. BPH population, was high in normal and late plantings as compared to early planting whereas whitebacked planthopper was high in normal planting. Grasshopper damage and GLH population were observed high in early planting. White leafhopper (WLH) incidence was observed only at Chinsurah in early and late plantings.

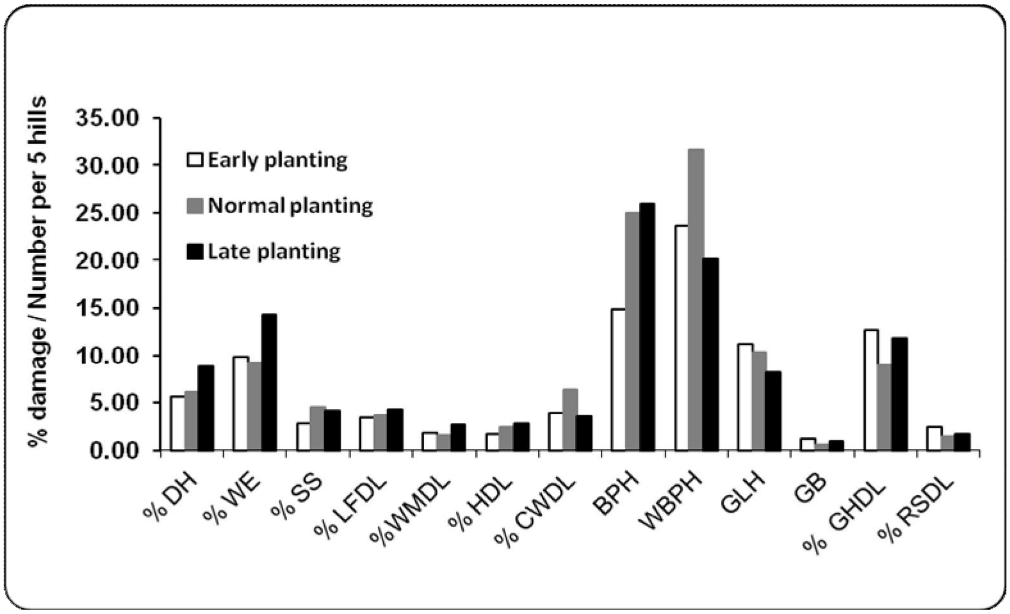


Figure 2.1: Insect pest incidence in different dates of plantings across locations during *Kharif* 2014

Effect of planting dates on insect pest incidence (EPDP) trial was conducted at 19 locations during Kharif 2014. Dead heart damage was low across 15 locations while white ear damage was high in early planting at Raipur alone (39.36%) and in late planting at Nawagam (35.4%), Faizabad (34.14%), Pusa (22.36%) and Raipur (20.09%). Gall midge damage was observed at 6 locations and found high at Sakoli during normal planting (14.88% SS) followed by late planting (12.79%). Leaf folder damage was low in all the plantings at 15 locations except at Nawagam in late planting (16.52%) and Ranchi in normal planting (12.38%). Incidence of whorl maggot, hispa, case worm, grasshopper, rice skipper and GLH was low in all the plantings across the locations. BPH and WBPH incidence was observed at 7 locations but was found high only at Gangavathi in normal planting (28.21 BPH/hill & 26.02 WBPH/ hill). White leafhopper (WLH) incidence was observed only at Chinsurah in early and late plantings.

ii) Pest Incidence in Selective Mechanization for Enhancing Productivity and Profitability of Rice Cultivation Trial (PISMT)

This trial was initiated last year with an objective to assess the insect pest incidence in different methods of rice cultivation in collaboration with Agronomy section. There were five treatments *viz*, T1 = SMSRI (15 day old seedling mat nursery, use of transplanter for planting followed by SRI principles of crop management); T2 = Drum seeding (Dibbling at 25 x 25 cm followed by SRI principles); T3 = Normal transplanting (Best management practices - Flooded rice system); T4 = T3 + Vigore application @ 625 g/ ha as basal application along with urea + 1 g/ liter spray at the time of panicle initiation; T5 = Farmers practice of the location. Observations on insect pest incidence were recorded at 10 day interval in unprotected sub-plot of all the treatments from 4 replications starting from 15 days of planting.

During *Kharif* 2014, the trial was conducted at five locations *viz.,* Raipur, Aduthurai, Pattambi, Rajendranagar and Gangavathi. Location wise results are discussed as under:

At **Raipur**, incidence of stem borer, leaf folder and hispa was observed on Maheswari variety in all the cultivation methods **(Table 2.17)**. The incidence of leaf folder and hispa was very low (<5% DL). Dead heart damage was significantly low in farmers practice (3.7%) as compared to other methods (7.0 – 13.9%) while white ears were significantly high in farmers practice (34.5%) followed by normal transplanting method (27.3%). Grain yield was significantly high in direct seeding (4143 kg/ ha) as compared to other methods. However, yield was at par in SM SRI and normal transplanting method and significantly low in farmers practice (2461 kg/ ha). Total grains were significantly high in SM SRI (1669 / 10 hills) whereas grain weight was high and at par in all the three methods (595 – 486 g) as compared to farmers practice (413 g).

At **Aduthurai**, incidence of stem borer, gall midge, whorl maggot, hispa, brown planthopper (BPH) and green leafhopper (GLH) was observed in all the methods of rice cultivation, however, none of these pests crossed ETL to draw any valid conclusions **(Table 2.18)**. Grain yield of ADT 43 was significantly low in farmers practice (7250 kg/ ha) as compared to other methods (8125 – 9250 kg/ ha).

At **Pattambi**, gall midge, stem borer, leaf folder, whorl maggot, caseworm and blue beetle incidence was observed on Aishwarya variety grown in this trial **(Table 2.19)**. Dead heart damage was significantly low in SM SRI (1.3%) as compared to other methods with high damage (21.1 – 28.5%) and at par with each other. Similar trend was observed with respect to white ear occurrence in different cultivation methods. Gall midge incidence during 15-75 DAT was significantly high in drum seeding plot (52 - 71% SS) at par with normal transplanting (28 – 56.3% SS) and farmers practice (30 – 60 % SS), while SM SRI plot showed significantly low damage (3 – 13% SS). Leaf folder damage was significantly high in normal method (12.3% DL) compared to drum seeding (6.0% DL). Damage by whorl maggot, caseworm and blue beetle was significantly low in SM SRI as compared to other methods of rice cultivation. However, there were no significant differences in grain yield among the treatments (3720 – 4525 kg/ ha).

Table 2.17: Pest incidence in selective mechanization trial (PISMT) at **Raipur**, *kharif* 2014

Treatments	**% DH**	**% LFDL**	**% HDL**	**% WE**	**Yield**	**Total grains/ 10 hills(No.)**	**Grain weight / 10 hills(g)**
	45 DAT	**45 DAT**	**45 DAT**	**Pre harvest**	**Kg/ ha**		
SM SRI	10.2 (3.2)	1.6 (1.2)	1.8 (1.3)	24.6 (4.9)	3464	1669.0	595.0
Drum seeding	7.0 (2.7)	1.1 (0.9)	2.3 (1.5)	22.8 (4.7)	4143	1335.3	537.5
Normal transplanting	13.9 (3.7)	1.2 (1.0)	1.9 (1.4)	27.3 (5.1)	3429	1282.8	486.2
Farmers practice	3.7 (1.8)	1.4 (1.1)	2.7 (1.6)	34.5 (5.8)	2461	1084.3	412.5
LSD (0.05)	1.2	0.4	0.3	1.1	313	178.0	58.4
CV (%)	27.3	23.9	11.2	13.3	5.8	8.3	7.2

Figures in parentheses are square root transformed values

Table 2.18 Pest incidence in selective mechanization trial (PISMT) at **Aduthurai**, *kharif* 2014

Treatments	**%DH**	**%WE**	**%SS**	**%WMDL**	**%HDL**	**BPH**	**BPH**	**GLH**	**Yield**
	45 DAT	**Pre harvest**	**15 DAT**	**15 DAT**	**15 DAT**	**45 DAT**	**75 DAT**	**35 DAT**	**Kg/Ha**
SM SRI	5.5 (2.3)	4.9 (2.2)	1.5 (1.2)	3.0 (1.7)	8.7 (2.9)	12.5 (3.5)	11.3 (3.3)	5.5 (2.3)	9250
Drum seeding	4.7 (2.1)	3.4 (1.8)	1.2 (1.0)	1.7 (1.3)	2.3 (1.5)	5.0 (2.2)	8.3 (2.8)	7.8 (2.6)	8650
Normal transplanting	4.1 (2.0)	3.4 (1.8)	3.2 (1.8)	4.0 (2.0)	0.0 (0.71)	2.5 (1.1)	5.0 (2.1)	9.3 (3.0)	8125
Farmers practice	5.6 (2.2)	3.5 (1.8)	1.9 (1.4)	3.9 (1.9)	4.7 (2.2)	4.0 (2.0)	5.0 (2.2)	5.8 (2.4)	7250
LSD (0.05)	0.93	0.5	0.34	0.34	0.22	1.2	0.77	1.2	721.4
CV (%)	26.7	16.4	15.55	12.04	8.22	33.99	18.29	28.01	5.42

Figures in parentheses are square root transformed values

Table 2.19 Pest incidence in selective mechanization trial (PISMT) at **Pattambi**, *kharif* 2014

Treatments	% DH	%WE	%SS			% LFDL	%WMDL		% CWDL	% BBDL	Yield
	65 DAT	Pre harvest	15 DAT	45 DAT	65 DAT	75 DAT	15 DAT	25 DAT	15 DAT	25 DAT	Kg/ ha
SM SRI	1.3 (1.1)	2.4 (1.5)	13.0 (2.9)	3.0 (1.3)	4.9 (2.3)	8.0 (2.8)	19.8 (4.4)	8.4 (2.9)	0.0 (0.7)	32.6 (5.7)	4525
Drum seeding	21.1 (4.6)	11.0 (3.3)	52.0 (7.0)	71.0 (8.4)	66.0 (8.1)	6.0 (2.4)	43.4 (6.6)	20.9 (4.6)	28.0 (5.3)	55.8 (7.5)	4150
Normal transplanting	23.5 (4.8)	12.6 (3.5)	28.0 (5.3)	56.3 (7.5)	52.2 (7.2)	12.3 (3.5)	55.0 (7.4)	42.2 (6.5)	55.4 (7.3)	79.4 (8.9)	3720
Farmers practice	28.5 (5.4)	12.3 (3.5)	30.0 (5.0)	52.1 (7.2)	60.0 (7.8)	6.6 (2.5)	35.0 (5.6)	27.1 (5.2)	52.7 (7.1)	62.3 (7.9)	3730
LSD (0.05)	1.3	0.15	3.5	1.4	1.1	0.9	1.2	0.7	2.5	1.2	539.5
CV (%)	20.6	10.9	43.7	44.4	10.6	19	20.8	9.8	30.8	9.7	8.4

Figures in parentheses are square root transformed values

At **Gangavathi**, low incidence of stem borer and leaf folder was observed in different treatments on IET 19251 grown in this trial. High incidence of BPH, WBPH and GLH was observed from 15 DAT onwards till harvest in all the treatments **(Table 2.20).** BPH population was significantly low in drum seeding (9.35 – 23.8/ hill) and SM SRI (10.4 – 26.1/ hill) as compared to farmers practice (16.6 – 34/ hill), normal transplanting (12.2 – 30.1/ hill), normal transplanting + Vigore (12.6 – 32.3/ hill) which were at par with each other across observations. Similarly, WBPH population was significantly low in drum seeding (9.3 – 23.9/ hill) followed by SM SRI (11.9 – 27.2/ hill) as compared to farmers practice (14.9 – 37.6 / hill) which was at par with normal transplanting (12.6 – 34.9/ hill) and normal transplanting + vigore (13.5 – 35.7/ hill) in different observations. GLH population was significantly low in drum seeding (3/ hill) as compared to other treatments (4.7 – 5.7/ hill) at 35 DAT. Due to the high incidence of planthoppers, grain yield was low across the treatments and at par with each other (1311 – 1524 kg/ ha).

At **Rajendranagar**, incidence of stem borer and leaf folder was low (<5%) on Sugandha samba variety grown in different treatments **(Table 2.21).** Grain yield was significantly high in normal transplanting (6106 kg/ ha) as compared to other methods that were at par with each other (5318 – 5654 kg/ ha).

Table 2.20 Pest incidence in selective mechanization trial (PISMT) at **Gangavathi**, *kharif* 2014

Treatments	**% DH**	**% WE**	**% LFDL**	**BPH (No. /10hills)**						**WBPH (No./10hills)**				**GLH**	**Yield**
	95 DAT	**Pre harvest**	**65 DAT**	**35 DAT**	**45 DAT**	**55 DAT**	**65 DAT**	**85 DAT**	**105 DAT**	**35 DAT**	**65 DAT**	**75 DAT**	**95 DAT**	**35 DAT**	**Kg/ ha**
SM SRI	2.9 (1.8)	0.9 (0.9)	2.1 (1.4)	174.3 (13.2)	222.0 (14.9)	261.3 (16.0)	241.0 (15.5)	185.3 (13.6)	104.0 (10.2)	272.0 (16.5)	204 (14.2)	200.5 (14.1	119.0 (10.9)	48.0 (6.8)	1502
Drum seeding	2.8 (1.8)	8.7 (2.7)	1.4 (1.2)	132.0 (11.4)	165.5 (12.7)	238.0 (15.4)	217.7 (14.7)	151.5 (12.2)	93.5 (9.6)	239.3 (15.4)	195.0 (13.9)	175.8 (13.2)	93.0 (9.6)	30.0 (5.4)	1524
Normal transplanting	4.1 (2.0)	7.3 (2.6)	1.5 (1.2)	214.3 (14.5)	271.0 (16.4)	301.0 (17.3)	283.0 (16.8)	208.0 (14.7)	122.0 (10.9)	349.0 (18.7)	257.3 (16.0)	219.3 (14.8)	126.3 (11.1)	47.0 (6.8)	1333
T3 + Vigore	5.1 (2.3)	6.8 (2.6)	2.1 (2.0)	220.2 (14.7)	287.5 (16.9)	322.7 (17.9)	300.0 (17.3)	222.5 (14.9)	126 (11.0)	357.0 (18.9)	277.0 (16.6)	224.3 (15.0)	134.8 (11.5)	52.0 (7.2)	1321
Farmers practice	5.5 (2.4)	7.4 (2.7)	4.3 (2.0)	230.7 (15.2)	299.5 (17.3)	341.0 (18.4)	332 (18.2)	246.2 (15.7)	166.3 (12.8)	376.2 (19.4)	317.8 (17.8)	234.5 (15.3)	149.0 (12.1)	56.8 (7.8)	1311
LSD (0.05)	0.59	0.9	0.47	1.9	2.3	2.4	1.64	1.93	2.2	1.7	1.7	1.7	2.7	1.3	9.9
CV (%)	18.4	27.6	21	9	9.7	9.18	6.44	8.84	113	6.12	7.19	7.59	15.63	12.6	213.2

Figures in parentheses are square root transformed values

Table 2.21 Pest incidence in selective mechanization trial (PISMT) at **Rajendranagar**, *kharif* 2014

Treatments	**%DH**	**%LFDL**	**Yield**
	105 DAT	**105 DAT**	**Kg/ ha**
SM SRI	3.1 (1.9)	3.4 (1.9)	5318
Drum seeding	0.6 (1.0)	0.0 (0.7)	5654
Normal transplanting	4.0 (2.1)	3.9 (2.1)	6106
Farmers practice	5.1 (2.3)	1.0 (1.2)	5421
LSD (0.05)	0.8	0.6	367.7
CV (%)	25.7	24.4	4.1

Figures in parentheses are square root transformed values

Insect Pest Incidence in Selective Mechanization for Enhancing Productivity and Profitability of Rice Cultivation Trial (PISMT), was carried out at 5 locations during Kharif 2014. Incidence of stem borer, leaf folder, gall midge, BPH, WBPH, GLH, whorl maggot and hispa was observed in all the treatments. However, the damage by stem borer was low (< 10%) in all the locations except at Raipur wherein white ears were high and were at par with each other in all the treatments (22.8 – 34.5% WE). Leaf folder damage was low in all the locations in various treatments (<10%). At Gangavathi, significantly low population of BPH (9.35 – 23.8/ hill) and WBPH (9.3 – 23.9/hill) was recorded in Drum seeding as compared to other methods, in all the observations. Damage by whorl maggot, caseworm and blue beetle was significantly low in SM SRI compared to other methods of rice cultivation at Pattambi. Across locations, grain yield was significantly low in farmers practice and high in drum seeding which was at par with SM SRI.

2.5 BIOCONTROL AND BIODIVERSITY STUDIES

These studies covered i) Monitoring of pest species and their natural enemies (MPNE) and ii) Ecological Engineering for Planthopper Management (EEPM)

i) 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 22 centres *viz*., Aduthurai, Coimbatore, Gangavathi, Karaikal, Mandya, Moncompu, Nellore, Pattambi, Ragolu and Rajendranagar (South India) Kaul, Ludhiana, Pantnagar, Ghaghraghat and New Delhi (Northern India), Pusa, Chinsurah (Eastern India), Karjat, Navsari and Nawagam (Western India), Raipur (Central India) and Malan (Hills). The study involved recording at regular intervals on stem borer and planthopper species composition and their natural enemy populations from an area of 1000 m^2 unsprayed plot.

Results

1. Stem borer:

The stem borer species composition and the egg parasitoids observed were reported from 17 centres. Five species of stem borer were observed *viz*., yellow stemborer (YSB), *Scirpophaga incertulas*, pink stemborer (PSB), *Sesamia inferens*, dark headed borer (DHB) *Chilo polychrysus,* White stem borer (*WSB) Scirpophaga fusciflua* and striped stem borer (SSB) *Chilo suppressalis.*

Species composition

The data on species composition was received from 17 centres (Fig.2.2). YSB was the dominant species in all locations except Ludhiana and Malan. It was the only species reported from Coimbatore, Gangavathi, Karaikal, Karjat, Ghaghraghat, Nellore, Nawagam, Pantnagar and Rajendranagar while it accounted for 95.94 per cent at Raipur, the rest being PSB. At Ludhiana three species were observed, PSB being dominant accounting for 68.23%, followed by YSB (21.02%) and WSB (10.75%). The population of YSB (37.84%) was less than PSB (47.29%) even up to tillering stage. PSB dominated from flowering to dough stage (71.27 to 86.11%). WSB accounted for 4.6-12.76 per cent through crop stages. At Pattambi, three species of stem borers were recorded – YSB, PSB and WSB. YSB dominated up to tillering stage with 65.21-75.00 per cent of the population. During reproductive phase YSB population waned to 7 per cent while PSB became dominant accounting for 89.87 per cent. WSB occurred at a lower level throughout crop season (mean 20.77%). Similarly at Moncompu, three species of stemborers observed were YSB (55.07%), PSB (8.61 %) and WSB (41.09 %).

At Aduthurai, two species (YSB and SSB) were observed over three dates of observation 28, 50 and 60 DAT. While YSB was the dominant species accounting for 85-100 % over the crop season, SSB accounted for an average of 4.76 per cent. At Navsari, two stem borer species were observed over four dates of observation. YSB was again dominant, accounting for 82.83%, the rest being

WSB 17.17%. YSB population ranged from 77-88% across the crop stages while WSB peaked at 75 DAT reaching 22 per cent of population. Two species of stemborers were observed in Malan- PSB and WSB. WSB dominated accounting for 96.64 %, the rest being PSB. At Ragolu, YSB was the dominant species ranging from 84-100 % through all crop stages.

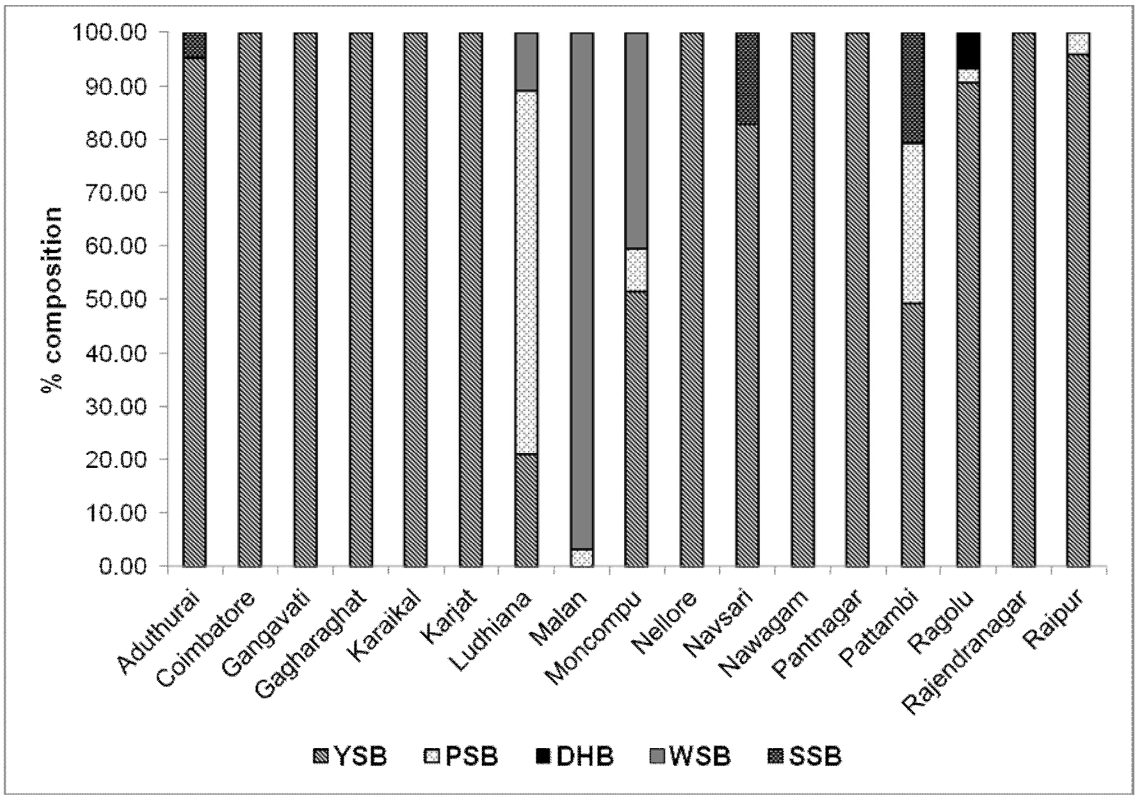


Fig:2.2 Stem borer species composition at various centres, MPNE, *kharif* 2014

Egg parasitoids of stem borer: *E*gg parasitoids of yellow stem borer were reported from 13 centres. The egg mass parasitisation ranged from 8.00-98.96% while the egg parasitisation varied from 11.66 to 64.21 % at various locations **(Fig.2.3)**. The mean highest egg mass parasitisation was observed at Rajendranagar (92.81%) while the lowest was observed at Raipur (8.00%). The egg parasitisation was the lowest at Navsari (11.66%) and highest at Rajendranagar (64.21%) followed by Raipur (56.72%). Three species of parasitoids were recorded and *Tetrastichus schoenobii* was the most prevalent parasitoid in five locations **(Fig.2.4)** accounting for 100 per cent of the egg parasitoids observed at Aduthurai and Nawagam; 83.33 % at Nellore. *Telenomus* sp. was the dominant parasitoid at five locations Navsari, Pattambi, Pantnagar, Coimbatore, and Raipur accounting for 100, 93.75, 84.82, 65.24, and 54.79 % respectively.

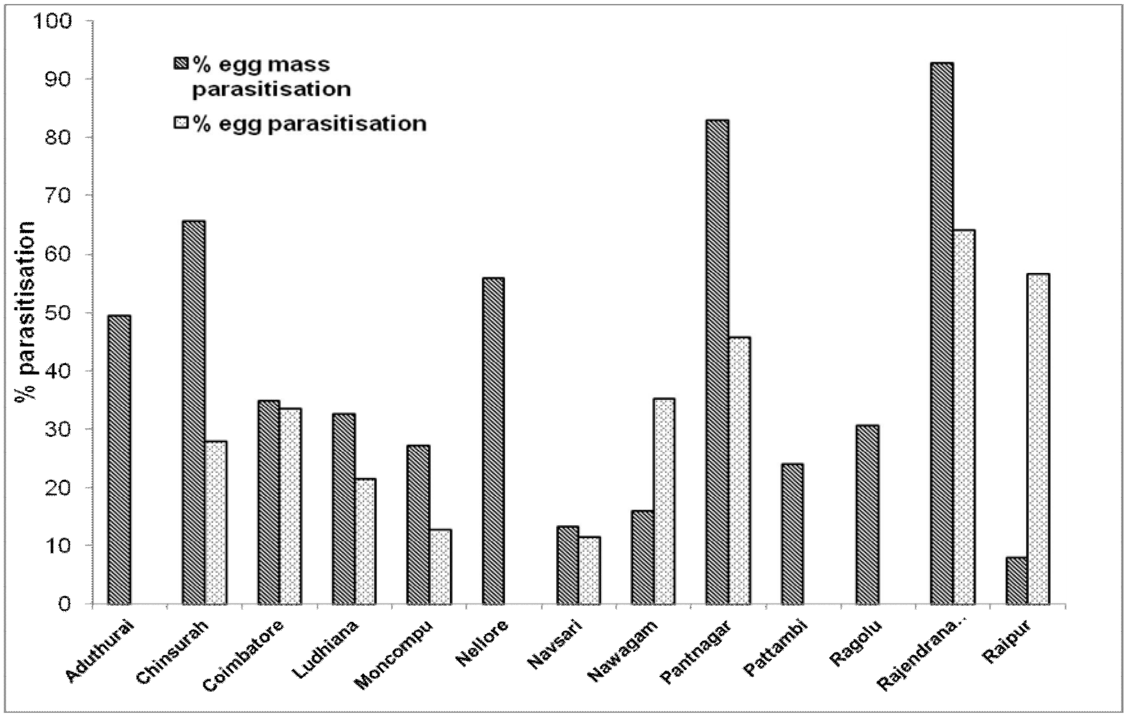


Fig 2.3 Parasitisation of stem borer eggs at various centres, MPNE, *kharif* 2014

At three locations Moncompu, Ragolu and Ludhiana, *Trichogramma* was the dominant parasitoid. The average composition of the three parasitoids over all locations was *Tetrastichus* (38.84%), *Telenomus* (42.86%) and *Trichogramma* (18.24%). The hyperparasitoid *Trichamalopsis apanteloctena* was reported from one centre- Rajendranagar. It appeared at the later stage of crop growth and accounted for 1.96% of the emerging parasitoids.

Hoppers

Species composition: Eleven centres *viz*., Aduthurai, Coimbatore, Gangavathi, Karaikal, Ludhiana, Mandya, Maruteru, Navsari, Nawagam, New Delhi, and Pusa reported on the status of hoppers and their natural enemies. Two locations reported only a population of BPH *viz*., Aduthurai and Mandya, while two locations reported only WBPH to be present – Nawagam and New Delhi. All other locations had a mixed population of planthoppers. At Aduthurai only BPH was reported among planthoppers occurring at a very low mean population level of 0.5hoppers/hill over 5 observation dates. Two leaf hoppers, the green leafhopper and White leafhopper were also observed. Similarly the population was very low though mixed at Karaikal BPH 0.08 and WBPH 0.03/ per hill. The highest population of planthoppers was observed at *Gangavathi.* A mixed population of BPH (44.26/hill) and WBPH (39.00/hill) occurred. Similarly a mixed population of BPH and WBPH were observed at Ludhiana throughout the crop growth.

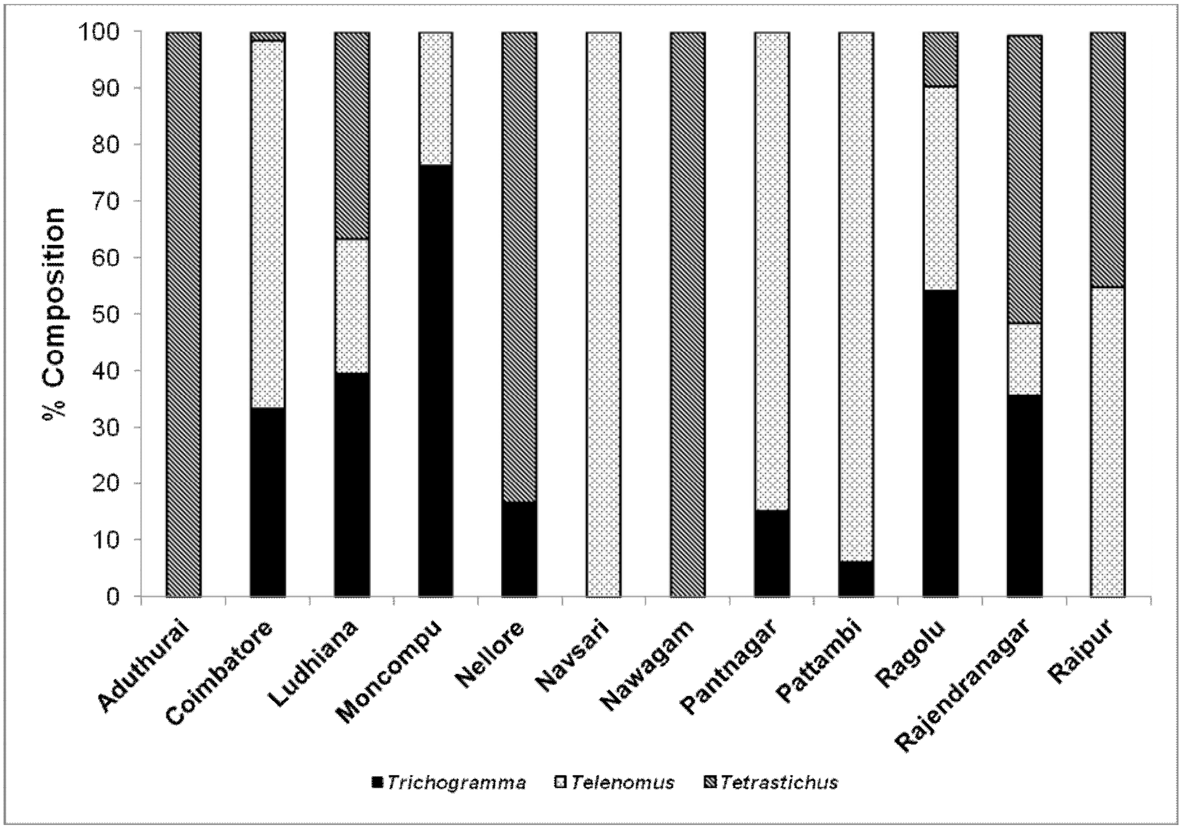


Fig 2.4 Relative composition of stem borer parasitoids at different locations, MPNE, *kharif* 2014

The WBPH population was always higher than that of BPH population. The mean population of planthoppers was generally low, BPH 1.35 and WBPH 2.44 per hill. The second highest population of planthoppers occurred in Maruteru. Though both planthopper species were observed at Maruteru, BPH was dominant and built up in numbers as crop progressed from 2.46 per hill to even up to 50 per hill whereas WBPH population ranged from 0-8.42 per hill over the crop growth stages. At New Delhi, low incidence of WBPH (1.81/hill) was observed.

***Natural enemies*:** In general, observations on hopper natural enemies were reported from nine locations. The egg parasitoids of hoppers were recorded at five locations, Gangavathi, Maruteru, Navasari, Nawagam and Ludhiana. The total egg parasitisation was 19.37%, with *Anagrus, Oligosita and Gonatocerus* accounting for 66.37, 28.32 and 5.31per cent respectively at Gangavathi. At Ludhiana parasitisation was observed by destructive sampling of tillers. The total egg parasitisation was 51.60%, with *Anagrus, Oligosita and Gonatocerus* accounting for 46.54 39.60 and 13.86 per cent respectively. At *Navasari* the total egg parasitisation ranged from 0-50% and a mean parasitisation of 8.77 %. *Anagrus and Gonatocerus* accounted for 61.11and 38.89 per cent of the parasitoids respectively. *Anagrus* was the only parasitoid observed at Nawagam accounting for 5.46% egg parasitisation. Drynid parasitisation of planthoppers was not observed in the field at Coimbatore due to low population level, but in

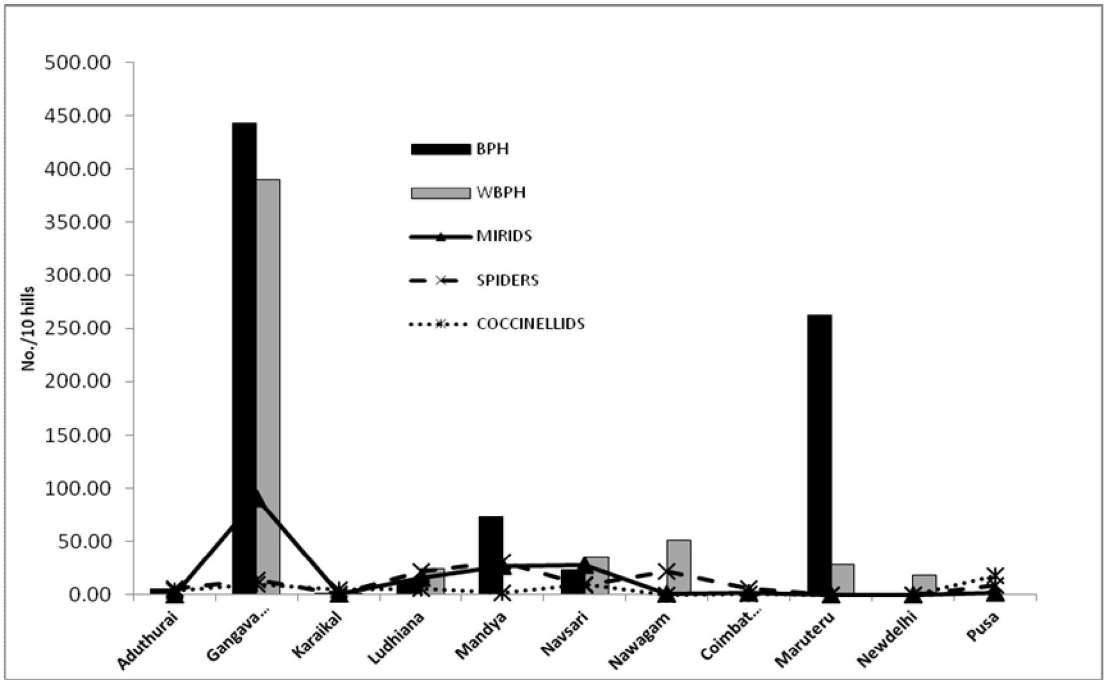


Fig 2.5 Planthopper population and their predators across locations, MPNE, *kharif* 2014

glasshouse it was observed up to 7 per cent. A mean egg parasitisation of 22.67 per cent was observed at *Maruteru*. *Oligosita* was the only parasitoid observed. The predators of hoppers were recorded from 9 locations **(Fig 2.5)**. The mean population of mirids was very low at *Aduthurai* (0.02/hill); spiders and coccinellids were observed at 0.62 and 0.39/hill respectively. At *Karaikal*, Spiders and coccinellid were reported at 0.11 and 0.53 per hill respectively. The highest population of mirids was observed at *Gangavathi* (9.03/hill). The spider population was highest in Mandya (3.07/hill).

The leaf folder species was also reported from Chatha as *Cnaphalocrocis medinalis*. Three natural enemies were recorded from larvae and pupae of *C. medinalis viz*., *Apanteles* sp, *Charops* sp. and *Trichogramma chilonis* during the crop period. The per cent parasitization of *Apanteles* sp. on *C. medinalis* ranged from 10-15%.

Observations on species composition of stem borer revealed the presence of five species distributed over 17 locations with YSB being dominant in 14 locations. The egg mass parasitisation ranged from 8.00-98.96% while the egg parasitisation varied from 11.66 to 64.21 % at various locations. Tetrastichus schoenobii was the dominant egg parasitoid in 5 locations followed by Telenomus sp. in 5 locations and Trichogramma in 3 locations. Two locations reported only a population of BPH viz., Aduthurai and Mandya, while two locations reported only WBPH to be present – Nawagam and New Delhi. All other locations had a mixed population of planthoppers. Anagrus, Oligosita and Gonatocerus were the *parasitoids reported on hopper eggs. Mirids, spiders, staphylinid beetles, and coccinellids were abundant natural enemies of hoppers*.

ii) Ecological Engineering for Planthopper Management (EEPM)

This 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. Data were recorded on hoppers and their natural enemies and analyses were done using the independent‘t’ test.

Table 2.22 Effect of ecological engineering on populations of hoppers and their natural enemies at Aduthurai, EEPM, *kharif* 2014

Parameters	GLH (No./hill)		Green mirids (No./hills)		Spiders (No./hills)		Coccinellids (No./hills)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	0.79	1.17	0.47	0.71	0.94	1.05	0.58	0.62
t value	4.032**		2.26*		1.38NS		0.58 NS	
df	398		198		398		398	
P - value	<0.01		0.02		0.19		0.57	

At **Aduthurai,** bund cropping with cowpea and cultural methods *viz*., line planting with alleyways, vermicompost as basal application and midseason draining of water were followed. Augmentation of planthopper parasitoids was done by keeping the left over seedling in the field. Four observations were recorded on green leafhoppers and their natural enemies through the crop period. Despite low natural incidence of GLH the population was significantly low in EE plot as compared to FP plot **(Table 2.22)**. Consequently the populations of green mirids, spiders and coccinellids were also very low and no conclusive results could be drawn from the study.

At **Gangavathi,** two interventions *viz*., alleyways and growing border crop of cowpea and sunhemp were undertaken in the ecological engineering (EE) plots. Four observations were recorded on planthoppers and their natural enemies through the crop period. Hopper numbers were significantly higher in EE plots (BPH 35.61 and WBPH 66.70/hill) in comparison to farmers’ practices (FP) (BPH 7.57 and WBPH 7.86/hill, **(Table 2.23)**, the populations of green mirids, spiders and coccinellids were also significantly more in EE plots indicating a positive trend for these practices in conservation of natural enemies. The egg parasitisation by egg baiting method was also assessed under the two practices. Mean parasitisation by three species of parasitoids in the EE plots was significantly higher all three dates of observation (27.0%; t= 10.38; P= <0.01) compared to 9.33 % under farmers practice. 63-68 per cent of parasitisation was by *Anagrus* sp followed by *Oligosita* (26-29%) and least by *Gonatocerus* (6-8%).

Table2.23 Effect of ecological engineering on populations of hoppers and their natural enemies at Gangavathi, EEPM, *kharif* 2014

A. Predators

Parameters	BPH (No./ hill)		WBPH (No./hill)		Green mirids (No./hill)		Spiders (No./hill)		Coccinellids (No./hill)	
	EE	FP	EE	FP	EE	FP	EE	FP	EE	FP
Mean	35.61	7.57	66.70	7.86	11.25	2.46	2.6	0.72	1.94	0.27
t value	11.35 **		14.01**		17.15**		12.78**		9.99**	
df	398		398		398		398		398	
P - value	<0.01		<0.01		<0.01		<0.01		<0.01	

B. Parasitoids

Parameters	Egg Parasitisation % at						Mean parasitisation	
	45 DAT		60 DAT		75 DAT			
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	25.87	10.81	28.00	7.98	27.12	9.21	27.00	9.33
t value	5.05**		7.10**		5.78**		10.38**	
df	48		48		48		148	
P - value	<0.01		<0.01		<0.01		<0.01	

At **Kaul**, the hoppers and their natural enemies were sampled in plots of CSR 30, that followed farmers' practice and EE plots with wider spacing (20*20), alleyways, FYM application, mid season drainage and bund plantings of Sesamum. One application of Cartap hydrochloride @ 7.5 kg/acre was given in plots with farmers practice. The population of hoppers was lower though not significantly, in farmers practice plots (10.42/hill) compared to EE plots (13.0/hill). The population of mirids, and spiders in EE plots were higher but there was no significant difference between the two treatments **(Table 2.24)**.

Table2.24 Effect of ecological engineering on populations of hoppers and their natural enemies at Kaul, EEPM, *kharif* 2014

Parameters	Hoppers (No./ hill)		Spiders (No./ hill)		Green mirids (No./ hill)	
	EE	FP	EE	FP	EE	FP
Mean	13.00	10.42	12.43	11.43	4.49	3.77
t value	0.79[NS]		0.49 [NS]		1.49 [NS]	
df	68		68		68	
P - value	0.43		0.61		0.14	

The EE interventions followed at **Ludhiana** included alleyways, water management, bund flora of flowering plants like cosmos and marigold. The populations of hoppers were very low though significantly higher in EE plots **(Table 2.25A)**. Similarly, population of spiders, mirids and coccinellids were significantly higher in EE practice stressing the positive effect of flowering plants on predator abundance. But the level of population was very low. Egg baiting for parasitisation revealed 37.29 % parasitisation of hopper eggs in the EE plots **(Table 2.25B)** of which 43.35% was by *Anagrus* and the rest by *Oligosita* (40.63%) and *Gonatocerus* (15.63%).

Table 2.24 Effect of ecological engineering on hoppers and their natural enemies at Ludhiana, MPNE, *Kharif* 2014

A. Predators

Parameters	BPH (No./hill)		WBPH (No./hill)		Green mirids (No./hill)		Spiders (No./hill)		Coccinellids (No./hill)	
	EE	FP	EE	FP	EE	FP	EE	FP	EE	FP
Mean	0.95	0.64	1.24	0.82	0.45	0.21	1.29	0.74	0.28	0.19
t value	4.23**		4.61**		4.66**		7.17**		2.32*	
df	598		598		598		598		598	
P - value	<0.01		<0.01		<0.01		<0.01		<0.02	

B. Parasitoids

Parameters	Egg Parasitisation % at						Mean Parasitisation %	
	30 DAT		45 DAT		60 DAT			
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	19.37	20.51	38.63	31.54	53.87	27.27	37.29	26.11
t value	0.21NS		1.63NS		5.73**		3.43	
df	48		48		48		148	
P - value	0.83		<0.11		<0.01		<0.01	

At **Mandya**, the EE interventions were alleyways, organic manuring, bund flora of cowpea, *Tridax* sp., sesamum and marigold. The mean population of BPH in EE plots was significantly lower (52.5/10hills)) than that of FP plots (91.0/10hills) **(Table 2.26)**. Similarly, the green mirid coccinellid and spider population were significantly higher in EE plots than those in FP plots**.**

Table 2.26 Effect of ecological engineering on hoppers and their natural enemies at Mandya, MPNE, *kharif* 2014

Parameters	HOPPERS (No./ hill)		Green mirids (No./ hill)		Spiders (No./hill)		Coccinellids (No./ hill)	
	EE	FP	EE	FP	EE	FP	EE	FP
Mean	5.25	9.10	3.75	3.20	4.45	3.62	0.46	0.17
t value	3.58**		2.14*		3.76*		4.69**	
df	398		398		398		30	
P - value	<0.01		0.03		<0.01		<0.01	

The EE interventions tested at **Maruteru** were alleyways, organic manuring and bund flora. The observations on hoppers and their natural enemies were taken 9 times from 20 DAT every 10 days. The overall analysis of pooled data showed a lower population of BPH and WBPH in plots with farmers practices compared to population of hoppers in EE plots but they were statistically insignificant **(Table 2.27)**. Similarly the population of spiders and mirids though higher in EE plots were not significantly different. The yield difference recorded in FP and EE plots were significant surprisingly with EE plots recording a mean of 15.04kg/25 sq. m. as compared to FP plots (13.10 kg/25 sq. m). The parasitisation of BPH eggs was assessed by egg baiting in the EE plots. *Oligosita* was the major parasitoid recorded causing 33.33-100 per cent parasitisation of BPH eggs. It accounted for 100 per cent of parasitoid composition in EE plots.

Table 2.27 Effect of ecological engineering on hoppers and its natural enemies at Maruteru, MPNE, *kharif* 2014

Para-meters	BPH (No./ hill)		WBPH (No./ hill)		MIRIDS (No./ hill)		SPIDERS (No./ hill)		Yield/25m^2	
	EE	FP	EE	EE	EE	FP	EE	FP	EE	FP
Mean	44.92	39.31	15.87	11.75	3.26	2.46	0.86	0.68	15.04	13.10
t value	1.12 NS		1.76NS		1.43NS		1.82NS		2.17*	
df	478		238		358		478		10	
P - value	0.26		0.08		0.15		0.07		0.05	

Ecological engineering for pest management was taken up in six locations with a combination of interventions such as organic manuring, alleyways, spacing management, water management and growing of flowering plants on bunds. Such interventions increased the natural enemy populations like mirids, spiders and coccinellids and increased egg parasitisation across the locations but had mixed results in the reduction of hopper population.

2.6 INTEGRATED PEST MANAGEMENT

This section includes two trials *viz.*, i) Yield loss estimation trial (YLET) and ii) Integrated pest management special (IPMs) trial. The results of these two trials are presented below:

i) Yield Loss Estimation Trial (YLET)

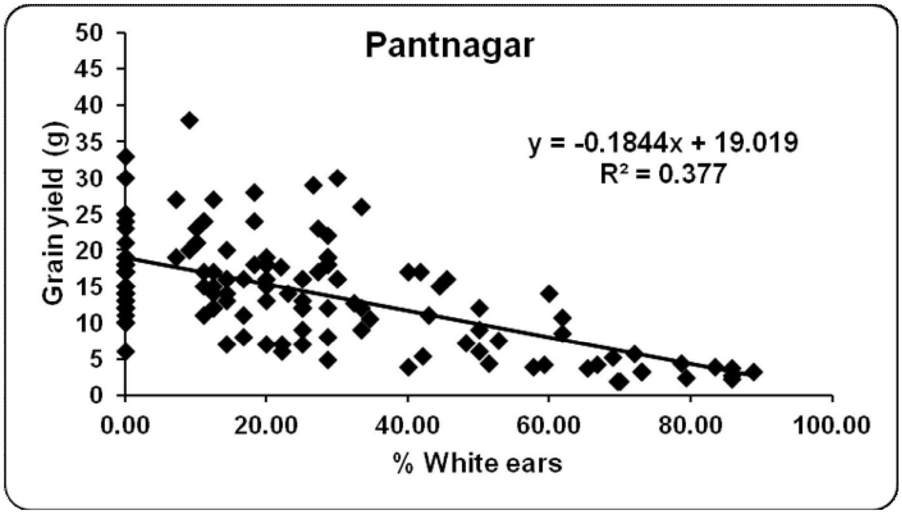
Data on actual yield losses caused by various insect pests in a rice crop is limited and imprecise. Hence the present trial was aimed to generate data on the exact losses caused by stem borer and leaf folder at different stages of crop growth period. Varying levels of specific pest damage was created by augmenting through the release of egg masses or larvae at different crop growth stages to know the impact on grain yield.

At each location, experimental field was divided into two equal sized plots (250 sq.m each) and designated as natural infestation plot and augmentation plot. Each of these plots was again sub divided into 3 equal sized plots (80 sq.m each) and designated as Range 1, Range 2 and Range 3. In each range of natural infestation plot, 35 hills were marked and data on insect damage and grain yield was recorded. Thus, from natural infestation plot, data from 105 hills were recorded. In augmentation plot, four hills at nine spots were covered with a mylar cage in each range. Target pest was augmented by pinning egg masses or releasing larvae. Observations were recorded on these 36 hills in each range and thus data from 108 hills were recorded from augmentation plot.

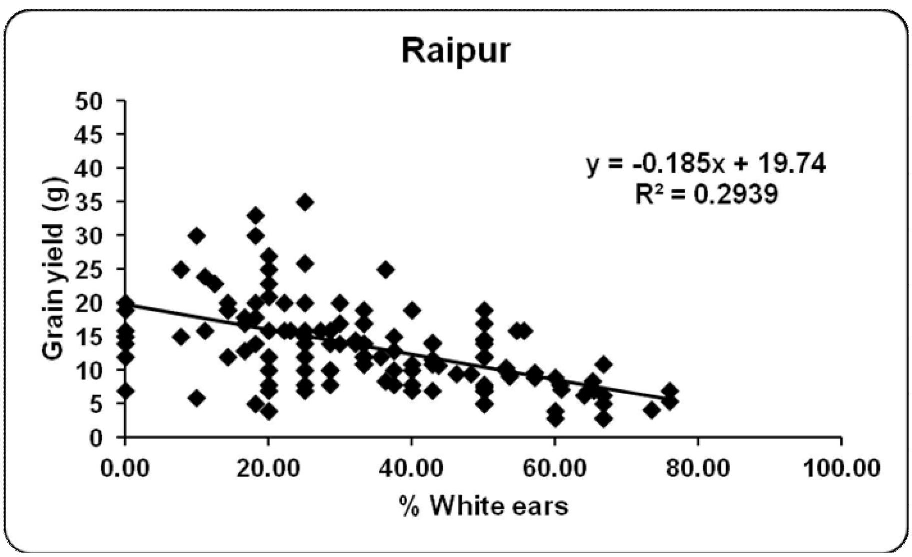
During *Kharif* 2014, the trial was conducted at 8 locations *viz.,* Aduthurai, Chinsurah, Jagdalpur, Ludhiana, Pantnagar, Pusa, Raipur and Malan. Data from Pusa were not considered for analysis due to the incomplete information. Pest - and location wise results are discussed:

Target pest: Stem borer

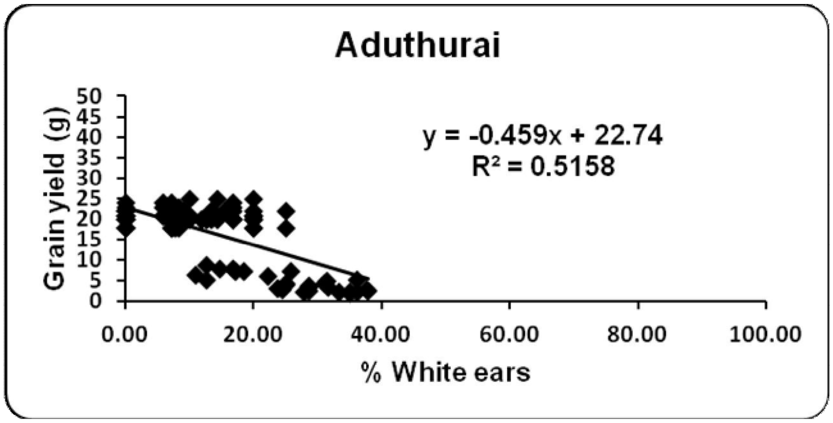
At **Pantnagar**, HKR 47 was grown in this trial. White ear damage by stem borer varied between 0 and 88.89% and grain yield ranged from 2 to 38 g per hill. Regression analysis of the data revealed a significant negative relationship between per cent white ears and grain yield. The data indicated that every 10% increase in white ear damage could result in loss of 1.84 g in grain yield.



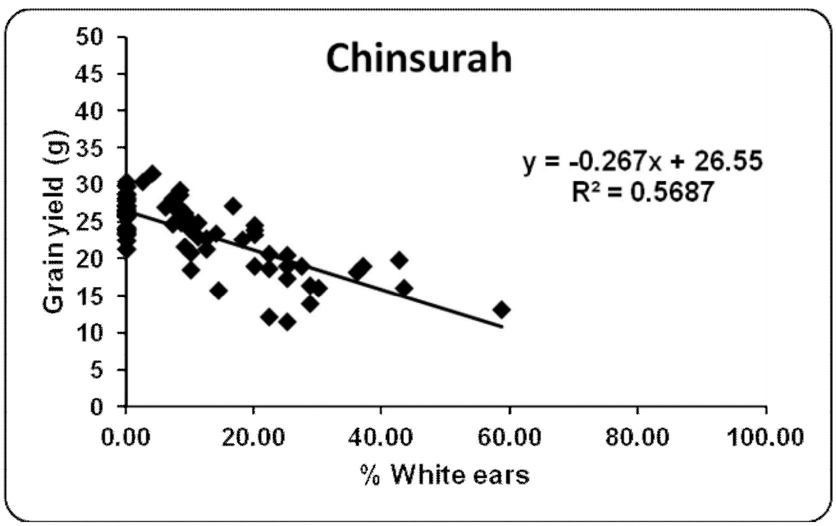
At **Raipur**, white ear damage varied between 0 and 75.86% on Chandrahasan variety grown in this trial. Grain yield of 3 to 35 g per hill was recorded. Regression analysis revealed a significant negative relationship between white ears and grain yield. There could be a reduction of 1.85 g in the grain yield with every 10% increase in white ears.



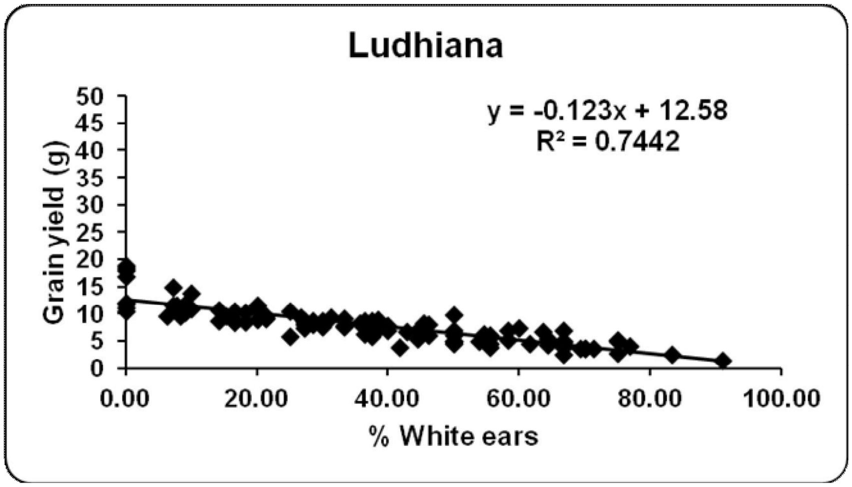
At **Aduthurai**, ADT 50 was grown in this trial. Less than 40% white ear damage was recorded despite augmentation. Damage ranged from 0 – 37.84% with a grain yield of 2.25 – 25 g per hill. Regression analysis revealed that for every 10% increase in white ear damage, there would be a reduction of 4.59 g grain yield.



At **Chinsurah**, white ear damage varied from 0 to 58.54% while grain yield of 12 to 32 g per hill was obtained in Swarna Sub 1. A significant negative relationship was observed between white ear damage and grain yield. Yield reduction of 2.67g was estimated for every 10% increase in white ear damage.

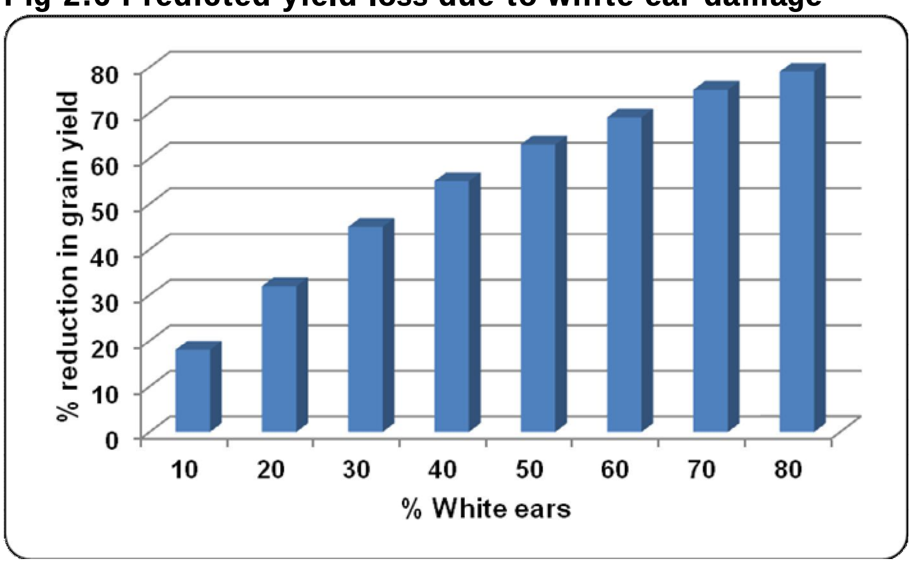


At **Ludhiana**, 0 to 90.91% white ears were observed with a grain yield of 2 to 19 g per hill in Punjab Basmati 2 grown in this trial. Regression analysis revealed a highly significant negative relationship with a loss of 1.23 g for every 10% increase in white ears.



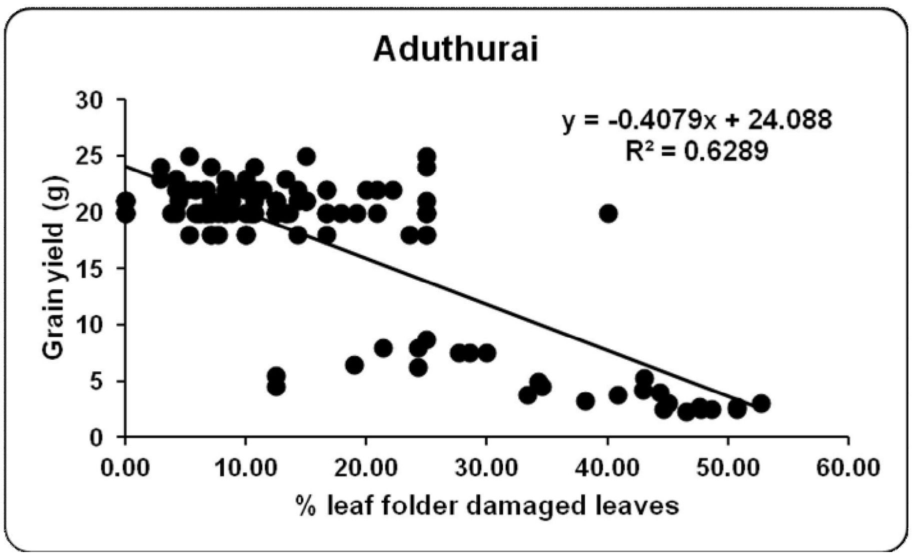
Pooled analysis was done from the data of all the locations. Grain yield values were transformed into natural logarithm values ln (GY) prior to analysis. Thus, data from 591 hills was considered to build a model. The equation of regression model is ln (GY) = 3.04 – 0.02X where X = % white ears. The coefficient of determination (R^2) for this model was 0.5160 ($p < 0.00001$). Based on this model % reduction in grain yield over control was predicted **(Fig.2.6)**. Model envisages that 10% white ears results in 18% reduction in grain yield over control, 20% white ears results in 32% reduction in grain yield over control and so on. These predicted values need to be validated.

Fig 2.6 Predicted yield loss due to white ear damage



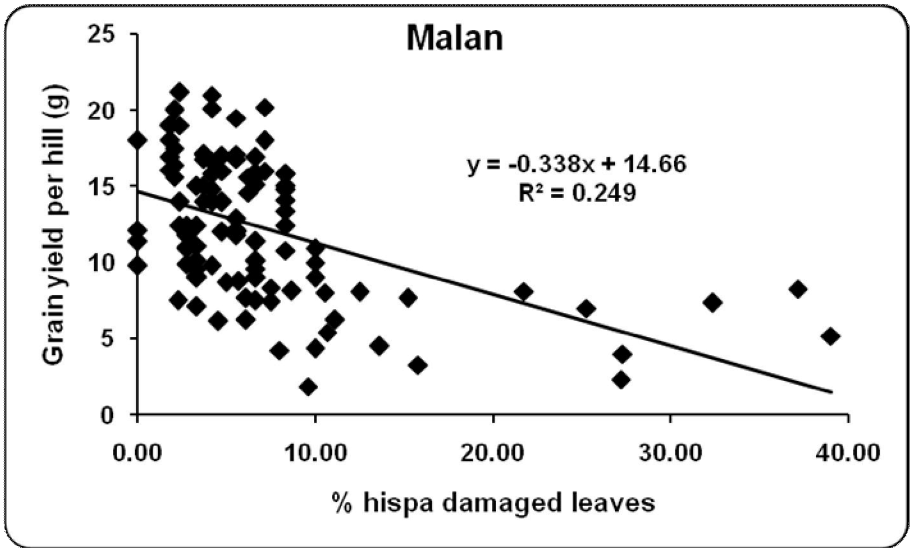
Target pest: Leaf folder

At **Jagdalpur**, most popular variety, swarna was grown in this trial. In spite of augmentation, leaf folder damaged leaves varied from 0 – 5.56%, flag leaf damage ranged between 0 – 14%, which was very low to draw valid conclusions.
At **Aduthurai**, leaf folder damaged leaves ranged from 0 to 52.70%, while number of flag leaves damaged per hill varied between 0 and 10%. Larval population ranging from 0- 6 per hill and pupae at 0 - 5 per hill were recorded with a grain yield ranging from 2.25 – 25 g/ hill. Regression analysis revealed a significant negative relationship between % LFDL and grain yield with good coefficient of determination (R^2 = 0.628). Every 10% increase in LFDL resulted in 4.07 g reduction in grain yield. Since the data were found segregated mainly at 2 points without proper distribution, conclusions need to be revalidated.



Target Pest: Hispa

At **Malan**, Kasturi variety was grown in this trial. Severe infestation of hispa was observed at this location. An attempt was made to estimate the yield loss due to hispa. Hispa damage ranged from 0 to 39% and grain yield varied from 1.85 to 21.20 g/ hill. Regression analysis revealed a negative relationship between hispa damaged leaves and grain yield, however it was not significant.



Yield Loss Estimation Trial (YLET) was conducted at 5 locations for stem borer, 3 locations for leaf folder and for hispa at Malan, during Kharif 2014. Regression analysis at each location revealed a significant negative relationship between the damage data and grain yield. Pooled analysis of % white ears vs natural logarithm of grain yield revealed a significant regression ($R^2 = 0.5160$; $P \leq 0.0001$; $n = 591$). Every 10% increase in white ears resulted in 1.02 g reduction in grain yield per hill. Based on this model, per cent reduction in grain yield was predicted for varying levels of white ear damage.

ii) Integrated Pest Management special trial (IPMs)

In recent years, intensive cultivation of rice has resulted in the frequent occurrence of biotic stresses that formed as major constraints in rice production. Although, IPM has been accepted as the most attractive option for protection of crops from the ravages of pests, implementation at the farmer's level has been limited. As IPM involves a number of components, farmers must have capability of taking decisions and selecting IPM options accordingly for economical and long term management. Most of these options also need to be refined at individual farm level keeping in view the availability of resources and feasibility of farmers. Therefore, IPM involves working with the farmers in their fields and devising technologies suitable to their conditions.

Keeping this in view, IPM special trail was conducted with an aim to manage pests (including insects, diseases and weeds) in a holistic way in farmers' fields involving them in a participatory way and allowing them to select IPM practices from a basket of options available.

During *Kharif* 2014, the trial was conducted at 12 locations *viz*. Aduthurai, Chinsurah, Gangavathi, Jagdalpur, Ludhiana, Maruteru, Raipur, Sakoli, Titabar, DRR, Karjat and Malan. Peak insect pest incidence data was calculated for each pest found at each location. Disease intensity over time was calculated as Area under disease progress curve (AUDPC). The pest management practices followed in IPM and farmers' practice at these locations are given in **Table 2.28**. The details of pest incidence at each location are discussed here:

Table 2.28 Details of Pest Management Practices followed in IPMs trial at various locations, *kharif* 2014

	Practices followed in IPM	Farmers practices
LOCATION: ADUTHURAI		
Area	**1 acre**	**1 acre**
Variety	**CR 1009**	**CR 1009**
Nursery	• Seed treatment with Pseudomonas @ 10 g/kg seed. • Application of 20 kg DAP	• **Application of 20 kg DAP**
Main field	• Application of 150 kg Urea, 130 kg potash and 45 kg SSP • Bund cropping of cow pea (Erect type). • Leaving Rogue space of 1 foot for every 8 feet. • Soil application of pseudomonas @ 1 kg/acre • LCC based N application • Monitoring of YSB by pheromone trap @ 5 nos /acre • Release of egg parasitoid, *Trichogramma japonicum* @ 2 cc /acre. • Spraying of botanical pesticide, Nimbicidine 10000 ppm @ 200 ml/acre. • Erection of bird perches	• Application of 170 kg Urea, 150 kg potash and 35 kg SSP • Spraying of Profenophos 50 EC @ 500 ml/acre. • Spraying of Chlorpyriphos 20 EC @ 500 ml/acre • Spraying of Debuconazole @ 250 ml/acre
LOCATION: LUDHIANA		
Area	0.5 acre	0.5 acre
Variety	PR 123	PR 123
Nursery	• Seed treatment done with 20g Bavistin 50WP and 1 g Streptocycline • Applied 1.040 kg urea and 1.0 kg Zinc sulphate	• Applied 1.040 kg urea and 1.0 kg Zinc sulphate for 1 acre nursery
Main field	• Application of Urea @ 110 kg/ acre; Zinc sulphate @ 25 kg/ acre • Alley ways of 30 cm after every 2 m • Installation of pheromone traps for monitoring stem borer @ 3 traps/ acre • Mid season drainage followed • Application of Butachlor @ 1.2 l/ acre • Application of Mortar @ 170 g/acre • Application of Propiconazole @ 200 ml/ acre	• Application of Urea @ 150 kg/ acre; Zinc sulphate @ 25 kg/ acre • Application of Butachlor @ 1.2 l/ acre • Application of Chlorpyriphos @ 1.0 l/ acre • Application of confidor 17.8 SL@ 100 ml/ acre • Application of Monocil @ 600 ml/ acre • Application of Propiconazole @ 200 ml/ acre
LOCATION: MARUTERU		
Area	1 acre	1 acre
Variety	MTU 7029 (Swarna)	MTU 7029 (Swarna)
Nursery	• Seed treatment with bavistin and application of Carbofuran 3G • Application of NPK @60:40:40 kg/ha in the form of Urea, SSP and MOP • Tray nursery were sprayed twice with 1% 19-19-19 nutrient solution	• Tray nursery were sprayed with twice 1% 19-19-19 nutrient solution • Applied Carbofuran 3G
Main field	• Application of 100 Kg SSP; 27 Kg MOP and 50 Kg Urea/acre • Application of Pretilachlor weedicide and one hand weeding	• Application of DAP one bag; Urea 50 kg; 25 kg MOP/acre • Application of Pretilachlor weedicide and one hand weeding

	• Sprayed Propiconazole and hexaconazole against sheath blight • Sprayed Pymetrozine and imidacloprid against planthoppers • Sprayed cartap hydrochloride 50 SP against stem borer and leaf folder • Installation of pheromone traps @ 8 / ha • Release of tricho cards for leaf folder and stem borer management	• Sprayed hexaconazole four times • against sheath blight • Tebuconazole spray at the time of grain hardening against grain discolouration • Sprayed profenophos for leaf mite and fipronil 5 SC against stem borer; • Sprayed imidacloprid twice, pymetrozine and dinotefuran once against planthoppers
LOCATION: RAIPUR		
Area	1 acre	1 acre
Variety	Hy. 6444 Gold(Popular hybrid)	Hy. 6444 Gold(Popular hybrid)
Nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed • Application of Carbofuran @ 1.1 kg/ha before pulling of seedlings	
Main field	• Application of 50 kg DAP, 50 kg MOP & 50 kg Urea • Planting at 25 x 25 cm spacing • Alley ways of 30 cm after every 2 m • Application of Butachlor • Installation of pheromone traps • Application of cartap hydrochloride	• Application of 50 kg DAP, & 50 kg Urea • Staggered planting • Application of Phorate • Spraying of chlorpyrophos + cypermethrin • Spraying of Dichlorvos • Application of Imidacloprid
LOCATION: TITABAR		
Area	500 sq.m	500 sq.m
Variety	Ranjit	Ranjit
Nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed	
Main field	• Application of 20 kg N, 10 kg P_2O_5 & 10 kg K_2O • Application of Butachlor • Installation of pheromone traps @ 3/ acre for stem borer monitoring • Application of chlorpyriphos • Placement of tricho cards	• Application of 60 kg N, 20 kg P_2O_5 & 40 kg K_2O • Application of Butachlor • Application of chlorpyriphos
LOCATION: DRR		
Area	1 acre	1 acre
Variety	BPT 5204	BPT 5204
Nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed • Application of carbofuran 3 G@ 160 g/ acre nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed
Main field	• Application of 1 bag urea, 3 bags SSP, 0.5 bag MOP • Application of Pretilachlor @ 500 ml/ acre • Application of monocrotophos @ 1 liter/ acre • Installation of pheromone traps @ 3/ acre for stem borer monitoring • Application of Buprofezin @ ½ liter/ acre • Spraying of Acephate @ 250 g/ acre • Spraying of Dicofol @ 1 liter • Spraying of Propiconazole @ 250ml/ acre	• Application of 1 bag urea, 3 bags SSP, half bag MOP • Application of Pretilachlor @ 500 ml • Application of Phorate @ 4 kg/ acre • Spraying of chlorpyrifos@ 1 liter/ acre • Appln. of Buprofezin @ ½ liter/ acre • Spraying of Acephate @ 250 g/ acre • Spraying of Glamor (Ethiprole + Imidacloprid) @ 50 g/ acre • Spraying of Dinotefuran @ 80 g/ acre - twice

		• Spraying of Propiconazole @ 250ml/ acre • Spraying of Profenofos @1 liter/ acre
LOCATION: CHINSURAH		
Area	0.5 acre	0.5 acre
Variety	MTU 7029 (Swarna)	MTU 7029 (Swarna)
Nursery	• Seed treatment with Carbendazim @ 2 g/ kg seed • Application of 1.5 kg mustard cake	• Seed treatment with Carbendazim @ 2 g/ kg seed • Application of 5 kg mustard cake
Main field	• Application of 31 kg 10-26-26; Urea 28 KG • Installation of pheromone traps @ 3/ acre for stem borer monitoring • Application of Butachlor + 1 hand weeding • Application of Ferterra granules @ 4 kg/ acre + coragen spray @ 60 ml/ acre	• Application of 30 kg SSP; 23 kg MOP; Urea 30 kg • Application of Butachlor + 2 hand weedings • Application of Phorate 10 G + spraying of Triazophos (Tarzan) @ 750 ml/ acre twice
LOCATION: GANGAVATHI		
Area	• 1 acre	• 1 acre
Variety	• BPT 5204	• BPT 5204
Nursery	• Seed treatment with Pseudomonas @ 10gm/l for 30 mins	
Main field	• Seedling dip with pseudomonas@ 4 g/l for 20 mins • Fertilizer application at recommend dose @200:100:100 NPK/ha • Leaving alleyways • Application of Butachlor @ 400 ml/l • Application of Carbofuran 3G • Application of COC @ 0.05 g/l + Stpetocycline@ 0.05gm/l (for BLB) • Installation of Pheromone traps @ 10/ac • Application of Imidacloprid +Ethiprole @ 0.4 g/l • Application of Buprofezin @ 1 ml/l + DDVP@ 1 ml/l + Hexaconazole 2 ml/l • Application of Dinotefuran @ 0.4 g/l + Tricyaclazole @ 0.6 g/l	• Fertilizer application @ 300:125:125 kg/ha NPK • Leaving alleyways • Application of Butachlor @ 400 ml/ac • Application of phorate 10 G @ 12 kg/ha • Application of hexaconzole @ 2 ml/l+ Streptocycline @ 0.06g/l + chlorpyriphos & cypermethrin (Hamla 505) + Acephate • Application of carbbendizim @ 1gm/l + Glamore (Imidacloprid+ ethiprole) + Lambda cyhalothrin @ 0.5 ml/l • Appln.of Buprofezin@1ml/l+ Hexa conazole @2 ml/l +Acephate @ 2 g /l • Application of Dinotefuran @ 0.4g/l+ DDVP @ 1 ml/l + Lambda halothrin @0.5 ml/l + Acephate @ 1 gm/l + trifloxystrobin & tebuconazole (Nativo) @ 0.4 g/l • Spray of tricyaclazole @ 0.6 g/l + pymetrozine 50 WP @ 0.6 g/l + Acephate @ 1 g • /l + Hexaconazole @ 1 ml/l • Application of propiconazole @ 1 ml/l + Buprofezin @ 1 ml/l
LOCATION: JAGDALPUR		
Area	1 acre	1 acre
Variety	Hy-2244 (VNR)	Hy-2244 (VNR)
Nursery	• Application of 7.8 kg N, 15 kg P, 2 kg K / 400m^{2}nursery • Application of Carbofuran @ 1.1 kg/ha before pulling of seedlings	• Application of 2 kg N, 2 kg P, 1 kg K / 400m^{2}nursery

Main field	• Application of 78 kg N, 150 kg P & 20 Kg K/ acre • Seedlings transplanted at spacing of 20x 15 cm • Left alleyways of 30 cm after every 10 rows. • Applied Butachlor 1.5 kg ai/ha at 4 DAT • Applied chlorpyriphos @ 1 lit/acre at 20 DAT • Applied weedicide metsulfurom methyl @ 20 DAT + One hand weeding at 40 DAT • Nitrogen top dressing at 45 DAT • Sprayed Tricyclazole 300 g/ha against blast • Sprayed cartap hydrochloride 50 WP @ 600 g/ha at 60 DAT	• Application of 40 kg N, 50 kg P & 10 Kg K/ acre • Seedlings transplanted at spacing of 15x 15 cm • Applied phorate 10 G @ 5kg/ha • Hand weeding twice • Sprayed Carbendazim @ 200 g/ha against blast
LOCATION: SAKOLI		
Area	4000 sq.m	4000 sq.m
Variety	Jai Ram	Jai Ram
Nursery	• Seed treatment with Carbandezim @ 2 g/ kg seed • Application of Carbofuran @ 1.1kg ai/ ha before pulling seedlings	• Seed treatment with Carbandezim @ 1 g/ kg seed
Main field	• Application of 90 kg urea, 100 kg SSP & 8 kg Zinc Sulphate/ acre • Seedlings transplanted at spacing of 20 x 15 cm • Alleyways of 30 cm after every 2 m or 10 rows. • Application of Butachlor @ 1.5 kg a.i./ ha on 5th day after transplanting + 1 manual weeding • Installation of pheromone traps (Scirpoload) @ 3 traps/ acre for stem borer monitoring • Application of carbofuron 3 G@ 25 kg/ha • Application of Cartap hydrochloride 50 WP @ 600 g / ha at 60 DAT. • Application of Propiconazole 0.1%. • Mid season drainage was followed	• Application of 90 kg urea, 100 kg SSP & 8 kg Zinc Sulphate/ acre • Seedlings were transplanted randomly • Application of Butachlor @ 0.5 kg a.i./ ha on 5th day after transplanting + 1 manual weeding • Application of carbofuron 3 G@ 25 kg/ha
LOCATION: MALAN		
Area	1 ha	1 ha
Variety	HPR 2612	Raja hybrid
Nursery	• Application of 7 kg Urea, 9 kg SSP	
Main field	• Application of 250 kg IFFCO 12:32:16, 163 kg urea & 33 kg MOP • Application of Butachlor + 1 hand weeding • Application of Chlorpyriphos 2.5 liters	• Application of 108 kg urea • Application of Butachlor

Maruteru: Trial was carried out at Eletipadu village of Iragavaram mandal, West Godavari district of Andhra Pradesh, in the field of Sri. S. Ramakrishna Reddy. Low incidence of stem borer, gall midge, leaf folder, whorl maggot, hispa and sheath blight was observed. Planthopper incidence commenced at 45 DAT but exceeded ETL at 60 DAT in both IPM (21.7/ hill) and FP (23.4/ hill). There was no significant difference between IPM and FP plots in the disease severity of sheath blight. Grain yield was high in IPM (87.56 q/ ha) resulting in high BC ratio (2.32) while the high cost of cultivation in FP resulted in low BC ratio (1.86).

Aduthurai: IPM trial was conducted in Sri. Th. R. Perumal farmers field at Pasubathikovil village of Thanjavur mandal, Tamilnadu. CR 1009 was grown in this trial. Incidence of stem borer, leaf folder, gall midge, whorl maggot, hispa, BPH and GLH was observed in both IPM and farmers practices (Table----). Damage by all the pests at different stages of crop growth was low to draw valid conclusions. BPH incidence, though observed from 22 DAT, found exceeding ETL only at 99 DAT in Farmers practices (56/ 5 hills) as against 17.2 in IPM. The incidence of pests was low in IPM plot due to the prophylactic measures taken **(Table 2.30)**. Weed population and weed biomass was at par in both IPM and farmer practices. Grain yield was high in IPM plot mainly due to low pest incidence resulting in high BC ratio (4.26).

Ludhiana: Trial was conducted at Tugal village in Ludhiana district of Punjab in Sri. Jaspal Singh's field. PR 123 variety was grown. Incidence of stem borer, leaf folder, whorl maggot, BPH, WBPH, false smut and sheath blight was observed **(Table 2.31)**. Though the pest incidence started at 29 DAT in both IPM and farmers practices, damage did not reach ETL. Sheath blight and false smut were recorded based on the SES scale, throughout the season. AUDPC value of sheath blight (77.50) was high in the farmer practices as compared to IPM (38.50). A similar trend was observed in case of false smut (IPM: 1.40; FP: 14.70). The practices like adoption of seed treatment and application of specific plant protection chemicals against rice diseases reduced the disease intensity. The data on weed population and weed biomass were recorded at 29, 36,43,50,57 and 64 DAT and significant reduction in weed population, weed biomass in IPM plots was noticed. Grain yield was at par in both the practices which could be due to low pest incidence. However BC ratio was low in FP (3.93) as compared to IPM (5.91) mainly due to high cost of cultivation.

Table 2.29 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Maruteru**, *kharif* 2014

Treatments	% WE	PH (No./ 10 hills)		AUDPC - Sheath blight		Yield (Kg/ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
	110 DAT	60 DAT	90 DAT	DI	DS					
IPM	4.02 ±0.8	217.4 ±26.5	5.2 ±1.2	23.44	35.76	8756 ±283.3	113828	49050	64778	2.32
FP	6.13 ±1.0	234.6 ± 18.4	53.8 ±13.4	18.7	25.87	8152 ±279.3	105976	56875	49101	1.86

DI = Disease Incidence; DS = Disease severity; AUDPC = Area under disease progress curve; Price of paddy = Rs. 1300/q

Table 2.30 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Aduthurai**, *kharif* 2014

Treat-ments	% DH	% WE	%SS		No./ 5 hills		Weed biomass (g/m^2)	Weed population (No./sqm)	Yield (Kg/ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net Returns (Rs.)	BC ratio
					BPH	GLH							
	43 DAT	99 DAT	50 DAT	57 DAT	99 DAT	85 DAT							
IPM	4.06 ± 0.6	5.38 ± 0.5	4.59 ± 0.7	3.61 ± 0.8	17.2 ± 4.2	3.60 ± 0.7	5.06	25	5240 ±142.5	74408	17455	56953	4.26
FP	7.00 ± 0.5	8.47 ± 0.6	6.39 ± 0.8	5.31 ± 0.6	56 ± 3.4	7.60 ±1.0	5.08	27	4400 ±161.5	62480	18549	43931	3.37

All values are mean ± SE; Price of paddy = Rs. 1420/q

Table 2.31 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Ludhiana**, *kharif* 2014

Treatments	% DH	% WE	%LFDL		No./ 5 hills	AUDPC		Yield (Kg/ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
					WBPH	Sheath blight	False smut					
	57 DAT	85 DAT	57 DAT	85 DAT	43 DAT							
IPM	4.67 ± 0.8	2.46 ± 0.6	0.33 ± 0.1	2.27 ± 0.3	0.8 ± 0.4	38.50	1.40	7582 ± 69.2	106148	17955	88193	5.91
FP	6.50 ± 0.5	8.90 ± 0.6	3.34 ± 0.5	5.72 ± 0.8	3.4 ± 0.5	77.70	14.70	7064 ± 77.3	98896	25168	73728	3.93

Treatments	Weed biomass (dry wt- g/ m2)						Weed Population (No./sq.m)						
	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT	64 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT	64 DAT	92 DAT
IPM	7.4	5	8	11	11.2	0.0	0.40 (0.91)	0.20 (0.81)	0.40 (0.91)	0.40 (0.91)	0.40 (0.91)	0.00 (0.71)	0.00 (0.71)
FP	12.4	8.8	8.2	11.6	11.8	6.0	0.80 (1.09)	0.60 (0.99)	0.60 (0.99)	0.80 (1.06)	0.80 (1.06)	0.40 (0.91)	18.40 (2.49)

AUDPC = Area under disease progress curve; All values are mean ± SE; Price of paddy = Rs. 1400/q

DRR: The trial was conducted in balajinagar thanda of Damarcherla mandal, Nalgonda district of Telangana State in Sri. Mangiram's field. BPT 5204 was grown in this trial. Incidence of leaf folder, BPH, panicle mite, sheath blight and false smut was observed **(Table 2.32)**. BPH incidence was observed starting 45 DAT but exceeded ETL at 100 DAT. Leaf folder incidence was found high in IPM plot than farmer practices. The data on weed population and weed biomass at Maximum Tillering (MT) and Panicle Initiation (PI) stage was significantly low in IPM plots, contributing to higher resource availability to crop in IPM plots, which has reflected in higher grain yields. Grain yield was high in IPM resulting in high returns and high BC ratio (4.85).

Table 2.32 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **DRR**, *kharif* 2014

Treatments	% LFDL	BPH	Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
	90 DAT	100 DAT					
IPM	21.25 ± 0.60	24.65 ± 0.80	85.33	106663	21975	84688	4.85
FP	16.50 ± 0.50	36.77 ± 0.40	66.67	83338	34203	49135	2.44

Treatments	Weed biomass (dry wt - g/ m^2)		Weed Population (No./sq. m)	
	MT Stage	PI Stage	MT Stage	PI Stage
IPM	9.41	24.45	20(4.51)	24(4.91)
FP	21.95	39.41	59(7.70)	37(5.21)

MT = Maximum tillering; PI = Panicle initiation; Price of paddy = Rs.1250 /q

Raipur: IPM special trial was conducted in Khauli village, Aarang block, Raipur district of Chhattisgarh, in Sri Umesh Chadrakar's field. Hy. 6444 Gold was grown. Stem borer, leaf folder, hispa, BPH and WBPH was observed **(Table 2.33)**. Dead heart and white ear incidence was found high in FP plot as compared to IPM plot. High BPH population was recorded in farmer practices at 85 DAT. Grain yield and returns were high in IPM plot resulting in high BC ratio (5.15).

Table 2.33 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Raipur**, *kharif* 2014

Treatments	% DH	% WE	BPH (No./ 5 hills)		Yield Kg/ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
	99 DAT	106 DAT	57 DAT	85 DAT					
IPM	8.60 ±1.1	9.67 ±1.2	5.00 ±1.6	15.60 ±1.5	6920 ±103.5	96534	18750	77784	5.15
FP	15.66 ±1.7	26.93 ±3.6	17.00 ±2.4	171 ±70.5	5684 ±129.1	79291.8	17500	61792	4.53

Price of paddy = Rs. 1395/q

Titabar: Ranjit variety was grown in this trial in the farm of Sri. Ratul Lekhok, Mazgaon village, Titabar mandal, Assam. In general, the pest incidence was low (<5%) in both the practices **(Table 2.34)**. The data on weed population revealed 50% reduction in grassy weeds, 30% reduction in sedges and 59% reduction broadleaf weeds in IPM plots as compared to farmer practices. The data on dry weed biomass indicated a 56.88% less in IPM plots. The lower weed population and weed biomass is one of the main components of IPM contributing to higher grain yields. BC ratio was high in IPM plot (2.23) as compared to Farmer practices (1.87).

Jagdalpur: IPM trial was conducted at Sri Dashrath Baghel farmers' field in Tekameta village of Jagdalpur block, Chhattisgarh. Hybrid – 2244 (VNR) was grown in this trial. Though the incidence of stem borer, leaf folder, whorl maggot, thrips, BPH, WBPH and GLH was observed starting from 15 DAT, numbers were low and have not crossed ETL for taking any IPM intervention **(Table 2.35)**. The data on weed population and weed biomass indicated that 76.76% higher population of sedges, 85.2% higher population of Broad leaved weeds (BLW); 61% higher biomass of sedges, 68.2% higher biomass of BLW were recorded in farmer practice adopted plots, resulting in 18.01% lower grain yield of hybrid -2244 (VNR), compared to IPM implemented plots. Yields were high in IPM plot resulting in high BC ratio (6.30) than FP.

Chinsurah: This trial was conducted in Damra Mogra village, West Bengal, in Sri Prosanta Ghosh's field. MTU 7029 (Swarna) variety was grown. Stem borer, leaf folder, whorl maggot, hispa, BPH, WBPH, GLH, leaf blast and sheath blight was recorded in both IPM and farmers practices **(Table 2.36)**. The incidence of all these pests observed from 22 DAT but never reached ETL to draw valid conclusions. Leaf blast and sheath blight were low in IPM due to the adoption of IPM practices that reduced the disease severity. The data on weed population and biomass at 20, 40 and 60 DAT showed drastic reduction in IPM adopted plots and resulted is significantly higher grain yields. Grain yield was at par in both the plots resulting in similar BC ratio of 2.59 and 2.30 in IPM and FP plots, respectively.

Gangavathi: IPM trial was conducted at Sri Shankara Bhatt farmers' field in Bapireddi camp of Gangavathi taluk, Karnataka. BPT 5204 variety was grown. Low incidence of stem borer, leaf folder and high incidence of BPH, WBPH, GLH, leaf blast and BLB was observed **(Table 2.37)**. Though BPH and WBPH populations were found starting from 25 DAT to 105 DAT. BPH exceeded ETL from 65 DAT onwards in farmer practices (35/hill) while it was high in IPM plot at 105 DAT only (23/ hill). Similarly WBPH population also exceeded ETL in farmer practices from 65 DAT onwards while it did not reach ETL in IPM field indicating effective management with IPM practices. Leaf blast and bacterial leaf blight were recorded as disease score and AUDPC value of both the diseases were low (LB -128; BLB - 216) when IPM practices such as application of balanced dose of fertilizers and application of need based plant protection measures were adopted as compared to Farmer practices (LB -160; BLB - 317).

BC ratio was high in IPM (6.13) due to low cost of cultivation and higher grain yield as compared to farmer practices.

Malan: The trial was conducted in Sri. Amin Chand's field at Kohala village, Kangra district, Himachal Pradesh. HPR 2612 cultivar was grown. Very low incidence of stem borer and leaf folder was observed **(Table 2.38)**. High hispa damage was recorded starting from 29 DAT in both IPM and farmer practices which gradually decreased. The data on weed population and weed biomass at 29 and 57 DAT was significantly low in IPM plots (31.06 to 72.05% lower weed population and 63% less weed biomass) than in farmer practices. Grain yield was high in IPM as compared to FP resulting in high gross returns and BC ratio (2.34).

Sakoli: IPM trial was conducted at Sakoli village in Bhandara mandal, Maharashtra, in Sri. Anil Shanker Gahane's field. Jai Ram variety was grown in both IPM and farmer practices plots. Incidence of stem borer, leaf folder, gall midge, BPH, WBPH, GLH, leaf blast, neck blast, sheath blight, sheath rot, brown spot and bacterial leaf blight was observed but none of them crossed ETL either in Farmer practices or in IPM plots **(Table 2.39)**. Only prophylactic measures were taken in addition to monitoring through pheromone traps. Adoption of IPM practices reduced the severity of all the diseases except bacterial blight. The data on weed population and weed biomass were recorded at 30 and 60 DAT. The weed population was 53.8% to 63% higher in farmers practice plots and weed biomass was 20.45% to 21.67% higher, as compared to IPM implemented plots. BC ratio was similar in both the plots (2.90 – 2.94) due to good yield and high returns.

Karjat: IPM trial was conducted at Tamnath village, Karjat mandal, Raigad district of Maharashtra in Shri. Pandarinath Vittal Dbhade's field. Karjat 8 was grown in this trial. Very low incidence of Stem borer was observed in both IPM and farmer practices, to draw valid conclusions.

Table2.34 Insect Pest incidence, grain yield and BC ratio in IPMs trial at **Titabar**, *kharif* 2014

Treatments	% DH	% WE	% SS	% LFDL	weed dry weight (g/m^2)	weed population (No/ m^2)			Yield	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
	78 DAT	Pre harvest	57 DAT	50 DAT		Grasses	Sedges	BLW	Kg/ ha				
IPM	1.00 ± 0.4	0.70 ± 0.4	0.96 ± 0.39	0.46 ± 0.14	35.7	11.00 (3.31)	92.4 (9.48)	7.6 (2.69)	5928 ± 135.7	77064	34500	42564	2.23
FP	3.08 ± 0.4	2.54 ± 0.4	1.56 ± 0.40	1.08 ± 0.12	82.8	22.00 (4.67)	292.6 (17.00)	18.6 (4.21)	4312 ± 165.1	56056	30000	26056	1.87

Price of paddy = Rs. 1300/q

Table 2.35 Insect Pest incidence, grain yield and benefit cost ratio in IPMs trial at **Jagdalpur**, *kharif* 2014

Treatments	% DH	%LFDL	% ThDL	Number per 5 hills							Weed biomass (dry wt - g/ m^2)	
				BPH		WBPH	GLH					
	60 DAT	45 DAT	30 DAT	105 DAT	120 DAT	120 DAT	75 DAT	90 DAT	105 DAT	120 DAT	Sedges	BLW
IPM	1.05 ± 0.6	2.88 ±1.2	2.76 ±1.1	1.0 ±0.3	2.40 ±0.9	0.40 ±0.2	3.60 ±0.9	5.40 ±0.7	2.20 ±0.5	5.50 ±0.8	2.47	2.33
FP	3.12 ± 1.4	9.36 ±0.9	9.29 ±1.9	14.00 ±2.3	16.60 ±1.8	9.60 ±1.6	13.60 ±0.9	16.60 ±0.8	22.40 ±0.5	31.80 ±3.0	6.34	7.33

Treatments	Weed population (No./ sq.m)		Yield (q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
	Sedges	BLW					
IPM	6.6(2.17)	4.4(2.64)	58.32	78732	12500	66232	6.30
FP	28.4(5.47)	29.8(5.36)	47.84	64584	13000	51584	4.97

Price of paddy = Rs. 1350/q

Table2.36 Insect Pest incidence, grain yield and benefit cost ratio in **IPMs** trial at **Chinsurah**, *kharif* 2014

Treat-ments	% DH	% WE	%LFDL	% WMDL	% HDL	GLH (No./ 5 hills)		BPH (No./ 5 hills)				
	36 DAT	Pre harvest	64 DAT	43 DAT	22 DAT	36 DAT	50 DAT	64 DAT	71 DAT	78 DAT	85 DAT	92 DAT
IPM	1.94 ± 0.43	2.88 ± 1.44	2.21 ± 0.52	1.44 ± 0.11	0.72 ± 0.23	18.4 ± 4.45	8.6 ± 1.21	3.00 ± 0.55	4.00 ±1.05	2.80 ±0.73	3.2 ± 0.37	9.0 ±1.05
FP	2.84 ± 0.22	3.49 ± 1.92	2.71 ± 0.24	4.08 ± 0.45	1.25 ± 0.30	0.00 ± 0.00	20.4 ± 0.81	24.0 ± 3.96	23.2 ±3.51	21.4 ±3.51	23.8 ± 2.72	17.2 ±1.98

Treat-ments	WBPH (No./ 5 hills)					AUDPC		Yield Kg/ ha	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
	64 DAT	71 DAT	78 DAT	85 DAT	92 DAT	Leaf blast	Sheath blight					
IPM	2.40 ±0.75	3.80 ±1.32	2.60 ± 0.60	3.00 ±0.55	5.40 ±1.36	1.40	128.8	6096 ± 109.3	71140	27505	43635	2.59
FP	22.0 ± 2.70	24.0 ±3.34	22.4 ± 2.08	23.6 ± 2.54	17 ±1.22	8.40	1005.2	5584 ± 77.6	65165	28305	36860	2.30

Treat-ments	Weed biomass (dry wt g/ m2)			Weed Population (No./sqm)		
	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
IPM	4.73 ±0.52	7.47 ±0.64	10.72 ±0.58	40.66 ± 5.26	63.20 ±4.84	88.20 ±5.80
FP	9.39 ± 0.72	10.49 ±0.43	15.53 ± 1.49	77.20 ± 5.82	89.20 ±5.26	133.60 ±10.70

AUDPC = Area under disease progress curve; Price of paddy = Rs.1167/ q

Table 2.37 Insect Pest incidence, grain yield and benefit cost ratio in IPMs trial at **Gangavathi**, *kharif* 2014

Treatments	BPH (No./ 10 hills)			WBPH (No./ 10 hills)				GLH (No./ 10 hills)				
	55 DAT	65 DAT	105 DAT	25 DAT	55 DAT	65 DAT	105 DAT	35 DAT	45 DAT	55 DAT	65 DAT	105 DAT
IPM	26.6 ± 4.5	68.0 ± 11.3	230.8 ± 23.5	72.6 ±10.5	41.0 ±10.6	87.4 ± 15.5	98.2 ± 9.5	20 ± 4.3	84.2 ± 9.9	12.0 ± 2.8	25.6 ± 5.1	47.6 ±10.1
FP	75.8 ± 9.7	354.8 ± 24.6	285.8 ± 33.0	91.2 ±11.9	96.6 ±11.6	369.2 ±42.1	236.4 ± 24.3	31.6 ± 4.1	111.6± 10.0	25.6 ± 6.0	61.0 ± 10.4	57.4 ±10.6

Treatments	Leaf blast	Bacterial leaf blight	Yield Q/ ha	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
IPM	128	216	78.88	145928	23820	122108	6.13
FP	160	317	76.72	141932	39429	102503	3.60

AUDPC = Area under disease progress curve; Price of paddy = Rs.1850/ q

Table 2.38 Insect Pest incidence, grain yield and benefit cost ratio in IPMs trial at **Malan,** *kharif* 2014

Treatments	% DH	% WE	% LFDL		% HDL			Weed biomass (dry wt - g/ m2)		Weed Population (No./sq. m)	
	92 DAT	Pre harvest	92 DAT	106 DAT	29 DAT	36 DAT	57 DAT	29 DAT	57 DAT	29 DAT	57 DAT
IPM	4.06 ± 0.28	5.08 ± 0.33	3.33 ± 0.09	3.01 ± 0.20	23.04 ± 0.84	1.90 ± 0.22	2.13 ± 0.14	12.63	24.84	32.00 (5.57)	47.20 (6.74)
FP	9.28 ± 0.75	8.90 ± 0.4	13.36 ± 1.03	14.00 ± 1.23	60.96 ± 2.29	39.58 ± 3.50	32.95 ± 3.50	18.32	88.88	87.20 (9.33)	127.80 (11.21)

Treatments	Yield (Kg/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
IPM	9920 ± 233.24	119040	50800	68240	2.34
FP	5520 ± 265.33	66240	39120	27120	1.69

Price of paddy =Rs. 1200/ q

Table 2.39 Insect Pest incidence, grain yield and benefit cost ratio in **IPM**s trial at **Sakoli**, *kharif* 2014

Treatments	% DH		% WE	% SS		% LFDL	Number per 5 hills				
							BPH		WBPH		GLH
	78 DAT	92 DAT	Pre harvest	64 DAT	92 DAT	71 DAT	92 DAT	99 DAT	92 DAT	99 DAT	85 DAT
IPM	7.48 ± 1.63	9.86 ± 0.75	2.66 ± 0.31	7.05 ± 1.64	10.12 ± 0.99	6.14 ± 0.72	15.60 ± 0.40	15.40 ± 0.60	22.4 ± 0.68	19.80 ± 1.32	8.00 ± 1.05
FP	8.07 ± 1.31	7.90 ± 1.15	9.94 ± 2.01	9.68 ± 2.43	7.17 ± 1.23	5.88 ± 0.84	14.20 ± 0.58	17.20 ± 0.91	19.20 ± 1.16	26.20 ± 1.07	9.20 ± 0.97

Treatments	Area Under disease progress curve (AUDPC)							Weed biomass (dry wt/ m²)		Weed Population (No./sq.m)	
	Leaf blast	Neck blast	Sheath blight	Sheath rot	Brown spot	Stem rot	Bacterial leaf blight	30 DAT	60 DAT	30 DAT	60 DAT
IPM	17.64	286.30	44.80	322.70	1.40	343.70	1122.10	17.74	17.98	11.60(3.46)	9.80(3.19)
FP	18.48	338.80	57.40	462.70	23.80	611.80	1096.20	22.3	22.96	31.80(5.60)	21.20(4.57)

Treatments	Yield (Q/ ha)	Gross returns (Rs.)	Cost of cultivation (Rs.)	Net returns (Rs.)	BC ratio
IPM	**57.84**	**98331**	**33938**	**64393**	**2.9**
FP	**50.19**	**85318**	**29004**	**56314**	**2.94**

AUDPC = Area under disease progress curve; Price of paddy = Rs. 1700/ q

Integrated Pest Management special (IPMs) trial was conducted at 12 locations during Kharif 2014, with an aim of managing all pests including insects, diseases and weeds in a holistic way in farmers' fields involving them in a participatory way and allowing them to select IPM practices from a basket of options available. Insect pest incidence exceeded ETL and found high in farmers practices at Aduthurai, Maruteru, Raipur, DRR and Gangavathi while the incidence was low at other 6 locations viz., Ludhiana, Titabar, Chinsurah, Jagdalpur, Sakoli and Malan. Adoption of IPM practices reduced the incidence of BPH at Maruteru (21.7/hill), DRR (24.6/hill), Gangavathi (6.8/hill) and Aduthurai (3.4/hill) as against 23.4, 36.7, 35 and 11.2 BPH/hill, respectively in Farmer practices. At Raipur alone white ears were low in IPM (9.67%) than in Farmer practices (26.9%). In general, adoption of IPM practices reduced area under disease progress curve (AUDPC) of major diseases like leaf blast, sheath blight, bacterial blight and brown spot at Sakoli, Ludhiana, Chinsurah and Gangavathi while at Maruteru there wsa no difference between IPM and farmers practices with respect to sheath blight severity. Weed population and weed biomass recorded at eight locations were considerably reduced in IPM implemented plots as compared to farmers practice resulting in increased grain yields. Grain yield was significantly high in IPM plots resulting in high BC ratio.

2.7 POPULATION DYNAMICS OF INSECT PESTS ASSESSED THROUGH LIGHT TRAP CATCHES

Knowledge on 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 economically viable location specific pest management strategies. 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. 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 centres 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 mor), evening (RH eve) and sun shine hours (SSH) are computed from the daily data and are presented with reference to the internationally adopted standard week protocols. However, in the previous years one of the main causes of variability in light trap catches from centres has been the lack of uniformity in type of light traps being used at each centre. Hence, this year an attempt was made to adopt a single type of light trap (Fine trap model light trap designed and commercialized by NCIPM) uniformly across 29 centres and evaluate its performance compared to that of existing model at different locations over a period of 2-5 months.

The summary of observations on light trap catches of insect pests, their natural enemies and weather parameters recorded during the year (Jan-Dec, 2014) and general trends are presented here. Detailed data are available in the softcopy format and may be requested from DRR.

ANDHRA PRADESH

Maruteru (June to December 2014)

Important pests recorded in light trap collections at this centre include yellow stem borer (YSB), gall midge (GM), green leafhopper (GLH), leaf folder (LF), brown planthopper (BPH), White backed planthopper (WBPH). These pests occurred in high numbers between 10th and 20th standard weeks. The peak population of YSB (1166 females + 284 males) prevailed during 17th week, while gall midge population was highest (1822) during 12th week. The population of leaf folder was low throughout the year with a small peak (77) occurring during 47th week. However, this being an endemic area, very high populations of planthoppers consisting of mainly BPH (50675) and WBPH (2060) occurred during 16th and 38th weeks, respectively. Compared to previous year, there was an increase in their population. GLH population was at its peak (1881) during 39th week. The occurrence of high numbers of mirid bug coincided with the high populations of plant and leafhoppers, suggesting a density dependent relationship between the predator and prey.

1. **Ragolu** (January to December 2014)

At this centre, YSB, GM and LF occurred in very low numbers. YSB and GM occurred during both *kharif* and *rabi* seasons. Peak populations of gall midge (175) and YSB (31 females+32 males) occurred during 39th and 4th week respectively.

2. **Nellore** (January to December 2014)

BPH and WBPH occurred in high numbers with peak populations of BPH (5850) and WBPH (6550) recorded during 37th and 41st week, respectively. GM, GLH and LF were recorded in low numbers in light trap catches at this centre. Peak population of YSB (1615 females) was noticed during 39th week. Peak populations of LF (111) and GM were observed during the 12th week. Population of BPH, WBPH, GLH and YSB were relatively more during *kharif* while catches of GM were more during *rabi* season. Among natural enemies, mirid bugs were recorded in high numbers coinciding with high populations of leaf and planthoppers.

TELANGANA

3. **Rajendranagar** (January to December 2014)

The major insect pests recorded at this centre were YSB, GLH and BPH. Other pests such as green stink bug, leaf folder and blue beetle were also observed in low numbers. Among natural enemies, mirid bugs and coccinellids were recorded. Two peak populations of YSB (145 females + 17 males) and (133 females + 43 males) occurred during 13th and 43rd weeks. Leaf folder occurred in low numbers with a peak (69) during 45th week. Peak population (297) of green leafhopper occurred during 44th week. BPH population was more during *kharif* season with the peak population (1031) occurring during 47th week. Mirid bug populations were also prevalent with the highest population (1771) during 18th week.

4. **Warangal** (January to December 2014)

At this centre, YSB, GM, GLH, BPH, WBPH and LF were recorded in low numbers. YSB (64 females + 62 males) reached peak during 52nd week, while highest GM population (871) was observed during 43rd week. Peak populations of GLH (1976), BPH (2105) and WBPH (2352) were recorded during 46th week. Hot and humid weather conditions (max temp. 29.7, min temp. 20.7 ^{o}C, RH morn. 91.8%, and 3.4 SSH were observed during this period.

TAMIL NADU

5. Aduthurai (January to December 2014)

Important pests reported from light trap catches at this centre are YSB, GLH, BPH, black bug and blue beetle. Moderate populations of YSB were prevalent throughout the year with peak (3018 females + 76 males) occurring during 1st week. Highest population of GLH (9670 and BPH (21160) were recorded during 50th week. Peak populations of Black bug (52342) and blue beetle (819) were occurred during 33rd and 9th week, respectively. Among natural enemies, coccinellids, and ground beetles were recorded. The peak catches of major insect pests like YSB, BPH, black bug recorded during this year were considerably higher than that of last year at this centre.

6. Coimbatore (January to December 2014)

Pest populations in general were low at this centre. YSB, LF, EHB, BPH and WBPH and white jassids were prevalent in very low numbers. The peak populations of WBPH (46) and BPH (51) occurred during 1st week while the peak population of GLH (60) was recorded along with that of mirid bug (1053), during 51st week.

PUDUCHERRY

7. Puducherry (January to December 2014)

Moderate to low numbers of YSB, LF, GB, GLH, BPH and WBPH were observed and peak populations of YSB (70 females + 32 males) and GLH (*N. v.* 52) were recorded during 25th and 32nd week, respectively. Peak populations of LF (60), BPH (39) and GB (46) were noticed during 34th, 29th and 41st week, respectively.

9. Karaikal (January to December 2014)

Very low numbers of YSB, GLH, ear head bug, BPH, WBPH and coccinellids were recorded during *kharif* and *rabi* seasons at this centre. YSB catches were relatively more between 1st and 15th weeks while GLH catches were higher between 42nd and 52nd weeks.

KERALA

10. Pattambi (January to December 2014)

YSB was recorded with the highest catch (2761) during 50th week while white stem borer (WSB) was also recorded with peak population (108) during 51st week. Low populations of case worm, GM and LF recorded throughout the year. Peak populations of GLH, *N. virescens* (2799), *N. nigropictus* (3196) were recorded during 52nd week. BPH population was high during both *kharif* and *rabi* seasons with at its peak (2650) recorded during 52nd week. Among the predators mirid bug was prevalent in both *kharif* and *rabi* seasons with the highest catch (4679) observed during 52nd week. Overall, peak population of YSB observed during this year was more compared to the previous year while the reverse was true with BPH.

11. Moncompu (January-December 2014)

At this centre, the populations of BPH and GLH were higher during *rabi* compared to that of *kharif* season. Two peaks of BPH population, one each during *rabi* (7649) and Kharif (2479) were recorded during 10th and 39th week, respectively. Low numbers of YSB, LF, black bug, rice bug, and water bug were also observed. Peak population of GLH (*N.v* 177 + *N.n* 141) occurred during 9th week in *rabi* season. However, BPH and GLH peaks observed during this year were considerably lower compared to that of last year.

KARNATAKA

12. Mandya (January to Nov 2014)

YSB, BPH and GLH were recorded in low numbers. and populations of GLH (431) and YSB (& females+16 males 107) reached peaks during 49th and 46th week, respectively. However, the prevalent weather parameters could not explain for the low population levels during this period.

13. Gangavathi (January to Dec 2014)

YSB, LF, GLH, BPH and WBPH were the important pests observed throughout the year. Peak population of YSB (368 females+278 males) was recorded during 15th week. High populations of plant- and leafhoppers were observed both during *kharif* and *rabi* seasons. BPH population was at its peak (25698) during 48th week while that of WBPH (21638) was observed during 45th week. Peak population of LF (890) and GLH (*Nv* 1233+ *Nn* 1151) were observed during 48th week. Peak catches of BPH, WBPH and GLH recorded this year were relatively higher compared to that of last year.

MAHARASHTRA

14. Karjat (January to November 2014)

YSB, LF, GLH, BPH, WBPH, case worm, army worm and GB were observed in low numbers at this centre.. Peak population of YSB (57 females + 10 males) was observed during 37th week while GLH (*Nv*. 68+ *Nn* 57) and LF (80) peaks were recorded during 11th and 39th week, respectively.

15. Sakoli (January to December 2014)

Gall midge was predominant between 31st and 44th weeks with peak population (554) occurring during 39th week however their catches were low in *rabi* season. Peak catches of YSB (176 females+ 13 males) and leaf folder (83) were recorded during 32nd and 34th weeks respectively. Populations of BPH (308) and WBPH (308) were highest during 41st week. GLH occurred during both *Kharif* and *rabi* seasons with peak population (279) during 38th week.

ODISHA

16. Sambalpur (January to December 2014)

YSB, GM, LF and CW were recorded in very low numbers throughout the year at this centre. Moderate populations of GLH, BPH and WBPH were recorded in both *kharif* and *rabi* seasons. Peak populations of GLH (281), BPH (7468) and WBPH (7105) occurred during 13th, 20th and 15th week, respectively.

MADHYA PRADESH

17. Rewa (July to December 2014)

Low population of only gundhi bug (GB) was reported at this centre.

CHATTISGARH

18. Raipur (January to December 2014)

High populations of GLH and BPH were observed during *Kharif* season. and the peak populations (BPH -10342) and GLH -3375) were seen during the 42nd week at this centre. This period was characterized by optimum max. temp. (31.3 ^{o}C), low min. temp (23.8 ^{o}C), high RH (88.7 %), good sunshine (6.9 SSH) with 1 mm rainfall. Peak population of zigzag leafhopper (ZLH) (4235) was recorded during 46th week. Maximum population of YSB (116 females+67 males) was recorded during 4th week. Populations of case worm, PSB, LF, WBPH, *Spodoptera* and GB were also observed at this centre but were relatively very low. Other insects observed included ground beetles, rove beetles and coccinellids. Peak population of BPH recorded this year was considerably low compared to that of last year.

19. Jagdalpur (January- December, 2014)

High population of GLH and BPH were recorded between 39th and 47th weeks with GLH peak (*Nv.* 3945+ *Nn*. 1986) recorded during 45th week. Peak population of GLH recorded was almost ten times lower than that of the previous year. Other pests observed in low numbers at this centre include YSB, GM, WBPH, LF, CW, ZLH and GB. Among natural enemies, ladybird beetles and ground beetles were recorded.

GUJARAT

20. Nawagam (January to December, 2014)

YSB, LF, GLH and BPH occurred in low numbers at this centre. Peak populations of GLH (139) & WBPH (264) were noticed during 39th and 43rd week respectively, while LF (120) and YSB (119) peaks recorded during 41st and 42nd week, respectively. Other insects observed in low numbers include grasshoppers and dragon flies. Insect catches were relatively more during *kharif* season.

UTTAR PRADESH

21. Faizabad (July to December 2014)

YSB, LF and GLH are the major pests recorded in light trap catches at this centre. Peak populations of YSB (441), LF (617) and GLH (636) were occurred during 39th and 42nd and 44th week, respectively.

UTTARANCHAL

22. Pantnagar (June to November, 2014)

Maximum population of YSB (431 females+ 6 males) occurred during 33rd week. Peak population of BPH (142), WBPH (332) and GLH (544) were observed during 40th, 46th and 39th week, respectively.. However, BPH and WBPH s were considerably lower compared to that of previous year. Very low numbers of LF and GB were also recorded .

WEST BENGAL

23. Chinsurah (January - November 2014)

YSB populations were prevalent throughout the year with peak catches (125 females + 206 males) during 43rd week. BPH (198), WBPH (111) and GLH (*N. vi.* 204 + *N.ni* 119) registered peak populations during the 45th week. . In addition to this, low numbers of LF, WLH, ZLH and GB were also reported.

JAMMU AND KASHMIR

24. **Khudwani** (April to October 2014)

At this centre, very low numbers of LF, rice skipper, cut worm and white grubs were observed.

PUNJAB

25. Ludhiana (January to December, 2014)

The peak populations of YSB (14 females + 37 males), PSB (81), BPH (58) and WBPH (125) observed in light trap catches at this centre were very low compared to that of last year. PSB and LF activity was high between 39th and 43rd weeks. Peak population of LF (170) was recorded during 42nd week. .

HARYANA

26. Kaul (January – December, 2014)

Very low numbers of PSB were reported in light trap catches at this centre between 8th and 15th weeks and again between 38th and 44th weeks. LF was also recorded in low numbers 38th and 44th week. Planthoppers?

HIMACHAL PRADESH

27. Malan (January to December, 2014)

Low numbers of WSB, case worm, whorl maggot, LF, GLH, BPH and WBPH were observed at this centre. Peak population (51) of LF was recorded during 38th week. GLH (51) and BPH (213) and WBPH (116) populations were at peak during 31st, 35th and 40th weeks, respectively. Other insects observed at this centre include black beetle and flea beetle. Hispa?

ASSAM

28. Titabar (January-December, 2014)

Important pests observed in light trap catches at this centre are YSB, GM, LF, GLH and Black bug. Insect catches were more during kharif compared to the rabi season. Peak catches of YSB (371 females+357 males), GM (178) and

GLH (Nv.1923, Nn.1852) were recorded during 38th, 33rd and 35th weeks, respectively. Other insects recorded at this centre include mole cricket, gundhi bug, ground beetles, dragon flies and rice butterfly.

MANIPUR

29. Wangbal (August to November, 2014)

Very low numbers of YSB, GM, LF, GLH, BPH and WBPH were recorded at this centre.

CONCLUSIONS

Population dynamics of major insect pests of rice along with the corresponding meteorological factors were reported from 29 centres during the year 2014. Yellow stem borer was reported from 26 centres with the highest peak catch (3038 females + 76 males) occurring during 1st week at Aduthurai followed by Pattambi (2761 females during 50th week) and Maruteru (1166 females + 284 males during 17th week). This pest maintained its status as number one pest of rice in India. **(Fig. 2.7)**

Brown planthoppers were reported from 22 centres, with maximum peak population (50675 insects/week) occurring during 16th week at Maruteru followed by Gangavathi (25698 insects/week during 48th week) and Aduthurai (21160 insects/week during 50th week). WBPH was present at 18 centres with the highest population of 21638 insects per week occurring during 45th week at Gangavathi. Thus, planthoppers continue to be second major pests with WBPH becoming important along with BPH at many places. **(Fig.2.8)**. Green leafhoppers were reported from 25 centres with the highest peak catch of 9670 insects per week during 50th week at Aduthurai centre. This pest continues to maintain its abundance, both in area and magnitude.

Gall midge was reported from 12 centres with a highest peak population of 1822 insects/week during 12th week at Maruteru, thus gall midge continued to damage the crop at low levels in localized pockets. **(Fig.2.9)**. Although occurrence of Leaf folder was reported from 26 centres, populations were very low in many centres. The highest population of 890 insects per week recorded during 48th week at Gangavathi followed by Faizabad with 617 insects/week at 42nd week. Thus, leaf folder is maintaining its presence in most of the regions of the country. Among other insect pests, case worm, gundhi bug, white leafhopper, white stem borer, pink stem borer, zigzag leafhopper, blue beetle, grasshopper, and black bug were observed in lesser numbers. Among the natural enemies, mirid bugs were reported from centres with high populations of plant and leaf hopper.

Some of the salient observations made during this year are: (i) At Maruretu, the peak population of BPH recorded during this year is very high compared to that of previous year, (ii) At Aduthurai also, the peak catches of major insect pests like YSB, BPH, Black bug were considerably higher than that of last year, (iii) At Pattambi, the peak populations of YSB higher but BPH populations recorded were lower than that of the, (iv) At Moncompu, the peak catches of BPH and GLH observed during this year were considerably low, (v) At Gangavathi, the peak catches of BPH, WBPH and GLH recorded this year were relatively higher compared to that of last year, (vi) At Raipur, the peak population of BPH recorded was considerably lowerthis year , (vii) At Jagdalpur, the peak population of GLH recorded was almost ten times lower than that of the previous year, (viii) At Pantnagar, BPH and WBPH populations observed were considerably lower compared to that noted in previous year, (ix) At Ludhiana, BPH, WBPH and LF catches observed during this year were also low compared to that of last year, (x) Occurrence of high numbers of mirid bug coincided with the high populations of plant and leafhoppers at many centres, conforming to the density dependent relationship between the predator and prey.

Comparison of performance of fine trap model of light trap with conventional light trap models existing at different locations

Attempts were made to compare the performance of existing models of light traps with fine trap model of light trap (developed by NCIPM and marketed by M/S Fine traps (India) in insect trapping at 12 different locations over a period of 2-5 months **(Table 2.40)**. The performance of fine trap varied with location and insect species.

Observations on yellow stem borer catches in fine trap and conventional traps reported from 11 centres revealed that cumulative catch of yellow stem borer during the study period was considerably higher in fine trap compared to the conventional trap at five locations (Coimbatore, Moncompu, Raipur, Sakoli and Titabar). But, at Maruteru and Rajendranagar centres, catches were considerably higher in conventional trap **(Fig.2.10A)**. (The data on YSB, Leaffolder and Planthoppers from Titabar centre not shown in Fig.2.10 due to unusually high numbers recorded at this centre). Difference between conventional trap and fine trap catches were marginal at other locations.

Twelve centres reported observations on leaf folder catches in fine trap and conventional traps. Cumulative catch of leaf folder was considerably higher in fine trap at five locations (Coimbatore, Jagdalpur, Kaul, Sakoli and Titabar) while at four centres (Malan, Maruteru, Rajendranagar and Warangal), conventional trap showed higher catches. Marginal differences between conventional trap and fine trap catches were observed at other locations **(Fig.2.10B)**.

Ten centres reported observations on planthoppers catches And cumulative catches during the study period were considerably higher in fine trap compared to the conventional trap at seven locations (Coimbatore, Jagdalpur, Moncompu, Maruteru, Raipur, Sakoli and Titabar). At three centres (Malan, Rajendranagar and Warangal), planthopper catch was considerably higher in conventional trap. Differences among the two trap catches were marginal at other locations **(Fig.2.10C)**. Green leafhopper (*N. virescens*) catches in fine trap and conventional traps reported from eight centres revealed considerably higher catches in fine trap compared to the conventional trap at five locations (Jagdalpur, Moncompu, Maruteru, Sakoli and Titabar). Differences in trap catches were marginal at other locations (Fig.xx). Observations on gall midge catches from five centres revealed that cumulative catch of gall midge during the study period was considerably higher in fine trap compared to the conventional trap at two locations (Sakoli and Titabar). However, at Maruteru and Warangal centres, conventional trap trap catches were considerably higher than that of fine trap. Difference between traps were found to be marginal at Jagdalpur (Fig.xx).

Observations on trap catches of natural enemies revealed that cumulative catch of coccinellids during the study period was considerably higher in fine trap compared to the conventional trap at two locations (Jagdalpur and Sakoli). At Raipur, coccinellid catch was considerably higher in conventional trap. Marginal differences between conventional trap and fine trap catches were observed at other locations (Fig.xx). The mirid bug catches during the study period were considerably higher in conventional trap compared to the fine trap at two locations (Maruteru and Rajendranagar), while at Coimbatore differences between were found to be marginal (Fig.xx).

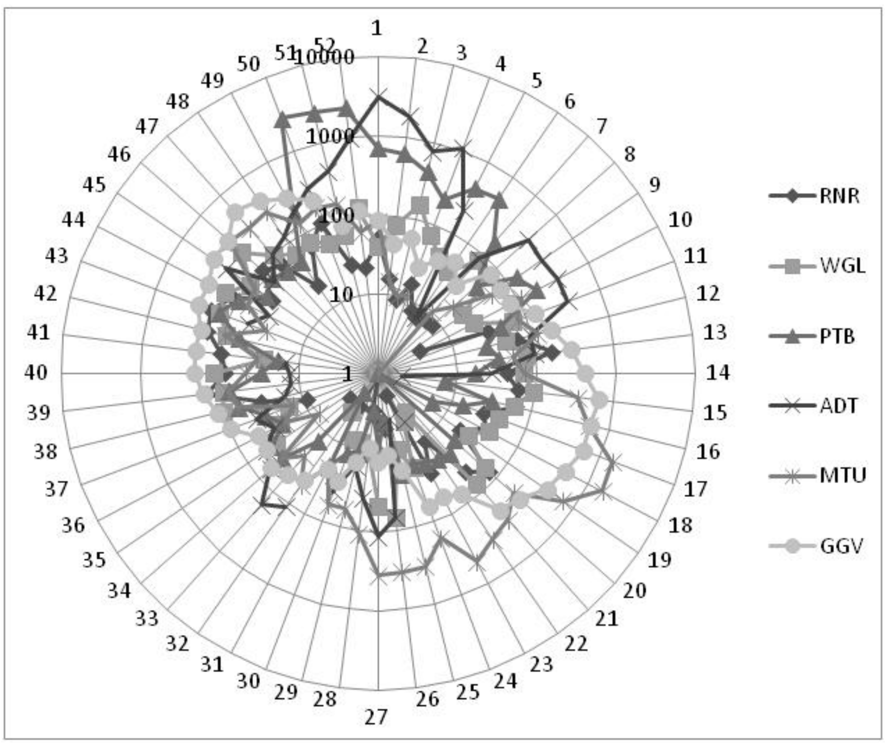


Fig.2.7 Weekly light trap catches of yellow stem borer (on log scale) reported from different locations (see Appendix I for location details)

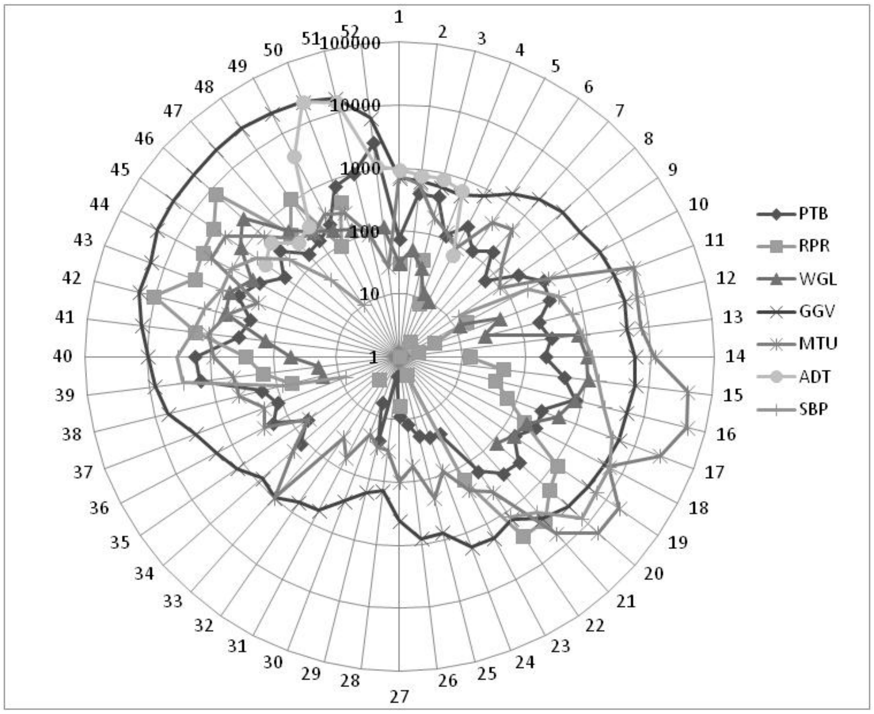


Fig. 2.8 Weekly light trap catches of BPH (on log scale) recorded at different locations (see Appendix I for location details)

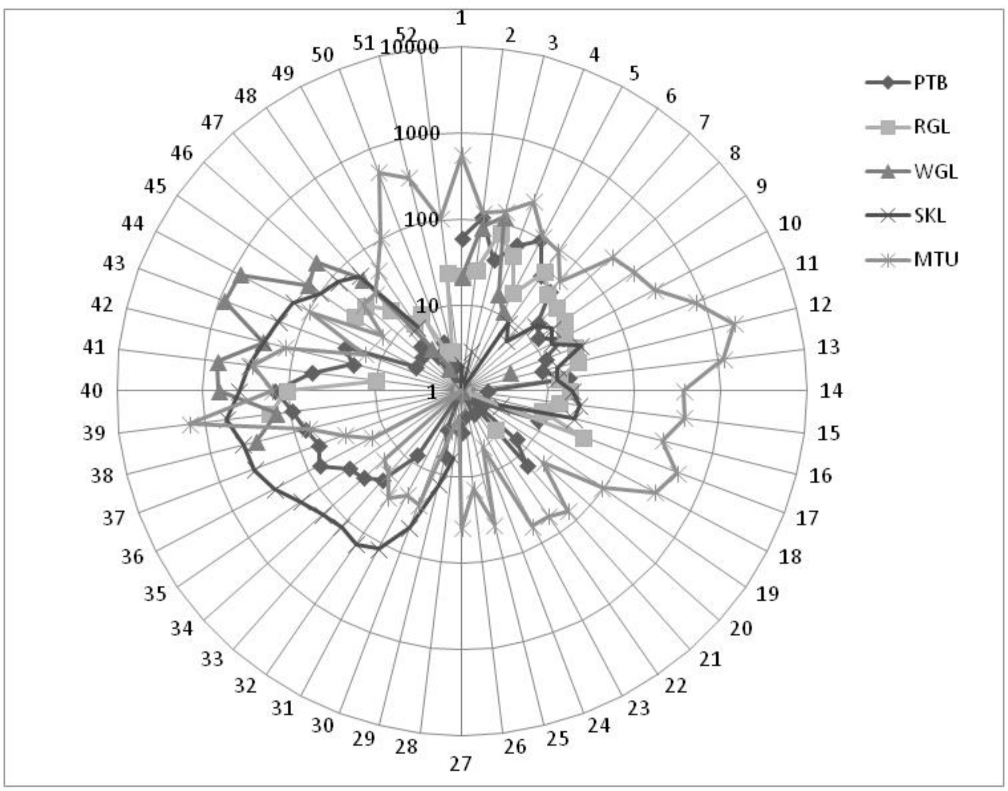


Fig. 2.9 Weekly light trap catches of gall midge reported from different locations (see Appendix I for location details)

Table 2.40 Details of fine trap and conventional light trap models, period and total duration of study at different locations

Centre	Existing Light Trap model	Period of study (in Std. weeks)	Total no. of weeks
Coimbatore	Robinson	(33^{th} - 52^{nd})	20
Jagdalpur	-	(35^{th} - 52^{nd})	18
Karjat	-	(33^{th} - 48^{th})	15
Kaul	Chinsurah	(35^{th} - 52^{nd})	18
Malan	Ryrholm	(35^{th} - 44^{th})	10
Moncompu	-	(42^{nd} - 52^{nd})	11
Maruteru	-	(37^{th} - 52^{nd})	16
Rajendranagar	Chinsurah	(41^{st} - 47^{th})	07
Raipur	SM-84	(35^{th} - 50^{th})	16
Sakoli	-	(34^{th} - 2^{nd})	19
Titabar	Chinsurah	(31^{st} - 52^{nd})	22
Warangal	Chinsurah	(44^{th} - 52^{nd})	09

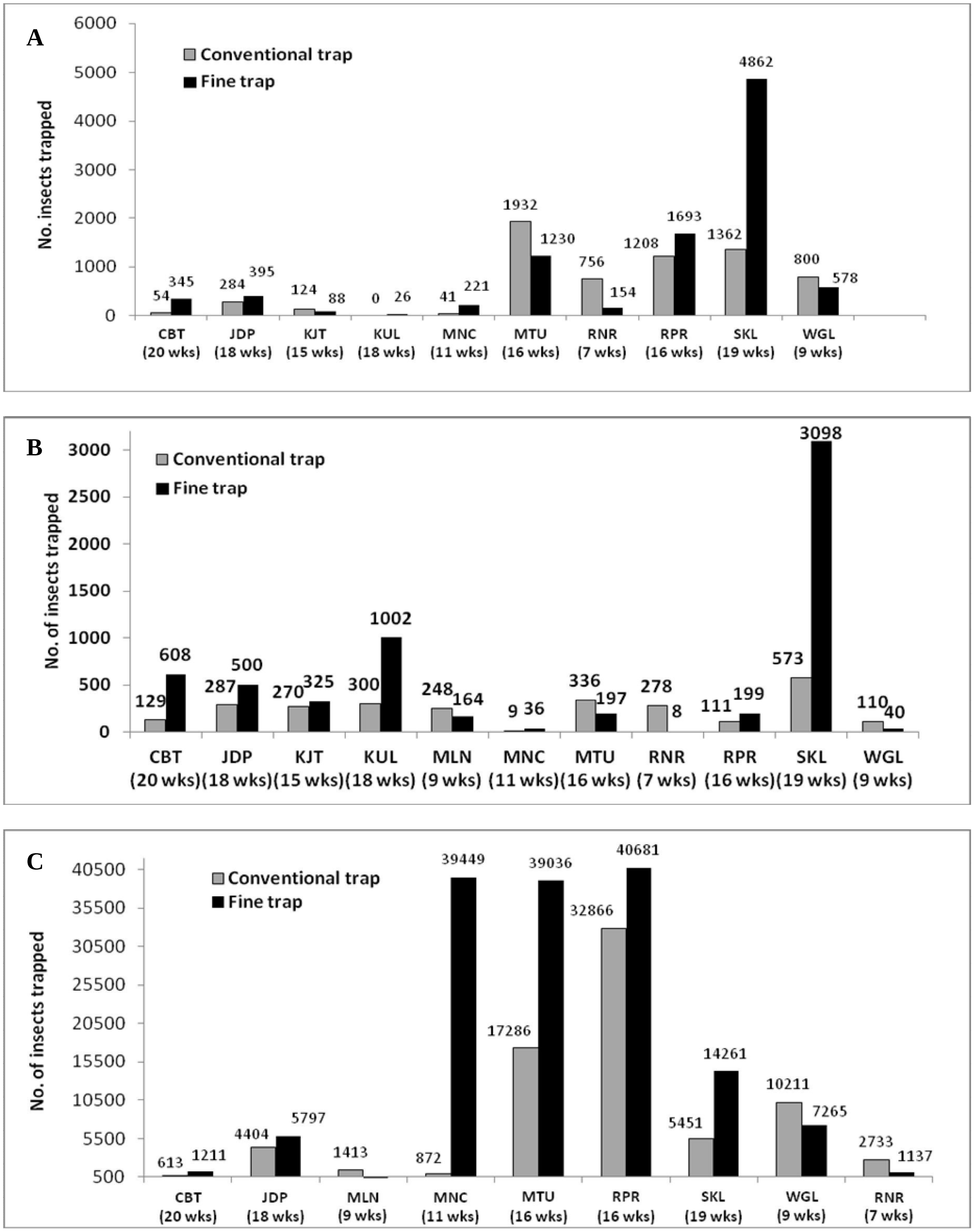


Fig 2.10. Cumulative catches of (A) Yellow stem borer, (B) Leaf folder and (C) Plant hoppers in conventional model and fine trap model of light traps at different locations.

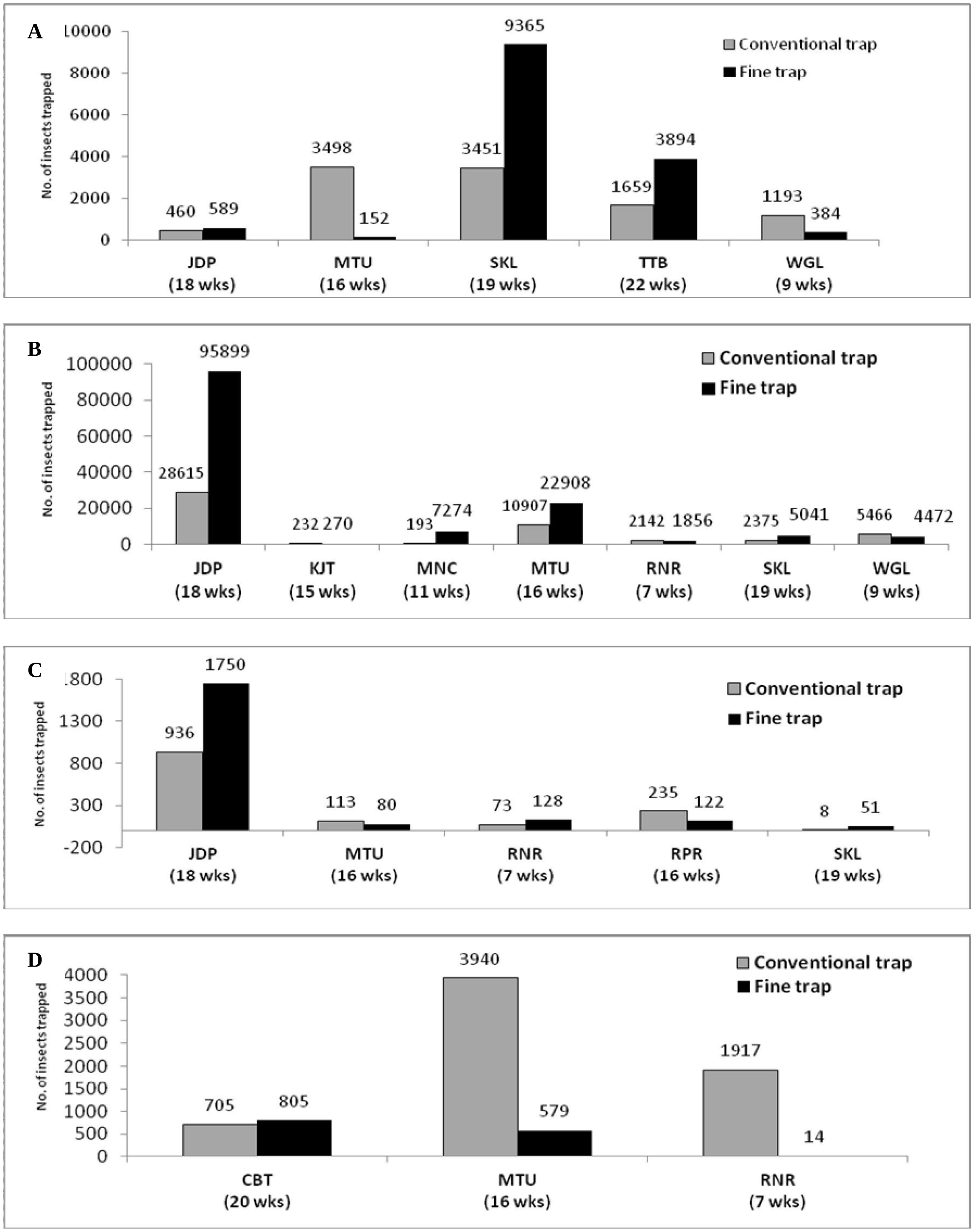


Fig 2.11 Cumulative catches of (A) Gall midge, (B) GLH (C) Coccinellids and (D) Mirid bugs in conventional model and fine trap model of light traps at different locations.

Entomology Rabi 2014

SUMMARY

Insecticide Evaluation Trial (IET) was carried out at 11 locations to evaluate the impact of a non ionic wetting agent, Ek boond on the efficacy of three newer and recommended insecticides *viz.,* rynaxypyr, acephate and dinotefuran against major insect pests of rice and consequent impact on grain yield. Based on the performance of the insecticide treatments for their efficacy in reducing pest infestation and their impact on grain yield across locations, it was evident that rynaxypyr treatment performed well against stem borer and leaf folder, while against gall midge all the treatments were at par. Dinotefuran was effective against planthoppers and leafhoppers. The impact of Ekboond was evident only in case of acephate treatment against brown planthopper. Rybnaxypyr with Ek boond yielded the highest and was on par with the same treatment without Ek boond.

Pesticide Compatibility Trial (PCT) was carried out at 6 centres 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. Based on the performance of the treatments when applied alone vis a vis their respective combinations in reducing pest infestation, it was evident that there were no significant differences in the performance of the two newer insecticide formulations in their efficacy when applied alone or in combination with fungicides were at par. Yield point of view also the insecticide fungicide combination treatments yielded better than insecticides applied alone. Though the combination product of flubendiamide plus buprofezin was superior to triazophos, there was no adverse impact on the efficacy of either of the insecticides when applied with either hexaconazole or tricyclazole or vice versa confirming the compatibility of the chemicals when used as tank mix in the field.

Influence of rice cultivation methods on insect pest incidence (IRCP) trial was conducted at Coimbatore and Ragolu during Rabi 2013-14. In general dead heart damage was significantly low in direct seeded rice while white ear damage was low in direct seeded rice at Coimbatore (7.71%) but was low in normal transplanted method (10.00%) at Ragolu indicating inconsistency. Leaf folder damage was observed only at Coimbatore and was found significantly low in normal transplanted method as compared to direct seeded rice. Among the cultivars, KRH2 & CORH3 hybrids recorded significantly high pest incidence compared to MTU 1010 & CO 51 varieties grown in this trial.

Effect of planting dates on insect pest incidence (EPDP) trial was conducted only at one location i.e., Chinsurah during Rabi 2013-14. Dead heart damage by stem borer was high in normal and late plantings while the incidence of defoliators like leaf folder and whorl maggot was very low (< 5% DL). Very low

white leafhopper incidence was observed only in early and normal plantings (0.5 – 0.7/ hill).

Monitoring of pest species and natural enemies (MPNE) trial was carried out at 4 locations. The stem borer species observed were YSB and DHB. Three egg parasitoids of stem borer were observed with Trichogramma japonicum being dominant at Warangal and Rajendranagar and Tetrastichus at Aduthurai. Only BPH was observed in three locations Aduthurai, Maruteru and Warangal.

Ecological Engineering for Planthopper Management (EEPM) was taken up in Maruteru with a combination of interventions such as organic manuring, and growing of flowering plants on bunds. Such interventions increased the natural enemy populations like mirids, spiders. The yield was higher in ecologically engineered plots.

Yield loss estimation trial (YLET) was conducted at three locations during Rabi 2013-14. A significant negative relationship was observed between white ears and grain yield at Chinsurah ($Y = -0.241x + 24.20$; $R^2 = 0.590$), Pattambi ($Y = -0.113x + 19.42$; $R^2 = 0.201$) and Aduthurai ($Y = -0.188x + 18.67$; $R^2 = 0.6142$). Pooled analysis revealed that for every 10% increase in white ear, there will be 1.01 g reduction in grain yield.

Integrated Pest Management special (IPMs) trial was conducted at 3 locations viz., Maruteru, Sakoli and Chinsurah, during rabi 2013-14. Stem borer damage was high in farmer practices at Sakoli (20.35% DH) while whorl maggot damage was high in farmer practices at Chinsurah (22.85% DL). Disease incidence was high at Sakoli and Chinsurah wherein adoption of IPM practices resulted in reduced disease severity. IPM implemented plots showed significantly lower weed population and weed biomass than farmers practice resulting in higher grain yield and high BC ratio.

2.1 CHEMICAL CIONTROL STUDIES

i) Insecticide Evaluation Trial (IET)

During rabi 2014, the trial on evaluation of a newer non ionic organo silicone wetting agent, Ek boond was continued to confirm its efficacy in improving wetting and penetration of three newer and recommended insecticides viz., rynaxypyr (Coragen 20 EC), acephate (Acephate 95 SG) and dinotefuran (Token 20 SC) at specified dosages for their effectiveness against insect pests at different locations. The trial was carried out at 11 locations.

Treatments:

The three newer insecticide formulations *viz*., Coragen 20% SC (Rynaxypyr) supplied by Dupont India Ltd. at 30 g a.i./ha, acephate 95% SG (Acephate) supplied by Rallis India Ltd., and Token 20 SC (Dinotefuran) supplied by Indofil Chemicals @ 40 g a.i./ha each, were mixed with Ek boond supplied by Sequia Biosolutions Pvt. Ltd. @ 200 ml/ha and evaluated. These treatments were compared with the three insecticides applied alone, Ek boond applied alone and untreated control treatment without any insecticide application. There were eight treatments with three replications laid out in Randomized Complete Block Design (RCBD). 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 ranged from one to three across locations. The insecticides were applied as high volume sprays @ 500 litres of spray fluid/ha.

Location	Date of sowing	Date of planting	Date of harvesting	No of applications	Times of application (DAT)
Coimbatore	22/01/14	12/02/14	21/05/14	2	35 & 45 DAT
Cuttack	16/12/13	17/01/14	-	3	44,60 & 78 DAT
Gangavathi	15/12/13	13/01/14	03/05/14	3	35,70 & 98 DAT
Karjat	31/12/13	10/02/14	13/05/14	1	51 DAT
Maruteru	17/12/13	21/01/14	25/04/14	3	15,35 & 55 DAT
Pattambi	24/11/13	16/12/13	25/03/14	3	10,30 & 50 DAT
Puducherry	21/01/14	04/02/14	09/06/14	-	-
Ragolu	20/12/13	25/01/14	09/05/14	2	10 & 55 DAT
Rajendranagar	11/12/13	21/01/14	22/05/14	3	15,51 & 99 DAT
Sambalpur	02/01/14	29/01/14	22/05/14	3	15,45 & 65 DAT
Warangal	26/11/14	24/12/14	25/04/14	2	13 & 85 DAT

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

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

Results

Pest Infestation (Table 2.41):

Stem borer infestation during vegetative stage ranged from 0.6 to 28.7% DH in the insecticide treatments across 8 locations with minimum damage exceeding 5% DH in untreated control, during 30 to 86 DAT. At 7 locations, there were significant differences among the treatments. The mean infestation across these locations varied between 5.1 and 9.4% DH in insecticide treatments compared to 10.9% DH in Ek boond and 13.3% DH in untreated control. All the insecticide treatments were significantly superior to Ek boond and control. Among the insecticides, rynaxypyr and acephate treatments performed better in combination with Ek boond than when applied alone. At heading stage, more than 5% white ears (WE) were recorded at 9 centres and differences were significant at 8 locations. At Gangavathi relatively higher incidence was recorded upto 24.0%, compared to other locations. The mean infestation ranged from 3.1 to 9.3% WE in insecticide treatments compared to 12.0% in Ek boond and 12.6% in untreated control. However, there were no significant differences between insecticide treatments with and without Ek boond.

Overall, the effect of Ek boond on the performance of insecticides was significant in case of rynaxypyr and acephate at vegetative stage, while differences were not significant at reproductive stage. Among the three insecticides, rynaxypyr was superior to acephate and dinotefuran in reducing stem borer incidence.

Brown planthopper incidence was severe at Maruteru (maximum up to 564.8 hoppers/ 10 hills) and Rajendranagar (upto 429 hoppers/10 hills) and moderate at Gangavathi (up to 148.3 hoppers/10 hills) and low at Sambalpur and Warangal (up to 68.3 hoppers/10 hills). Across the locations, dinotefuran treatment was the best showing 55.3 and 60.4 hoppers/10 hills, respectively in treatments with and without Ek boond followed by acephate with respective populations of 79.1 and 104.2 hoppers/10 hills while rynaxypyr treatment was on par with Ek boond and control (126.2 and 123.9 hoppers/10 hills). The impact of Ek boond was more evident in case of acephate compared to that of dinotefuran as, there were significant differences in performance of acephate treatments with and without Ek boond.

Whitebacked planthopper infestation was observed only at Gangavathi ranging from 8.0 to 121.3 hoppers/10 hills during 40 to 100 DAT. The mean infestation varied between 27.1 and 94.3 hoppers/10 hills. Dinotefuran with and without Ek boond (27.1 and 29.4 hoppers/10 hills, respectively) was the best treatment followed by acephate (37.8 and 40.6 hoppers/10 hills, respectively). There were no significant differences between the treatments with and without Ek boond.

Green leafhopper populations were also recorded only at Gangavathi. The incidence ranged from 6.2 to 42.0 hoppers/10 hills at 54 DAT. Dinotefuran was the best treatment showing the least population of 6.2 and 7.0 hoppers/10 hills with and without Ek boond, respectively. It was significantly superior to acephate treatment showing 14.7 and 15.8 hoppers/10 hills, respectively. All the insecticide treatments were significantly superior to Ek boond and control (39.8 and 42.0 hoppers/10 hills, respectively). The impact of Ek boond was not significant.

Gall midge damage was observed at Maruteru at 50 DAT ranging between 20.9 and 24.5% SS. There were no significant differences among treatments including control.

Leaf folder damage was recorded ranging from 0.1 to 8.5% during 45 to 60 DAT at two locations viz., Gangavathi and Pattambi. The mean infestation did not exceed 7.2% and no valid conclusions could be drawn on the impact of Ek boond at both locations.

Data on **natural enemies** were recorded at three locations *viz.,* Gangavathi, Maruteru and Warangal. Mirid bug populations were high in rynaxypyr treatment (70.3 and 69.8 bugs/10 hills) on par with that of control (76.8 bugs/10 hills) and Ek boond(67.9 bugs/10 hills). The other two insecticide treatments showed significantly lower populations of mirid bugs(37.8 to 52.6 bugs/10 hills). There was no impact of Ek boond on the effect of insecticides. The spider populations ranged from 4.7 to 52.7 per 10 hills and there were no significant differences in mean infestation(16.2 to 26.9 per 10 hills) among the treatments including control across locations. Coccinellids were observed at Warangal and the trends were similar to that of spiders as the treatments including control were at par showing no significant differences in their populations(8.3 to 10.3 per 10 hills).

Grain Yield (Table 2.42)

There were significant differences in grain yield among the treatments at 10 locations. Based on mean yield of these locations, rynaxypyr with Ek boond treatment yielded the highest of 4685 kg/ha with an increase of 25.4% over control (3497 kg/ha) at par with rynaxypyr without Ek boond (4653 kg/ha and 24.9% IOC) followed by acephate and dinotefuran treatments with Ek boond (4171 and 4172 kg/ha, respectively and 21.8 % IOC). Dinotefuran without Ek boond (4167 kg/ha and 16.1% IOC) and acephate without Ek boond

(4110kg/ha with 14.9% IOC) were the next best treatments at par. The Ek boond alone treatment yielded 3618 kg/ha.

Insecticide evaluation trial was carried out at 11 locations to evaluate the impact of a non ionic wetting agent, Ek boond on the efficacy of three newer and recommended insecticides viz., rynaxypyr, acephate and dinotefuran against major insect pests of rice and consequent impact on grain yield. Based on the performance of the insecticide treatments for their efficacy in reducing pest infestation and their impact on grain yield across locations, it was evident that rynaxypyr treatment performed well against stem borer and leaf folder, while against gall midge all the treatments were at par. Dinotefuran was effective against planthoppers and leafhoppers. The impact of Ekboond was evident only in case of acephate treatment against brown planthopper. Rynaxypyr with Ek boond yielded the highest and was on par with the same treatment without Ek boond.

Table 2.41 Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formula-tion	g a.i./ha	g or ml formula-tion/ha	Stem Borer Damage (%Dead hearts)						
					CBT	CBT	CBT	CTC	CTC	KJT	MTU
					30DAT	40DAT	55DAT	30DAT	50DAT	50DAT	30DAT
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	15.8a	6.0a	3.6a	18.3b	18.0b	5.7a	0.9a
Acephate+Ek boond	Acephate+Ek boond	95	500	526	12.7a	7.4a	4.3a	4.4a	5.7a	5.9a	2.8a
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	12.1a	5.8a	4.0a	6.6a	6.1a	5.7a	1.4a
Rynaxypyr	Coragen+Ek boond	20	30	150	12.0a	6.1a	5.5a	6.8a	11.5ab	5.8a	0.7a
Acephate+Ek boond	Acephate+Ek boond	75	600	750	13.2a	10.0a	8.3ab	12.1ab	23.9b	5.8a	3.3a
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	15.1a	8.1a	7.0a	15.1b	25.3b	5.9a	3.9a
Ekboond	Ek boond			200	11.9a	14.0b	8.7ab	13.5b	28.7b	6.1a	2.4a
Untreated control	Untreated Control				14.1a	16.0b	14.3b	12.4ab	28.4b	6.2a	5.3a

Table 2.41 Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formula-tion	g a.i./ha	g or ml formula-tion/ha	Stem Borer damage (%Deadhearts)							Mean
					PTB		RNR	SBP		WGL		
					30DAT	50DAT	49DAT	56DAT	76DAT	35DAT	86DAT	
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	5.7a	2.8a	0.5a	1.8b	1.1ab	2.3a	6.3a	**6.3a**
Acephate+Ek boond	Acephate+Ek boond	95	500	526	15.5a	2.9a	3.4a	2.8b	2.0b	3.4a	7.2a	**5.7a**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	12.7a	5.6a	5.3b	5.5c	4.0c	4.5b	9.3a	**6.3a**
Rynaxypyr	Coragen+Ek boond	20	30	150	8.6a	2.5a	1.4a	0.6a	0.8a	4.5b	5.1a	**5.1a**
Acephate+Ek boond	Acephate+Ek boond	75	600	750	11.1a	3.4a	2.3a	4.4c	2.5b	4.2b	7.8a	**8.0b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	15.8a	6.1a	4.5b	5.2c	4.4c	6.0b	9.1a	**9.4b**
Ekboond	Ek boond			200	20.7a	10.3b	10.8b	7.0cd	5.7c	7.0b	6.2a	**10.9b**
Untreated control	Untreated Control				19.8a	24.4b	11.0b	8.7d	10.4d	7.7b	8.1a	**13.3b**

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

Table 2.41 (Contd…) Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formula-tion	g a.i./ha	g or ml formula-tion/ha	Stem Borer Damage (%White ears)									
					CBT	CTC	GGV	KJT	MTU	PTB	RGL	RNR	SBP	Mean
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	1.4a	7.3a	1.2a	2.9a	3.3a	1.3a	3.2a	3.7a	3.5b	**3.1a**
Acephate+Ek boond	Acephate+Ek boond	95	500	526	4.9ab	7.3a	4.1b	3.4b	14.2b	9.6b	4.9ab	7.3a	2.2b	**6.4b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	4.7ab	5.1a	16.8c	2.1a	17.6b	6.7b	4.0a	7.9a	6.9c	**8.0b**
Rynaxypyr	Coragen+Ek boond	20	30	150	4.7ab	6.2a	1.7a	4.5b	3.6a	1.4a	2.9a	4.4a	1.1a	**3.4a**
Acephate+Ek boond	Acephate+Ek boond	75	600	750	8.5b	6.7a	6.0b	4.1b	15.0b	6.1b	6.3ab	8.4a	5.9c	**7.4b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	7.8b	6.2a	18.6c	3.8b	16.3bc	9.5b	4.9ab	9.2a	7.0c	**9.3b**
Ekboond	Ek boond			200	13.6c	5.6a	23.0c	7.2c	18.2bc	5.4b	9.3b	12.0b	13.9d	**12.0c**
Untreated control	Untreated control				15.1c	5.4a	24.0c	8.3c	23.1c	10.6b	10.2b	7.0a	9.6c	**12.6c**

Table 2.41 (Contd…) Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formula-tion	g a.i./ha	g or ml formula-tion/ha	Brown Planthopper (No./10hills)							
					GGV				MTU		RNR	
					40DAT	60DAT	80DAT	100DAT	55DAT		86DAT	96DAT
									BT	AT		
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	59.0b	91.3a	84.3c	71.3c	564.8b	34.0a	383.7a	343.7c
Acephate+Ek boond	Acephate+Ek boond	95	500	526	33.3a	79.3a	46.7a	36.7b	164.7a	30.3a	351.3a	215.7b
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	19.3a	67.7a	26.3a	15.7a	33.7a	31.2a	392.3a	79.0a
Rynaxypyr	Coragen+Ek boond	20	30	150	61.7c	92.3a	88.0c	75.0c	466.0b	49.3a	412.3a	380.7c
Acephate+Ek boond	Acephate+Ek boond	75	600	750	41.0b	87.7a	53.0b	44.7b	312.7b	29.8a	429.7aa	293.3b
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	25.0a	75.0a	32.0a	19.7a	54.7a	24.7a	408.7a	107.3a
Ekboond	Ek boond			200	72.7c	94.7a	140.3d	134.3d	278.7b	24.5a	382.3a	359.0c
Untreated control	Untreated control				82.3c	102.3a	148.3d	144.0d	283.7b	23.3a	362.7a	345.0c

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

Table 2.41 Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formula-tion	g a.i./ha	g or ml formula-tion/ha	Brown Planthopper (No. /10hills)						Mean
					SBP				WGL		
					45DAT		65DAT		86DAT	107DAT	
					BT	AT	BT	AT			
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	16.3b	11.7b	14.0a	10.3b	32.0a	49.7a	**126.2b**
Acephate+Ek boond	Acephate+Ek boond	95	500	526	20.3b	16.0c	25.0c	20.3c	27.0a	42.7a	**79.2a**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	12.0a	7.3a	11.3a	6.7a	27.0a	44.3a	**55.3a**
Rynaxypyr	Coragen+Ek boond	20	30	150	12.0a	9.0ab	11.7a	9.0a	23.3a	43.7a	**123.9b**
Acephate+Ek boond	Acephate+Ek boond	75	600	750	19.3b	16.0c	22.0b	17.7c	23.7a	68.3a	**104.2b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	9.7a	6.7a	12.0a	7.3a	20.7a	42.7a	**60.4a**
Ekboond	Ek boond			200	28.7c	31.3d	33.3d	47.3d	21.0a	46.0a	**121.0b**
Untreated control	Untreated control				38.0d	45.7e	51.3e	60.0e	23.7a	61.0a	**126.5b**

Table 2.41 Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formu-lation	g a.i./ha	g or ml formula-tion/ha	Whitebacked Planthopper (No./10hills)				Mean	Green Leafhopper (No./10hills)		Mean
					GGV					GGV		
					40 DAT	60 DAT	80 DAT	100 DAT		40 DAT	60 DAT	
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	58.7c	48.3b	80.3a	68.3c	63.9b	29.7c	22.0c	**25.8c**
Acephate+Ek boond	Acephate+Ek boond	95	500	526	19.3a	26.7a	68.3a	37.0b	37.8a	17.3b	12.0b	**14.7b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	8.0a	14.7a	65.7a	20.0a	27.1a	7.7a	4.7a	**6.2a**
Rynaxypyr	Coragen+Ek boond	20	30	150	63.0c	51.0b	84.3a	70.7c	67.3b	31.3c	24.0c	**27.7c**
Acephate+Ek boond	Acephate+Ek boond	75	600	750	21.0b	32.7b	70.0a	38.7b	40.6a	18.3b	13.3b	**15.8b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	10.7ab	17.0a	67.7a	22.3ab	29.4a	8.7a	5.3a	**7.0a**
Ekboond	Ek boond			200	78.7c	73.3c	85.0a	113.0d	87.5c	43.0c	36.7d	**39.8d**
Untreated control	Untreated control				87.3c	76.3c	92.0a	121.3d	94.3c	44.7c	39.3d	**42.0d**

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

Table 2.41 Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formula-tion	g a.i./ha	g or ml formula-tion/ha	Gall Midge Damage (% SS)	Leaf Folder Damage (%LFDL)			Mean	Blue Beetle Damage (%BBDL)	Whorl Maggot Damage (%WMDL)
					MTU	GGV	PTB			PTB	PTB
					50 DAT	60 DAT	45 DAT	60 DAT		25 DAT	25 DAT
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	20.9a	1.0a	0.5a	0.1a	0.6a	0.6a	8.7a
Acephate+Ek boond	Acephate+Ek boond	95	500	526	23.3a	2.7b	2.2ab	0.5a	1.8a	5.2b	10.8a
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	24.5a	6.9c	7.0b	4.6c	6.1c	8.1b	8.0a
Rynaxypyr	Coragen+Ek boond	20	30	150	24.3a	1.2a	0.3a	0.5a	0.7a	0.0a	10.5a
Acephate+Ek boond	Acephate+Ek boond	75	600	750	24.0a	3.4b	2.5ab	2.2b	2.7b	4.8b	16.3b
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	22.1a	7.5c	4.9b	5.6d	6.0c	6.6b	10.3a
Ekboond	Ek boond			200	22.3a	8.5c	7.4b	3.4c	6.4c	10.1b	12.4ab
Untreated control	Untreated control	-	-	-	21.2a	9.3c	6.3b	6.0d	7.2c	11.5b	12.9ab

Table 2.41 Insect pest incidence in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formu-lation	g a.i./ha	g or ml formula-tion/ha	Spiders							Mean
					GGV		MTU		WGL			
					60	80	10h_BT	10h_AT	107DAT	73DAT	86DAT	
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	42.7a	34.0b	5.8a	15.2a	21.7a	9.7a	14.3a	**20.5a**
Acephate+Ek boond	Acephate+Ek boond	95	500	526	34.0a	25.0b	5.3a	9.2a	19.7a	10.3a	10.0a	**16.2a**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	36.7a	31.3b	3.5a	7.5a	21.7a	6.0a	11.7a	**16.9a**
Rynaxypyr	Coragen+Ek boond	20	30	150	45.3a	35.3b	7.3a	12.2a	18.0a	9.7a	13.0a	**20.1a**
Acephate+Ek boond	Acephate+Ek boond	75	600	750	35.0a	27.0b	5.7a	12.0a	22.3a	11.0a	16.0a	**18.4a**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	39.7a	33.0b	4.7a	8.7a	18.7a	12.0a	14.0a	**18.7a**
Ekboond	Ek boond			200	46.7a	59.0a	5.0a	12.8a	19.0a	8.3a	15.7a	**23.8a**
Untreated control	Untreated control				52.7a	71.0a	5.3a	11.3a	21.7a	10.3a	15.7a	**26.9a**

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

Table 2.41 Incidence of Natural Enemies in different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formu-lation	g a.i./ha	g or ml formula-tion/ha	Coccinellids WGL 73DAT	Coccinellids WGL 86DAT	Mean	Mirid bugs GGV 100DAT	Mirid bugs GGV 60DAT	Mirid bugs MTU 10h_AT	Mean
Rynaxypyr+Ek boond	Coragen+Ek boond	20	30	150	7.3a	13.0a	10.2a	58.0ab	61.3a	91.5a	**70.3a**
Acephate+Ek boond	Acephate+Ek boond	95	500	526	8.7a	10.7a	9.7a	39.0b	50.0a	42.8b	**43.9b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	10.0a	10.7a	10.3a	47.0b	53.7a	12.7c	**37.8b**
Rynaxypyr	Coragen+Ek boond	20	30	150	7.7a	14.3a	11.0a	62.7ab	64.0a	82.7a	**69.8a**
Acephate+Ek boond	Acephate+Ek boond	75	600	750	6.0a	10.7a	8.3a	44.3b	54.0a	59.3a	**52.6b**
Dinotefuran+Ek boond	Token+Ek boond	20	40	200	8.0a	10.0a	9.0a	53.0ab	58.0a	19.3b	**43.4b**
Ekboond	Ek boond			200	8.7a	10.3a	9.5a	73.0a	68.3a	62.3a	**67.9a**
Untreated control	Untreated control				9.0a	10.3a	9.7a	101.3a	71.0a	58.2a	**76.8a**

Table 2.42 Grain yield under different treatments, IET, *Rabi* 2014

Treatment	Trade Name	% a.i. formu-lation	g a.i./ha	g or ml formula-tion/ha	Yield(Kg/ha) CBT	CTC	GGV	KJT	MTU	PDC	PTB	RGL	RNR	SBP	WGL	Mean	% IOC
Rynaxypyr+ Ek boond	Coragen+ Ek boond	20	30	150	4921a	3705b	6053a	4946a	5461a	5517ab	4475a	4688ab	3192a	4152b	4428a	**4685a**	**25.4**
Acephate+ Ek boond	Acephate+ Ek boond	95	500	526	4386b	5617a	5693a	4685a	4528b	5150b	3738b	4738ab	2229b	3976b	4443a	**4471a**	**21.8**
Dinotefuran+ Ek boond	Token+ Ek boond	20	40	200	4183bc	5053a	5920a	5167a	5121a	6317a	3789b	4546ab	1862bc	3702cd	3529a	**4472a**	**21.8**
Rynaxypyr	Coragen+ Ek boond	20	30	150	4437b	3977b	5973a	3923b	5656a	5883ab	4835a	5658a	1925bc	4524a	4392a	**4653a**	**24.9**
Acephate+ Ek boond	Acephate+ Ek boond	75	600	750	3932c	3141c	5453a	4226b	4855b	5908ab	3412b	3975b	1956bc	3799c	4555a	**4110b**	**14.9**
Dinotefuran+ Ek boond	Token+ Ek boond	20	40	200	3737c	2785c	5920a	4530a	4843b	5683ab	3532b	4421b	2090bc	3584d	4714a	**4167a**	**16.1**
Ekboond	Ek boond			200	3679c	2616c	3387b	3702b	4736b	5550ab	3378b	4267b	1791bc	3329e	3358a	**3618bc**	**3.3**
Untreated control	Untreated control				3348d	3183c	3360b	3399c	4351b	5183b	3721b	3902b	1584c	2487f	3943a	**3497c**	

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

ii) Pesticide Compatibility Trial (PCT)

The compatibility of two new and different groups of insecticides *viz*., combination product formulation of flubendiamide 4% + buprofezin 20% SC (RIL-IS-109), a broad spectrum compound supplied by Rallis India Limited and Sutathion 40% EC 24% SC from Sudarshan Chemicals Pvt. Ltd.and fungicides, was evaluated based on their efficacy when applied as tank-mix in the field. The fungicides consisted of hexaconazole (Contaf plus 5 SC) supplied by Rallis India Ltd., effective against sheath blight and tricyclazole (Baan 75 SP), a product of Indofil chemicals Ltd. recommended for blast. During rabi 2014, the trial was carried out at 6 locations *viz.*, Coimbatore, Chinsurah, Gangavathi, Puducherry, Pattambi and Sambalpur.

Treatments

The trial consisted of nine treatments including the combination product @ 1.75 ml/litre, sutathion @ 1.5 g/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 nine treatments with three replications were 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, percentage leaf folder damage was assessed based on counts of damaged leaves taken on 10 randomly selected hills per plot. Planthopper populations were recorded on ten randomly selected hills per plot before and after application of treatments. The severity of blast and sheath blight disease was assessed based on 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.

Results

Insect pest infestation (Table 2.43)

The **stem borer** infestation at vegetative stage across 5 locations was recorded up to a maximum of 24.1% DH, while mean infestation ranged from 6.0 to 13.9% DH across treatments including control. There were significant differences among the pesticide treatments at all the locations. The infestation in insecticides alone and combination treatments (6.0 to 7.9% DH) was significantly lower than that in fungicide alone treatments (11.5 and 11.9% DH %) and control (13.9% DH). The differences in efficacy between the two insecticides and their combinations with fungicides were at par.

At heading stage, there were significant differences among the treatments at 5 locations. The white ear incidence was significantly lower in insecticide treatments and their combinations (3.7 to 7.8% WE), compared to fungicide treatments and control (12.1 and 13.0% WE). Overall, against stem borer, the combination product performed better than triazophos, however there were no significant differences in insecticide treatments when applied alone or in combination with fungicides.

Brown planthopper populations were recorded upto 129.0 hoppers/hill at Gangavathi. The mean hopper population in individual insecticide and their fungicide combination treatments ranged narrowly between 56.3 and 59.3 hoppers/10 hills in combination product treatment significantly lower than that of triazophos (70.4 to 73.7 hoppers/10 hills). Both insecticides were superior to fungicide treatments (107.0 and 108.9 hoppers/10 hills) and untreated control (119.6 hoppers/10 hills). Both insecticides were at par in their efficacy individually as well as in combination with fungicides. **The white backed planthopper** population was recorded upto 88.3 hoppers/10 hills at Gangavathi. As observed in the case of BPH, the combination product was superior in performance showing significantly less WBPH population range after first (12.3 to 16.0 hoppers/10 hills) and second applications (8.7 to 9.3 hoppers/10 hills) than that of triazpohos treatment (33.7 to 36.3 hoppers per 10 hills after first application and 25.0 to 32.7 hoppers/10 hills after second application). The mean population was also less in combination product treatment (35.8 to 37.9 hoppers/10 hills) compared to trazophos(48.5 to 52.9 hoppers/10 hills). However, both insecticides individually as well as in combination with fungicides were superior to fungicides applied alone (67.6 and 69.6 hoppers/10 hills) and untreated control (80.5 hoppers/10 hills). Also there was no adverse effect on their performance due to combination with fungicides. At Sambalpur, **mixed planthopper** population was recorded upto 62.0 hoppers at 72 DAT. The trend in performance was similar to that of other location and combination product efficacy was better than that of triazophos. Both insecticides performed at par when applied alone and in combination with fungicides.

Disease incidence

Blast disease was recorded at Gangavathi and Sambalpur. The blast severity was reorded upto 45.9% at Gangavathi while it was very low at Sambalpur (up to 4.3%). There were no significant differences among the treatments including control at both locations.

Sheath blight incidence was observed at 3 locations viz., Chinsurah, Gangavathi and Pattambi. The disease severity varied from 2.7 to 89.0% across locations. At both locations, there was significant reduction in disease incidence in fungicide treatments and their combinations compared to insecticide treatments and control.

Grain yield (Table 2.44)

There were significant differences in grain yield among different treatments at all the 6 locations. The mean grain yield data across the locations revealed that the combined product of flubendiamide plus buprofezin in combination with hexaconazole was the best treatment showing the highest yield of 5211 kg/ha with an increase of 32.2% over control (IOC) followed by triazophos plus hexaconazole yielding 4859 kg/ha with 27.3% IOC on par with combined product plus tricyclazole showing next highest yield of 4791 kg/ha and 26.3% IOC. The combination product applied alone yielded 4764 kg/ha with 25.9% IOC, while sutathion applied alone showed an yield of 4687 kg/ha and 24.7 % IOC. The hexaconazole alone treatment yielded 4569 kg/ha with IOC of 22.7 % followed by sutathion plus tricyclazole (4501 kg/ha and 21.5% IOC). The tricyclazole applied alone yielded the least of 4245 kg/ha with an IOC of 16.8%.

Pesticide compatibility trial was carried out at 6 centres 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. Based on the performance of the treatments when applied alone vis a vis their respective combinations in reducing pest infestation, it was evident that there were no significant differences in the performance of the two newer insecticide formulations in their efficacy when applied alone or in combination with fungicides were at par. Yield point of view also the insecticide fungicide combination treatments yielded better than insecticides applied alone. Though the combination product of flubendiamide plus buprofezin was superior to triazophos, there was no adverse impact on the efficacy of either of the insecticides when applied with either hexaconazole or tricyclazole or vice versa confirming the compatibility of the chemicals when used as tank mix in the field.

Table 2.43 Insect pest incidence in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formula-tion	g or ml per litre of spray fluid	Stem Borer Damage (%Deadhearts)									
				CBT			CHN	GGV	PTB		SBP		
				30DAT	40DAT	55DAT	50DAT	50DAT	30DAT	50DAT	56DAT	76DAT	Mean
Flubendiamide 4%+ buprofezin 20%	Flubendiamide 4%+ buprofezin 20%	35G+175G	1.75	16.5a	5.3a	3.1a	11.5a	1.5a	6.4a	5.8ab	2.6a	1.5a	**6.0a**
Sutathion	Triazophos	40	1.5	15.2a	7.9a	4.8a	15.0a	4.0b	9.0ab	4.9ab	4.7b	2.7b	**7.6a**
Contaf plus	Hexaconazole	5	2	16.3a	12.7b	11.2b	21.8a	5.9bc	13.4b	9.5b	7.3c	9.1c	**11.9b**
Baan	Tricyclazole	75	0.6	11.4a	15.9b	11.1b	18.8a	6.6bc	12.9b	9.9b	7.6c	9.6c	**11.5b**
RIL-IS-109+contaf plus	Flubendiamide 4%+ buprofezin20%+hexaconazole		1.75+2.0	7.6a	6.4a	6.6a	13.5a	1.2a	13.2b	3.3a	2.4bc	1.1a	**6.1a**
RIL-IS-109+baan	Flubendiamide 4%+buprofezin 20%+tricyclazole		1.75+0.6	17.6a	6.5a	7.1a	11.0a	1.8a	11.0b	2.8a	3.5a	2.4b	**7.1a**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	14.7a	7.2a	5.8a	15.0a	4.3bc	8.1ab	2.6a	3.9a	3.3b	**7.2a**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	14.2a	7.7a	5.7a	12.7a	4.6bc	12.3b	5.0a	5.2b	4.1b	**7.9a**
Untreated control	Untreated control			17.6a	15.9b	12.3b	17.6a	7.6c	24.1c	8.3b	8.9c	13.1d	**13.9b**

Table 2.43 (Contd...) Insect pest incidence in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Stem Borer Damage (%White ears)					Mean
				Preharvest					
				CBT	CHN	GGV	PTB	SBP	
Flubendiamide 4%+buprofezin 20%	Flubendiamide 4%+buprofezin 20%	35G+175G	1.75	2.1a	6.9a	3.1a	3.5a	3.0a	**3.7a**
Sutathion	Triazophos	40	1.5	5.1a	9.1a	10.6b	6.0ab	4.8b	**7.1ab**
Contaf plus	Hexaconazole	5	2	7.3a	15.6b	25.0c	9.2b	8.2c	**13.0c**
Baan	Tricyclazole	75	0.6	7.5a	12.6ab	25.3c	6.5ab	8.7c	**12.1c**
RIL-IS-109+contaf plus	Flubendiamide 4%+buprofezin 20%+hexaconazole		1.75+2.0	4.1a	8.1a	2.8a	6.6ab	2.2a	**4.7a**
RIL-IS-109+baan	Flubendiamide 4%+buprofezin 20%+tricyclazole		1.75+0.6	5.1a	7.1a	3.3a	8.7b	3.9b	**5.6a**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	5.7a	11.4ab	11.1b	5.7ab	4.1b	**7.6ab**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	4.9a	10.6ab	11.8b	6.8ab	4.7b	**7.8ab**
Untreated control	Untreated control			11.3b	26.4c	28.5c	9.1b	11.2d	**17.3d**

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

Table 2.43 (Contd...) Insect pest incidence in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Brown Planthopper (No. /10 hills) GGV 77DAT BT	AT	99DAT BT	AT	Mean
Flubendiamide 4%+buprofezin 20%	Flubendiamide 4%+buprofezin 20%	35G+175G	1.75	101.0a	25.3a	93.3a	17.7a	**59.3a**
Sutathion	Triazophos	40	1.5	100.3a	48.3a	98.7a	47.3b	**73.7b**
Contaf plus	Hexaconazole	5	2	99.7a	102.3c	112.7a	113.3c	**107.0c**
Baan	Tricyclazole	75	0.6	100.3a	100.7c	117.3a	117.3c	**108.9c**
RIL-IS-109+contaf plus	Flubendiamide 4%+buprofezin 20%+ hexaconazole		1.75+2.0	102.3a	21.0a	91.0a	11.0a	**56.3a**
RIL-IS-109+baan	Flubendiamide 4%+buprofezin 20%+tricyclazole		1.75+0.6	100.7a	24.0a	91.3a	13.7a	**57.4a**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	100.7a	47.0b	94.3a	39.7b	**70.4b**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	98.7a	50.7b	98.0a	41.7b	**72.3b**
Untreated control	Untreated control			101.3a	120.3c	129.0a	127.7c	**119.6c**

Table 2.43 (Contd...) Insect pest incidence in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	GGV Whitebacked Planthopper (No./10 hills) 77DAT BT	AT	99DAT BT	AT	Mean	SBP BPH + WBPH 72 DAT BT	AT	Mean
Flubendiamide 4%+ buprofezin 20%	Flubendiamide 4%+ buprofezin 20%	35G+175G	1.75	61.7a	19.3a	64.7a	9.3a	**37.9a**	31.3a	24.0b	**34.5a**
Sutathion	Triazophos	40	1.5	67.0a	36.3b	75.7a	32.7b	**52.9b**	38.7b	37.3c	**47.9b**
Contaf plus	Hexaconazole	5	2	64.3a	58.0bc	79.0a	69.0c	**67.6c**	49.3c	62.0d	**63.6c**
Baan	Tricyclazole	75	0.6	68.0a	63.7bc	76.3a	70.3c	**69.6c**	48.7c	59.3d	**64.4c**
RIL-IS-109+contaf plus	Flubendiamide 4%+ buprofezin 20%+hexaconazole		1.75+2.0	62.0a	12.3a	60.0a	8.7a	**35.8a**	26.7a	15.3a	**30.8a**
RIL-IS-109+baan	Flubendiamide 4%+ buprofezin 20%+tricyclazole		1.75+0.6	66.7a	13.0a	61.3a	9.0a	**37.5a**	30.3a	25.3b	**34.3a**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	67.7a	33.7b	67.7a	25.0b	**48.5ab**	36.7b	37.0c	**44.6b**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	65.0a	34.7b	69.3a	29.3b	**49.6ab**	35.0b	30.3b	**43.9b**
Untreated control	Untreated control			69.0a	81.0c	88.3a	83.7c	**80.5d**	62.3d	75.7e	**76.7d**

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

Table 2.43 (Contd...) Insect pest incidence in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Blast (%sev/10 hills) GGV 70DAT BT	GGV 70DAT AT	SBP BT 66DAT	SBP BT 76DAT	Mean
Flubendiamide 4%+buprofezin 20%	Flubendiamide 4%+buprofezin 20%	35G+175G	1.75	31.9a	31.1b	3.0a	3.2a	**17.3a**
Sutathion	Triazophos	40	1.5	31.9a	34.4b	3.6a	3.7a	**18.4a**
Contaf plus	Hexaconazole	5	2	37.0a	29.6b	2.7a	2.5a	**18.0a**
Baan	Tricyclazole	75	0.6	35.2a	21.1a	1.3a	0.8a	**14.6a**
RIL-IS-109+contaf plus	Flubendiamide 4%+buprofezin 20%+hexaconazole		1.75+2.0	37.0a	31.9b	2.7a	2.4a	**18.5a**
RIL-IS-109+baan	Flubendiamide 4%+buprofezin 20%+tricyclazole		1.75+0.6	39.3a	23.7a	2.0a	1.8a	**16.7a**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	38.9a	35.9b	3.1a	3.0a	**20.2a**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	38.1a	21.9a	2.2a	1.7a	**16.0a**
Untreated control	Untreated control			37.4a	45.9c	4.3a	4.5a	**23.0a**

Table 2.43 (Contd...) Insect pest incidence in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Sheath Blight (% sev/10 hills) CHN 60DAT	CHN Pre-hav.	GGV 70DAT BT	GGV 70DAT AT	PTB BT	PTB AT	Mean
Flubendiamide 4%+ buprofezin 20%	Flubendiamide 4%+buprofezin 20%	35G+175G	1.75	17.3b	30.7b	27.4a	36.3b	75.3a	82.8b	**45.0b**
Sutathion	Triazophos	40	1.5	12.0b	36.0b	38.9a	38.2b	75.3a	90.0b	**48.4b**
Contaf plus	Hexaconazole	5	2	2.7a	6.7a	39.6a	20.4a	78.8a	47.5a	**32.6a**
Baan	Tricyclazole	75	0.6	20.0c	29.3b	44.1a	30.0b	80.3a	35.0a	**39.8b**
RIL-IS-109+contaf plus	Flubendiamide 4%+buprofezin 20%+ hexaconazole		1.75+2.0	5.7a	9.3a	38.5a	15.6a	78.0a	26.3a	**28.9a**
RIL-IS-109+baan	Flubendiamide 4%+buprofezin 20%+ tricyclazole		1.75+0.6	14.7b	25.3b	37.8a	31.9b	89.0a	22.5a	**36.9b**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	5.3a	8.0a	41.1a	18.9a	65.8a	23.8a	**27.1a**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	18.7c	30.7b	37.4a	31.9b	81.5a	20.0a	**36.7b**
Untreated control	Untreated control			24.0d	32.0b	38.5a	52.9c	82.3a	94.5b	**54.0c**

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

Table 2.44 Grain yield in different treatments, PCT, *Rabi* 2014

Trade Name	Common Name	% a.i. formulation	g or ml per litre of spray fluid	Yield(kg/ha)						Mean	% IOC
				CBT	CHN	GGV	PDC	PTB	SBP		
Flubendiamide 4%+buprofezin 20%	Flubendiamide 4%+buprofezin 20%	35G+175G	1.75	4944a	2933b	6253a	6350a	3853ab	4250b	**4764b**	**25.9**
Sutathion	Triazophos	40	1.5	4133c	4200a	5973a	5717b	4241a	3858c	**4687c**	**24.7**
Contaf plus	Hexaconazole	5	2	3842d	5511a	4187b	6567a	3763ab	3545d	**4569c**	**22.7**
Baan	Tricyclazole	75	0.6	3859d	3822b	4200b	6650a	3495b	3447d	**4245d**	**16.8**
RIL-IS-109+contaf plus	Flubendiamide 4%+buprofezin 20%+hexaconazole		1.75+2.0	4606b	4889a	6400a	6783a	3987ab	4602a	**5211a**	**32.2**
RIL-IS-109+baan	Flubendiamide 4%+buprofezin 20%+tricyclazole		1.75+0.6	4268c	3844ab	6333a	6567a	3913ab	3819c	**4791b**	**26.3**
Sutathion+contaf plus	Triazophos+hexaconazole		1.5+2.0	4069c	5467a	6040a	5950a	4062ab	3564d	**4859b**	**27.3**
Sutathion+baan	Triazophos+tricyclazole		1.4+0.6	3998c	3444b	6093a	5983a	3510a	3976c	**4501b**	**21.5**
Untreated control	Untreated control			3792d	3200b	2680c	5117ab	3674a	2722e	**3531e**	

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

2.2 ECOLOGICAL STUDIES

The ecological studies on insect pests includes i) Influence of rice cultivation methods on insect pest incidence (IRCP) and ii) Effect of Planting Date on Pest Incidence (EPDP). The results of these trials are presented below:

i) Influence of Rice Cultivation methods on insect Pest incidence (IRCP)

A major shift in the rice cultivation took place in the last few years from conventional puddled transplanted method to direct seeded rice mainly due to the water and labour constraints. Direct seeded rice either by manual method (dibbling) or mechanical method (drum seeding) has become popular with farmers in irrigated areas. The cultivation practices followed in direct seeded rice are quite different from normal transplanted rice that might have an influence on insect pest incidence. Keeping this in view the present trial was formulated to assess the insect pest incidence in direct seeded rice vs normal transplanted rice.

The field trial was conducted in split-plot design with cultivation methods as main plot treatments *i.e.,* S1) Normal transplanted system and S2) Direct seeded rice and cultivars as 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.

During Rabi 2013-14, the trial was conducted at two locations *viz.*, Coimbatore and Ragolu. The details of this trial are discussed location wise:

Coimbatore: Stem borer, leaf folder, gall midge, BPH and GLH incidence was recorded. Among the cultivation methods, dead hearts at 50 & 70 DAT and white ears were significantly low in direct seeded rice as compared to normal transplanted method whereas dead hearts at 60 DAT were low in normal transplanted method (10.58%) as against direct seeded rice **(Table 2.45)**. Nevertheless, leaf folder damage was significantly low in normal transplanted method (6.44 – 10.75%) as compared to direct seeded rice (9.96 – 13.07%). Among the cultivars, CO 51 variety recorded low damage as compared to CORH-3 hybrid. Interaction effects revealed a significant relationship with respect to dead hearts, white ears and leaf folder damage. Grain yield was significantly high in direct seeded rice (6944 kg/ ha) as against normal transplanted method (6018 kg/ha) while CO51 variety (7291.5 kg/ha) out yielded CORH-3 hybrid (5671.2 kg/ha).

Table 2.45 Influence of rice cultivation methods and cultivars on insect pest incidence and grain yield (**IRCP**) at **Coimbatore,** *Rabi* 2013-14

Main plots	Sub- plots	% DH	% DH	% DH	% WE	% LFDL	% LFDL	% LFDL	Yield (kg/ha)
		50 DAT	60 DAT	70 DAT	Pre harvest	30 DAT	60 DAT	90 DAT	
Normal	**Hybrid (CO RH3)**	26.44 (5.18)	13.25 (3.63)	14.13 (3.78)	11.15 (3.41)	7.05 (2.71)	13.44 (3.73)	10.63 (3.32)	4861.1
	Variety (CO 51)	6.35 (2.31)	7.92 (2.47)	6.85 (2.41)	11.77 (3.47)	5.84 (2.48)	8.05 (2.90)	8.99 (3.07)	7175.7
Direct seeded Rice	**Hybrid (CO RH3)**	14.04 (3.67)	15.43 (3.83)	12.35 (3.56)	9.64 (2.99)	13.71 (3.76)	15.56 (4.01)	14.28 (3.84)	6481.3
	Variety (CO 51)	4.99 (2.23)	7.41 (2.65)	5.78 (2.24)	5.77 (2.35)	6.22 (2.49)	10.58 (3.31)	10.61 (3.33)	7407.3
LSD 0.05	***M in S***	***1.11***	***1.05***	***1.37***	***0.68***	***0.60***	***0.35***	***0.24***	***830.41***
	S in M	***1.05***	***0.98***	***1.14***	***0.98***	***0.57***	***0.38***	***0.27***	***883.71***
Cultivation systems									
	Normal	16.39 (3.74)	10.58 (3.05)	10.49 (3.09)	11.46 (3.44)	6.44 (2.59)	10.75 (3.32)	9.81 (3.20)	6018.4
	Direct seeded Rice	9.52 (2.95)	11.42 (3.24)	9.07 (2.90)	7.71 (2.67)	9.96 (3.13)	13.07 (3.66)	12.45 (3.59)	6944.3
LSD 0.05	***Main***	***0.71***	***0.64***	***0.60***	***0.85***	***0.39***	***0.28***	***0.21***	***662.4***
CV (%)		22.95	22.09	21.80	30.22	14.54	8.83	6.84	11.05
Cultivars									
	Hybrid (CO RH3)	20.24 (4.43)	14.34 (3.73)	13.24 (3.67)	10.39 (3.20)	10.37 (3.24)	14.50 (3.87)	12.45 (3.58)	5671.2
	Variety (CO 51)	5.68 (2.27)	7.66 (2.56)	6.32 (2.33)	8.77 (2.91)	6.03 (2.48)	9.31 (3.11)	9.80 (3.20)	7291.5
LSD 0.05	***Sub***	***0.78***	***0.74***	***0.97***	***0.48***	***0.42***	***0.25***	***0.17***	***587.19***
CV (%)		28.42	28.64	39.40	19.03	18.03	8.63	6.09	11.00

Figures in parentheses are square root transformed values

Ragolu: Incidence of stem borer, leaf folder, gall midge, hispa, whorl maggot and thrips was observed in both the cultivation methods and cultivars **(Table 2.46)**. Stem borer damage was significantly high in direct seeded rice (17.25%WE) while gall midge damage was significantly high in normal transplanted method (22.84% SS). Among the cultivars, KRH2 hybrid recorded significantly high pest incidence as compared to MTU 1010 variety. Yield was significantly high in normal transplanted method (6950 kg/ ha) and KRH2 hybrid (6399 kg/ ha) out yielded MTU 1010 variety (6308.4 kg/ ha). However, MTU 1010 grown under normal method recorded the highest grain yield (7038.3 kg/ ha).

Table 2.46 Influence of rice cultivation methods and cultivars on insect pest incidence and grain yield (IRCP) at **Ragolu,** *Rabi* 2013-14

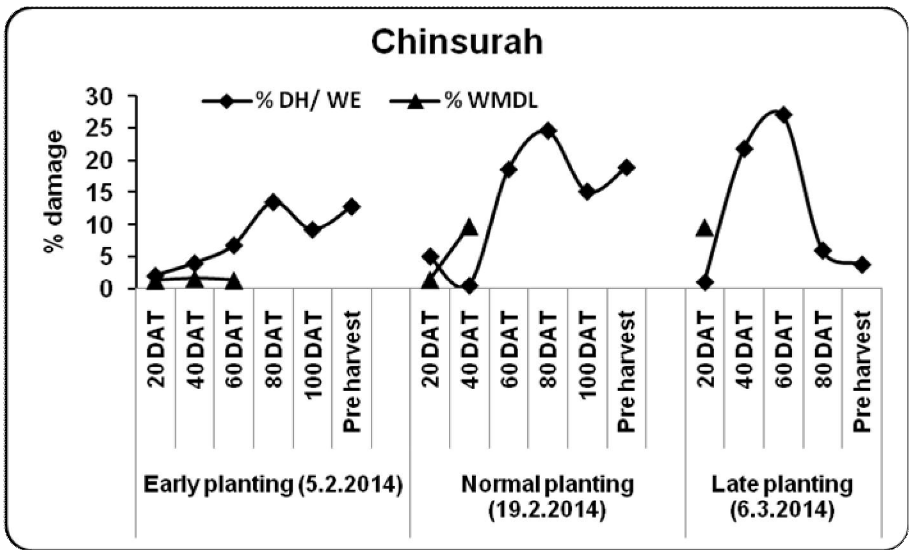
Main plots	Sub- plots	% DH	% WE	% SS	% SS	% ThDL	Yield (kg/ha)
		40 DAT	Pre harvest	50 DAT	60 DAT	60 DAT	
Normal	**Hybrid (KRH2)**	4.59 (1.99)	13.13 (3.54)	9.49 (3.00)	33.09 (5.18)	6.15 (2.38)	6861.9
	Variety (MTU 1010)	3.34 (1.62)	6.88 (2.57)	4.45 (2.17)	12.58 (3.51)	6.49 (2.53)	7038.3
Direct seeded	**Hybrid (KRH2)**	2.42 (1.30)	19.13 (4.33)	11.34 (3.31)	16.79 (4.05)	5.29 (2.21)	5938.0
	Variety (MTU 1010)	2.11 (1.25)	15.37 (3.86)	5.98 (2.49)	9.74 (3.07)	4.44 (2.10)	5578.6
LSD 0.05	***M in S***	***0.84***	***1.00***	***0.76***	***1.58***	***0.64***	***422.75***
	S in M	***1.24***	***0.82***	***0.68***	***1.67***	***0.72***	***528.41***
Cultivation systems							
	Normal	3.97 (1.81)	10.00 (3.06)	6.97 (2.59)	22.84 (4.35)	6.32 (2.46)	6950.1
	Direct seeded	2.27 (1.27)	17.25 (4.10)	8.66 (2.90)	13.27 (3.56)	4.87 (2.15)	5758.3
LSD 0.05	***Main***	***1.08***	***0.41***	***0.43***	***1.25***	***0.56***	***436.7***
CV (%)		16.07	12.47	16.91	24.26	26.47	7.43
Cultivars							
	Hybrid (KRH2)	3.50 (1.62)	16.13 (3.94)	10.41 (3.16)	24.95 (4.62)	5.72 (2.29)	6399.9
	Variety (MTU 1010)	2.73 (1.46)	11.13 (3.22)	5.22 (2.33)	11.61 (3.29)	5.47 (2.31)	6308.4
LSD 0.05	***Sub***	***0.57***	***0.71***	***0.54***	***1.12***	***0.45***	***298.9***
CV (%)		26.93	24.18	23.70	34.26	23.99	5.71

Figures in parentheses are square root transformed values

Influence of rice cultivation methods on insect pest incidence (IRCP) trial was conducted at Coimbatore and Ragolu during Rabi 2013-14. In general dead heart damage was significantly low in direct seeded rice while white ear damage was low in direct seeded rice at Coimbatore (7.71%) but was low in normal transplanted method (10.00%) at Ragolu indicating inconsistency. Leaf folder damage was observed only at Coimbatore and was found significantly low in normal transplanted method as compared to direct seeded rice. Among the cultivars, KRH2 & CORH3 hybrids recorded significantly high pest incidence compared to MTU 1010 & CO 51 varieties grown in this trial.

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

Effect of planting dates on insect pest incidence trial was conducted only at one location *i.e.,* Chinsurah during *Rabi* 2013-14. IET 4094 (Khitish) variety was grown in this trial. Incidence of stem borer, leaf folder, whorl maggot and white leafhopper was observed. Dead hearts by stem borer were high in normal (0.51 – 24.56% DH) and late plantings (1.05 – 27.05% DH) while white ear damage was high in normal planting only (18.88% WE). Low incidence of whorl maggot and leaf folder was observed in all the plantings (<5% DL). White leafhopper incidence, though observed only in early and normal plantings, was low (0.5-0.7/ hill). Grain yield of 52.50, 50 and 45 q/ ha was recorded in early, normal and late plantings, respectively.



Effect of planting dates on insect pest incidence (EPDP) trial was conducted only at one location i.e., Chinsurah during Rabi 2013-14. Dead heart damage by stem borer was high in normal and late plantings while the incidence of defoliators like leaf folder and whorl maggot was very low (< 5% DL). Very low white leafhopper incidence was observed only in early and normal plantings (0.5 – 0.7/ hill).

2.3 BIOCONTROL AND BIODIVERSITY STUDIES

i) Monitoring of Pests and Natural Enemies (MPNE)

The data were received from four centres *viz*., Aduthurai, Maruteru, Rajendranagar and Warangal.

1. Stem borer

Species composition: The stem borer species composition was reported from Aduthurai, Warangal and Rajendranagar. At Aduthurai, YSB dominated (100%) until 30DAT, while DHB became dominant 60 DAT (70.96%). At *Rajendranagar* and Warangal the yellow stem borer was the only species observed. YSB dominated in all phases of crop growth ranging from 69.0-77.0%, followed by SSB (16.9%), PSB (5.3%) and WSB (4.2%).

Natural enemies: At Aduthurai, the mean egg mass parasitisation was 53.33% and the mean egg parasitisation was 57.95%. *Tetrastichus shoenobii* was the dominant parasitoid accounting for 100% of the population. The mean egg mass parasitisation was very low at Rajendranagar and ranged from 16-20% and mean egg parasitisation was only 9.87%. Two parasitoids were observed *Trichogramma japonicum* being the dominant species (92.22%) followed by *Telenomus* sp. (7.78%). At Warangal, the mean egg mass parasitisation was 44% and the mean egg parasitisation was low (19.22%). Three species of parasitoids were observed- *Trichogramma* (56.06%), *Telenomus* (33.33%) and *Tetrastichus* (10.61%).

2. Hoppers

Information on the hoppers species composition was received from three centres Aduthurai, Maruteru and Warangal. At Aduthurai, BPH was the only planthoppers species observed with a mean of 5.15 per hill. Green leafhoppers were observed at 0.88 per hill. The predator population especially of mirids was quite low while that of observed spiders was (8.8/10hills) and coccinellids (4.9/10hills). Similarly only BPH was observed in Maruteru at 4.04/hill. Egg parasitisation was also recorded. The egg parsitisation ranged from 0-33.33% with a mean parasitisation of 3.17%. Only one species *Oligosita* was observed. At Warangal BPH was observed at 2.7/hill.

Monitoring of pest species and natural enemies (MPNE) trial was carried out at 4 locations. The stem borer species observed were YSB and DHB. Three egg parasitoids of stem borer were observed with Trichogramma japonicum being dominant at Warangal and Rajendranagar and Tetrastichus at Aduthurai. Only BPH was observed in three locations Aduthurai, Maruteru and Warangal.

ii) Ecological Engineering for Planthopper Management (EEPM)

This trial was taken up at only Maruteru during Rabi. The EE interventions tested at Maruteru were alleyways, organic manuring and bund flora. The observations on hoppers and their natural enemies were taken 8 times from 15 DAT every 10 days. The overall analysis of pooled data shows BPH population to significantly higher in plots with EE treatment when compared to farmers practices **(Table 2.47).** The population of green mirids and spiders were significantly higher in EE plots. The spider population was significantly higher with 8.1/10 hills observed in EE plots as compared to 5.2 in FP plots. The yield difference recorded in FP (12.06kg/25 sq.m) and EE plots (15.17 kg/25 sq.m) were highly significant (t = 3.48; df =10; p=<0.01). The parasitisation of BPH eggs was assessed by egg baiting. The level of parasitisation was low, ranging from 0-26.67%. *Oligosita* was the only parasitoid recorded.

Table 2.47 Effect of ecological engineering on hoppers and its natural enemies at **Maruteru**, **MPNE**, *Rabi* 2014

Parameters	BPH (No./hill)		Green mirids (No./hill)		Spiders (No./ hill)	
	EE	FP	EE	FP	EE	FP
Mean	36.21	15.08	6.47	3.67	0.81	0.52
t value	4.51 **		4.16**		3.57**	
df	358		358		718	
P - value	<0.01		<0.01		<0.01	

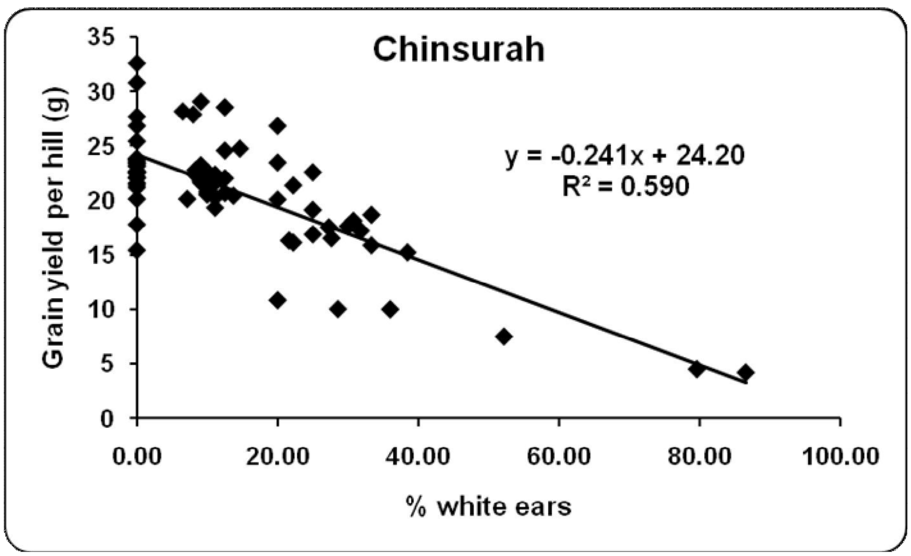
Ecological engineering for planthopper management was taken up in Maruteru with a combination of interventions such as organic manuring, and growing of flowering plants on bunds. Such interventions increased the natural enemy populations like mirids, spiders. The yield was higher in ecologically engineered plots.

2.4 INTEGRATED PEST MANAGEMENT

This section comprises of two trials *viz.*, Yield Loss Estimation Trial (YLET) and Integrated Pest Management special trial (IPMs). Details of these trials are given below:

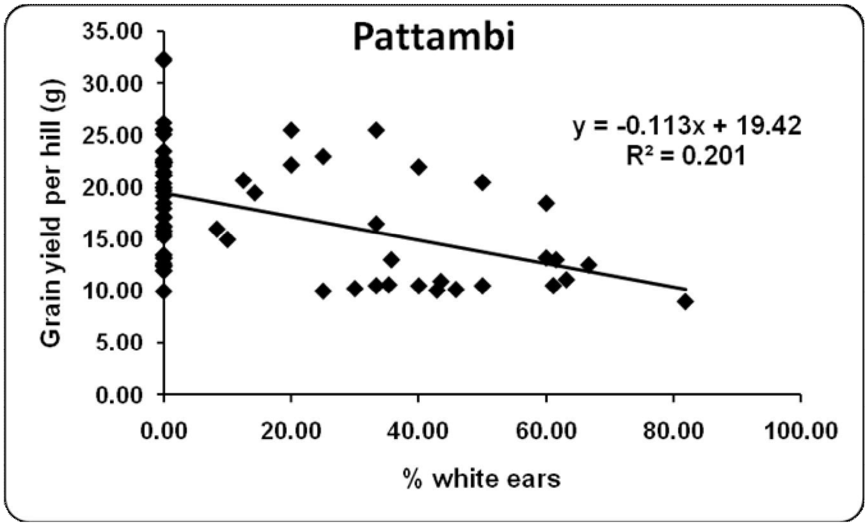
i. Yield Loss Estimation Trial (YLET)

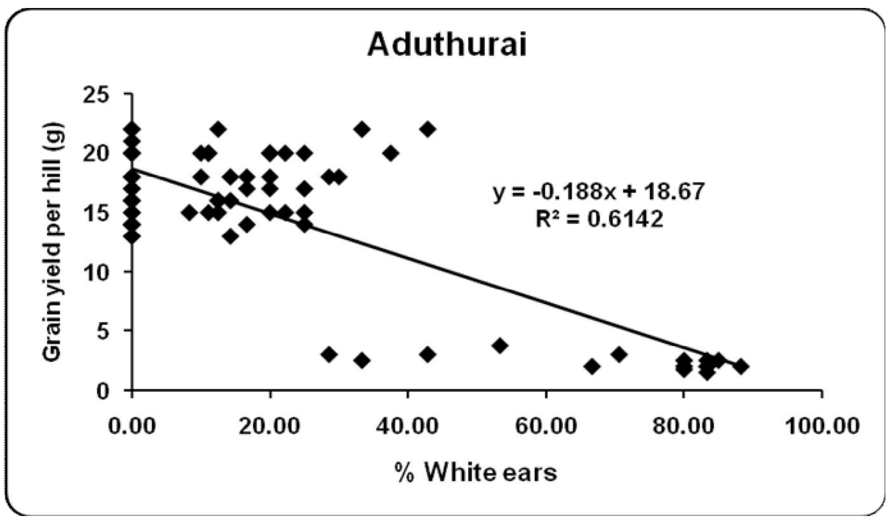
During *Rabi* 2013-14, YLET trial was conducted only at three locations. At **Chinsurah,** Khitish variety was grown in this trial. White ear damage ranged between 0 and 86.54% while grain yield varied from 4.24 to 32.60 g per hill. Regression analysis revealed a significant negative relationship between per cent white ears and grain yield. Every 10% increase in white ears resulted in a decrease of 2.41 g grain yield (R^2 = 0.590).



At **Pattambi,** Jyothi variety was grown in this trial. White ear damage ranged from 0 to 81.82% with a grain yield of 9.01 to 32.40 g per hill. Regression analysis revealed a significant negative relationship between white ears and grain yield. For every 10% increase in white ears, there was a reduction of 1.13 g grain yield.

At **Aduthurai,** ADT 46 variety was taken in this trial. Regression analysis revealed a significant negative relationship between % white ears and grain yield (R^2 = 0.6142) indicating that for every 10% increase in white ears, 1.9 g reduction in grain yield. White ears varied from 0 to 88.24% but were clustered as two groups.





Pooled analysis of the data of three locations revealed a significant negative relationship between white ears and natural logarithm of grain yield. Regression equation is Ln (GY) = -0.0195x + 3.088 (R^2 = 0.5568; P ≤ 0.0000; n = 223). Every 10% increase in white ears resulted in 1.01 g reduction in grain yield.

Yield loss estimation trial (YLET) was conducted at three locations during Rabi 2013-14. A significant negative relationship was observed between white ears and grain yield at Chinsurah (Y = -0.241x + 24.20; R^2 = 0.590), Pattambi (Y = -0.113x + 19.42; R^2 = 0.201) and Aduthurai (Y = -0.188x + 18.67; R^2 = 0.6142). Pooled analysis revealed that for every 10% increase in white ear, there will be 1.01 g reduction in grain yield.

ii. Integrated Pest Management special trial (IPMs)

During Rabi 2013-14, IPM special trial was conducted at 3 locations *viz.*, Maruteru, Sakoli and Chinsurah in farmers' fields. Location wise results are discussed below:

At **Maruteru,** MTU 1121 was machine transplanted in IPM field. Management practices followed are given in Table 2.48. Low incidence of stem borer (<2%), gall midge (<5%) and hispa was observed in both IPM and farmers practices **(Table 2.49)**, while BPH incidence was high in farmer practices at 80 DAT (25.40) as compared to IPM plot (16.80). Grain yield was significantly high in IPM (137.68 q/ ha) resulting in high BC ratio (4.51).

At **Sakoli,** MTU 1010 was grown in Sri. Shamrao Shravan Gadmade's field, Jambali (sadak), Sakoli tahsil, Bhandara (M.S) district of Maharashtra. Management practices followed were given in Table 2.48. Incidence of stem borer, gall midge, BPH, WBPH, leaf blast, neck blast, sheath blight, sheath rot, brown spot, stem rot and bacterial leaf blight was observed in addition to weeds in both IPM & farmer practices **(Table 2.50)**. Disease incidence was high as compared to insect pests. Adoption of IPM practices reduced the disease severity of all the recorded diseases. Weed population and weed biomass was high in farmer practices. Only stem borer damage crossed ETL at 36 DAT in both IPM and farmer practices (17.63 & 20.35% DH). Grain yield was high in IPM plot resulting in high returns and high BC ratio (3.87) as compared to farmer practices (2.45).

At **Chinsurah**, IET 4786 (Satabdi) was grown in Sri Prosanta Ghosh's field at Village Damra, Mogra, West Bengal. Stem borer, leaf folder, whorl maggot, hispa, BPH, WBPH, GLH, leaf blast, brown spot and sheath blight incidence was observed. Whorl maggot damage was high in FP plot at 50 DAT (22.85%) as compared to IPM plot (5.68%). Other pests' incidence was low in both IPM and FP plots **(Table 2.51)**. Adoption of IPM practices reduced the disease severity of leaf blast and brown spot. However sheath blight incidence was high in IPM plot with a high AUDPC value (80.50) as against FP plot (17.50). The IPM implemented plots showed significantly lower weed population and weed biomass than farmers practice resulting in higher grain yield. BC ratio of IPM (2.35) and FP (2.24) plots was similar mainly due to high cost of cultivation in IPM plot in spite of getting high returns.

Table 2.48 Details of Pest Management Practices followed in IPMs trial at various locations, *Rabi* 2013-14

	Practices followed in IPM	Farmers practices
LOCATION: MARUTERU		
Area	1 acre	1 acre
Variety	MTU 1121	MTU 1121
Nursery	• Application of NPK @ 180-90-60 kg/ha • Tray nursery - Monocrotophos sprayed once and Carbofuran 3G applied after keeping the trays in puddled soil • The soil was mixed with vermi compost and DAP. Foliar spray of Urea was applied	• Application of NPK @ 216-50-60 kg/ha • Tray nursery - Monocrotophos sprayed once and Carbofuran 3G applied after keeping the trays in puddled soil • The soil was mixed with vermi compost and DAP. Foliar spray of Urea was applied
Main field	• Application of 200 kg SSP; 40 kg MOP & 125 kg Urea/ acre • Weedicide applied (pretilachlor)+ one hand weeding • Application of Zinc sulphate twice , as basal and foliar spray • Application of Propiconazole against sheath blight • Spraying of Cartap hydrochloride 50 SP against stem borer and leaf folder • Pheromone traps installed and *Trichogramma* released	• Application of 125 kg urea; 40 kg MOP; 75 kg DAP & 50 kg 28-28-0/ acre • Application of Zinc sulphate twice , as basal and foliar spray • Application of weedicide, Pretilachlor + Almix & one hand weeding • Spraying of Propiconazole, tricyclozole and bavistin (twice) against sheath light, neck blast and false smut • Application of monocrotophos, fipronil, cartap 4G and confidor against stem borer & planthoppers
LOCATION: SAKOLI		
Area	• 0.40 ha	• 0.40 ha
Variety	• MTU 1010	• MTU 1010
Nursery	• Application of 100 kg SSP & 50 kg Urea • Seed treatment done with Carbandezim @ 20 g for 10 kg seeds (wet seed treatment) • The treated seed were soaked overnight in 10 litre water and kept in gunny bag for germination. • Application of Carbofuran @ 1.1kg a.i./ha, 5 days before pulling seedlings from nursery	• Application of 100 kg SSP & 50 kg Urea • Seed treatment done with 3 % salt
Main field	• Seedlings were transplanted at a spacing of 20 x 15 cm • Left alleyways of 30 cm after every 2 m / 10 rows. • Applied Butachlor 1.5 kg a.i./ ha at 3rd day after transplantation • At 15 DAT, installed pheromone traps with 5 mg lure (Scripoload) @ 8 traps/ ha for stem borer monitoring • Cartap hydrochloride 50 WP @ 600g /ha was	• Seedlings were transplanted randomly • The field were manually weeded • Soil application of Ferterra (Rynaxypyr) 0.4% G for management of stem borer • Sprayed the crop with copper oxy chloride @ 25 gm per 10 liter of water • Sprayed the crop with carbendazim @ 10 gm per 10 litre of • water

	sprayed for management of stem borer • Soil application of Ferterra (Rynaxypyr) 0.4% G • for management of stem borer • Blanket application of Propiconazole 0.1%. • Mid season drainage was followed for management of BPH	
LOCATION: CHINSURAH		
Area	• 0.5 acre	• 0.5 acre
Variety	• IET 4786 (Satabdi)	• IET 4786 (Satabdi)
Nursery	• Application of 1.5 kg mustard cake	• Application of 5 kg mustard cake
Main field	• Application of 31 kg 10-26-26; Urea 28 KG • Application of Ferterra granules @ 4 kg/ acre + coragen spray @ 60 ml/ acre	• Application of 30 kg SSP; 23 kg MOP; Urea 30 kg • Application of Phorate 10 G + spraying of Triazophos (Tarzan) @ 750 ml/ acre twice

Integrated Pest Management special (IPMs) trial was conducted at 3 locations viz., Maruteru, Sakoli and Chinsurah, during rabi 2013-14. Stem borer damage was high in farmer practices at Sakoli (20.35% DH) while whorl maggot damage was high in farmer practices at Chinsurah (22.85% DL). Disease incidence was high at Sakoli and Chinsurah wherein adoption of IPM practices resulted in reduced disease severity. IPM implemented plots showed significantly lower weed population and weed biomass than farmers practice resulting in higher grain yield. Grain yield was high in IPM plots resulting in high BC ratio.

Table 2.49 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Maruteru**, *Rabi 2013-14*

Treat ments	% DH	% WE	% SS	No./ 10 hills BPH	Yield Q/ ha	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC ratio
	40 DAT	Pre harvest	70 DAT	80 DAT					
IPM	0.11 ± 0.11	1.05 ± 0.28	2.18 ± 0.26	16.80 ± 6.76	137.68	172100	38200	133900	4.51
FP	1.05 ± 0.17	0.60 ± 0.30	2.29 ± 0.36	25.40 ±7.67	113.18	141480	46625	94855	3.03

Price of paddy = Rs. 1250/ q

Table 2.50 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Sakoli**, *Rabi 2013-14*

Treatments	**Weed biomass (dry wt/ m^2)**		**Weed Population (No./sq.m)**		**Area under disease progress curve (AUDPC)**						
	30 DAT	**60 DAT**	**30 DAT**	**60 DAT**	**Leaf blast**	**Neck blast**	**Sheath blight**	**Sheath rot**	**Brown spot**	**Stem rot**	**Bacterial leaf blight**
IPM	17.74	17.98	11.60 (3.46)	9.80 (3.19)	95.70	30.10	207.06	100.38	91.21	104.30	316.40
FP	22.3	22.96	31.80 (5.60)	21.20 (4.57)	177.66	39.90	200.90	128.10	129.22	209.30	438.90

Treatments	**% DH**	**% WE**	**% SS**	**No. per 5 hills**		**Yield (q/ ha)**	**Gross Returns (Rs.)**	**Cost of Cultivation (Rs.)**	**Net Returns (Rs.)**	**BC ratio**
				BPH	**WBPH**					
	36 DAT	**Pre harvest**	**43 DAT**	**99 DAT**	**92 DAT**					
IPM	17.63 ± 3.20	4.92 ± 1.49	1.34 ± 0.57	10.00 ± 0.32	11.80 ± 0.80	67.78	91503	23622.5	67880.5	3.87
FP	20.35 ± 2.44	10.71 ± 1.40	3.57 ± 0.33	11.20 ± 0.80	12.80 ± 1.16	40.28	54378	22202.5	32175.5	2.45

Price of paddy = Rs. 1350/ q

Table 2.51 Insect Pest incidence, grain yield and BC ratio in **IPMs** trial at **Chinsurah**, *Rabi 2013-14*

Treatments	% DH	% WE	% LFDL	% WMDL	% HDL	No. per 5 hills BPH	No. per 5 hills WBPH	AUDPC Leaf blast	AUDPC Brown spot	AUDPC Sheath blight
	64 DAT	Pre harvest	50 DAT	50 DAT	57 DAT	78 DAT	78 DAT			
IPM	2.37 ± 0.83	4.14 ± 0.37	2.37 ± 0.45	5.68 ± 0.20	0.74 ± 0.11	3.60 ± 1.03	1.20 ± 0.49	12.60	128.10	80.50
FP	7.55 ± 1.05	8.07 ± 0.58	4.27 ± 0.63	22.85 ± 2.34	4.30 ± 0.27	18.40 ± 4.40	10.20 ± 2.89	55.30	547.40	17.50

Treatments	Weed population (No./ sq.m) 20 DAT	Weed population (No./ sq.m) 40 DAT	Weed population (No./ sq.m) 60 DAT	Weed biomass (dry wt. in g/ sq.m) 20 DAT	Weed biomass (dry wt. in g/ sq.m) 40 DAT	Weed biomass (dry wt. in g/ sq.m) 60 DAT	Yield (q/ ha)	Gross Returns (Rs.)	Cost of Cultivation (Rs.)	Net Returns (Rs.)	BC ratio
IPM	28.00 ± 4.20	38.80 ± 1.56	66.00 ± 4.46	3.87 ± 0.38	5.07 ± 0.42	8.55 ± 0.68	56.7	79408	33740	45668	2.35
FP	41.00 ± 2.92	48.20 ± 1.59	101.20 ± 3.57	5.32 ± 0.44	6.30 ± 0.49	12.57 ± 0.79	53.7	75152	33603	41550	2.24

Price of paddy = 1400 Rs/ q

APPENDIX-I

Scientists involved in coordinated programme

IIRR headquarters, Hyderabad: Drs. G. Katti, V. Jhansi Lakshmi, N. Somasekhar, A. P. Padmakumari, Chitra Shanker, Ch.Padmavathi & M. Sampath Kumar

Cooperating centres

S. No.	State	Location	Code	Name of the cooperator, Designation
1	Andhra Pradesh	Maruteru	MTU	Dr. K.Vasanta Bhanu, Scientist (Entomology)
2		Nellore*	NLR	Dr. P. Raja Sekhar, Pr. Scientist (Entomology)
3		Ragolu	RGL	Dr. Visalakshmi, Pr.Scientist & Head (Ento)
4	Assam	Titabar	TTB	Dr. Mayuri Baruah, Junior Scientist
5	Bihar	Pusa	PUS	Dr. A. K. Misra, Chief Scientist (Entomology)
6	Chattisgarh	Jagdalpur	JDP	Dr. A. K.Gupta, Scientist, Entomology
7		Raipur	RPR	Dr. Sanjay Sharma, Pr. Scientist (Entomology)
8	New Delhi	New Delhi*	NDL	Dr. Subhash Chander, Pr. Scientist (Ento.), IARI
9	Jarkhand	Ranchi	RNC	Dr. Rabindra Prasad, Head, Dept. of Ent.
10	Gujarat	Nawagam	NWG	Dr. Dodhia, Assoc. Res. Scientist (Ent.)
11		Navsari	NVS	Dr. P. D. Ghoghari, Asst. Professor (Entomology)
12	Haryana	Kaul	KUL	Dr. Lakhi Ram, Entomologist
13	H.P	Malan	MLN	Dr. A. Srivastava, Sr. Entomologist
14	J & K	Chatha	CHT	Dr. Hafeez Ahmed, Asst. Prof.(Ento.)
15		Khudwani	KDW	Dr. Abu Manzar, Scientist, (Entomology)
16	Karnataka	Mandya	MND	Dr. Chethana, Asst. Professor (Rice),
17		Gangavathi	GGV	Dr. G.S. Guru Prasad, Asst. Professor (Ent.)
18		Brahmavar	BMR	Dr. S. U. Patil, Assoc. Professor
19	Kerala	Moncompu	MNC	Dr. Shanas Sudheer, Asst. Prof. (Ent.)
20		Pattambi	PTB	Dr. K. Karthikeyan, Assoc. Prof. of Ent.
21	M.P	Rewa*	REW	Dr. M. R. Dhingra, Sr. Entomologist
22	Maharashtra	Karjat	KJT	Mr.V. N. Jalgaonkar, Entomologist
23		Sakoli	SKL	Dr. B. N.Chaudhari, Jr. Entomologist
24	Manipur	Iroisemba*	IRS	Dr. K.I.Singh, Professor (Ent.)
25		Wangbal	WGB	Dr. Devananda Sharma, Jr. Entomologist.
26	Meghalaya	Upper Shillong	USG	Mrs.S. Dkar, Asst. Entomologist.
27	Odisha	Cuttack*	CTC	Dr. Mayabini Jena, Principal Scientist (Entomology)
28		Sambalpur	SBP	Dr. Atanu Seni, Jr Entomologist
29	Punjab	Ludhiana	LDN	Dr. P. S. Sarao, Sr. Entomologist
30	Tamil Nadu	Aduthurai	ADT	Dr. V.G. Mathirajan, Asst. Prof (Agril. Entomology)
31		Coimbatore	CBT	Dr. R. P. Soundararajan, Asst. Prof. (Ag. Entomology)
32		Madurai*	MDR	Dr. R Nalini, Assoc. Prof. of Entomology-
33	Telangana State	Jagtial*	JGT	Dr. Omprakash, Scientist (Entomology)
34		Rajendranagar	RNR	Dr. N. Ramagopala Verma, Sr. Scientist, (Entomology)
35		Warangal	WGL	Dr. S. Malathi, Scientist (Entomology)
36	U. Territory	Karaikal*	KKL	Dr. K. Kumar, Asst. Professor (Entomology)
37		Puducherry	PDC	Dr. J Krishna Kumar, Jr. Entomologist
38	Uttaranchal	Pantnagar	PNR	Dr. S. N. Tiwari, Prof. of Entomology
39	Uttar Pradesh	Faizabad	FZB	Dr. Kumud Singh, Entomologist
40		Ghaghraghat	GGT	Dr. S. S. Prasad, Assoc. Prof. (Ento.)
41	West Bengal	Chinsurah	CHN	Dr. S.K.Roy, Entomologist

* - Voluntary Centre.

APPENDIX-II

State	Location	No. of Trials			
		Rabi 2014		Kharif 2014	
		Sent	Recd.	Sent	Recd.
Funded co-operating centres					
Andhra Pradesh	Maruteru	4	4	14	14
	Ragolu	2	2	10	10
Assam	Titabar	1	0	6	6
Bihar	Pusa	-	-	11	8
Chattisgarh	Jagdalpur	-	-	12	12
	Raipur	-	-	15	15
Gujarat	Nawagam	-	-	10	10
	Navsari	-	-	11	9
Haryana	Kaul	-	-	9	8
Himachal Pradesh	Malan	-	-	8	8
Jammu & Kashmir	Chatha (R.S.Pura)	-	-	6	5
	Khudwani	-	-	5	3
Jharkhand	Ranchi	-	-	9	8
Karnataka	Mandya	-	-	12	10
	Gangavathi	2	2	13	13
	Brahmavar	-	-	11	10
Kerala	Moncompu	1	0	13	11
	Pattambi	4	4	10	10
Maharashtra	Karjat	1	1	9	7
	Sakoli	-	-	12	12
Manipur	Wangbal	-	-	5	4
Meghalaya	U. Shillong	-	-	1	1
Odisha	Sambalpur	2	2	10	10
Puducherry	Puducherry	2	2	11	8
Punjab	Ludhiana	-	-	17	17
Tamil Nadu	Aduthurai	6	1	15	15
	Coimbatore	3	3	10	10
Telangana State	Rajendranagar	2	2	11	11
	Warangal	2	2	10	10
Uttar Pradesh	Faizabad	-	-	8	8
	Ghaghraghat	-	-	10	9
Uttaranchal	Pantnagar	-	-	11	11
West Bengal	Chinsurah	-	-	11	11
	Total	37	30	336	314
Voluntary centres					
Andhra Pradesh	Nellore	-	-	8	8
Telangana State	Jagtial	-	-	3	3
New Delhi	New Delhi	-	-	5	5
Madhya Pradesh	Rewa	-	-	7	5
Manipur	Iroisemba	-	-	5	5
Odisha	Cuttack	2	1	8	7
Puducherry	Karaikal	-	-	6	6
Tamil Nadu	Madurai	-	-	5	4
	Total	2	1	47	43
Total trials in funded coop. & voluntary centres		39	31	383	357
% Receipt of data		**79.5**		**93.2**	
Grand totals for *kharif*& *rabi*				**422**	**388**
% Receipt of data (overall)				**91.9**	

APPENDIX-III

List of abbreviations

a.i.	:	Active ingredient
ADL	:	Average damaged leaves
AT		After treatment
Av.No./AN	:	Average number
AW	:	Army worm
B+WBPH	:	Mixed populations of BPH and WBPH
BB	:	Blue beetle
BCR	:	Benefit cost ratio
BPH	:	Brown planthopper
BT		Before treatment
Cocc.	:	Coccinellids
CPP	:	Cost of plant protection
CW	:	Case worm
DAT/DT	:	Days after transplanting
DG	:	Damaged grain
DH	:	Dead hearts
DHB	:	Dark Headed borer
DL	:	Damaged leaves
DP	:	Damaged plants
DS	:	Damage score
FR	:	Field reaction
GB	:	Gundhi bug
GH	:	Greenhouse reaction
GHC	:	Green horned caterpillar
GLH	:	Green leafhopper
GMB	:	Gall midge biotype
GRH	:	Grass hopper
HB	:	Hopper burn
HBP	:	Hopper burned plants
IOC	:	Increase over control
IPD	:	Infested Plants Dead
LF	:	Leaf folder
MB	:	Mirid bug
MLB	:	Mealy bug
N.n	:	*Nephotettix nigropictus*
N.v	:	*Nephotettix virescens*
N.ve	:	*Nezara viridula*
No./10h	:	Number per 10 hills
NP	:	Net profit
NPT	:	Number of promising tests
NT	:	Not tested
PH	:	Planthoppers
PLD	:	Promising level of damage
PPR	:	Percent Promising Reaction
PSB	:	Pink stem borer
R.d	:	Recilia dorsalis
RF	:	Rainfall
RH	:	Rice hispa
RH	:	Relative humidity
RT	:	Rice thrips
SBDH	:	Stem borer dead heart
SBWE	:	Stem borer white ear
SDW		Standard week
SS	:	Silver shoots
SSB	:	Striped Stem borer
SSH	:	Sunshine hours
WB	:	Water bug
WBPH	:	Whitebacked planthopper
WE	:	White ears
WLH	:	White leafhopper
WM	:	Whorl maggot
WSB	:	White Stem borer
YSB	:	Yellow stem borer

ACKNOWLEDGEMENTS

Our thanks are due to the scientists located at different centres for the conduct of trials as a part of the Coordinated Entomology Program. Thanks are also due to Dr. B. Sailaja, Scientist (SS) for helping in the statistical analysis of data. Thanks are due to technical staff of Entomology Section, Sri. P. M. Chirutkar, Sri. T. Venkaiah, Sri. K. Shravan Kumar and Sri S.Vijay Kumar for their efforts in conduct of the trials and/or preparation of the report at IIRR. We thank Smt. Aparna Das, Personal Assistant, for her assistance in coordination work. Special thanks are due to Sri. Amudhan Srinivasan, Sr.Technical Officer, Entomology Section, for his help in final page setting and printing of the report.