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Efficacy of newer insecticides against rice borer complex under North Bihar condition

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Abstract
The present experiment conducted to study the field efficacy of eight newer insecticides viz., Imidacloprid (17.8 SL), Thiamethoxam (25 WG), Sulfoxaflor (24 SC), Triazophos (40 EC), Dinotefuron (20 SG), Buprofezin (25 SC), Monocrotophos (36 SL) and Acephate (75SP) against different rice borers like yellow stem borer, pink borer, white stem borer and dark headed stem borer at Agricultural farm of Dr. Rajendra Prasad Central Agricultural University Pusa Samastipur (Bihar) during *Kharif* 2016 and *Kharif* 2017. The variety Rajendra Bhagwati was planted in RBD design with three replication and the result showed that among all treatments lowest deadheart infestation of yellow stem borer, pink stem borer, white stem borer and dark headed stem borer were recorded in Imidacloprid 17.8SL (4.20%, 1.37%, 1.33% & 1.62%) and Thiamethoxam 25SL (4.94%, 1.69%, 1.51% & 1.84%) respectively over the standard check Monocrotophos 36SL (6.73%, 1.95%, 1.68% & 2.18%). But the treatment Dinotefuron 20 SG found least effective against all borers. Among all treatments Imidacloprid 17.8SL (8.58%) and Thiamethoxam 25SL (9.33%) found superior in reducing white earhead percent of all stem borer over the standard check Monocrotophos (12.86%). Dinotefuron 20 SG found least effective among all treatments.

Keywords: Efficacy, insecticide, rice, borer complex

1. Introduction
Rice (*Oryza sativa*), is one of the most important crops in the world, also called the grain of life and staple food, providing food for nearly half of the global population [3]. Globally rice is cultivated over an area of about 163.19 million hectares with an annual production of about 719.3 million tonnes. In India rice is cultivated over an area of 44.5 million hectares with the productivity of 38782 kg/ha and production 172.5 million tonnes [4].

Rice has grown in both *Kharif* and *rabi* season under diverse ecological and climatic conditions apart from socio-economic diversities of the state. Over 1400 insect species attack standing and stored rice in the world [5], while Kalode, M. B. and Pasalu I. C reported that over 100 species of insect pests attack rice crop at various stages of its growth. Of the several insect species recorded as pests of rice, about 20 have major significance in different rice growing regions of India. Altogether 21 species of lepidopteran, stem borers have been recorded as rice pests throughout the world. Among these, 8 species are known to occur in India [11]. Various lepidopteran insect pests attacking on rice, yellow stem borer, *Scirpophaga incertulas* Walker, white stem borer, *Scirpophaga innotata* (Walker), dark headed borer, *Chilo polychrysus* (Meyrick) and pink stem borer, *Sesamia inferens* (Walker) are economically important. Among them yellow stem borer (YSB) is the most destructive and widely occurring insect pest of rice at all stages of the crop due to its monophagy to rice.

This pest causes severe yield loss by both white earheads and deadhearts formation. Insecticides are used as a major control tactic in managing pests of rice, *Oryza sativa* L. [7] with worldwide use estimated at $1.14billion in 1996 (International Rice Research Institute World Rice Statistics). Stem borers were the most damaging pest species in Asia until the 1960s [9] and are still causing substantial yield loss [8]. Chemical control, however, remains the only means of achieving economic and rapid suppression of stem borer infestations [1]. New molecules will be searched in the context of effective against rice pests vis-à-vis eco-friendly should be given top priority. Keeping above facts to study Efficacy of newer insecticides against Rice Borer pests was essencial for know about different insecticide efficacy against different insects pests of rice, this study also help to farmars for select best pest control element.

2. Materials and Methods

A field trial was conducted at research farm R.P.C.A.U., Pusa, Samastipur, Bihar during *Kharif*, 2016 and *Kharif*, 2017. The seedlings were raised in the properly prepared nursery beds for all the experiments Before sowing, the seeds were soaked for two days and kept in shad for allowed to sprout by keeping in gunny bag for 24 hours. The sprouted seeds were sown on the prepared seed beds and the seedlings were uprooted when they attained 4-5 leaf stage (30 days old). Seedlings were transplanted in $20m^2$ (5 x 4 m) plot area with 15 cm (plant to plant) x 20 cm (row to row) spacing. The rice variety Rajendra Bhagwati was used for the experiment. There was an untreated control in each replication. Out of the recommended doses of fertilizers (N:P:K : 100:60:40) half of the nitrogen and full dose of Phosphrus and Potash were applied before transplanting in soil into main plots and one fourth of nitrogen was given at 20 days after transplanting and remaining one fourth of nitrogen was given at 45 days after transplanting.

There were eight treatments which were replicated thrice in a randomized block design. Different insecticides viz. Imidacloprid 17.8 SL (110ml/ha), Thiamethoxam 25 WG (100g/ha), Sulfoxaflor 24 SC (150ml/ha), Triazophos 40 EC (700ml/ha), Dinotefuron 20 SG (200g/ha), Buprofezin 25 SC (700g/ha), Monocrotophos 36SL (1250ml/ha) and Acephate 75 SP (800g/ha) were used at its doses for the purpose to control of different insect pests. All the insecticides were applied at 15, 45 and 75 days after transplanting (DAT). Observation of borers deadheart (DH) infestation were made from randomly selected 20hills from each replication of each treatment of the investigation at one day before and 10 and 15 days after each application along with total tillers. Similarly, white earhead (WEH) and panicle bearing tillers was counted on 20 randomly selected hills from each plot just before harvest. The percentage of DH and WEH of the individual plot was calculated by the following formula described by Singha, S.S. and Pandey, V.

$$\text{Per cent incidence } (\%) = \frac{\text{Number of dead heart/white ear heads}}{\text{Total number of tillers/panicles}} \times 100$$

3. Results and Discussion

Statistically analyzed data of *Kharif* 2016 and 2017 (Table 1 & 2) season presented in the table revealed that the per cent infestation of Yellow stem borer, Pink borer, White stem borer and Dark headed stem borer and their pooled mean (*Kharif* 2016 and 2017, Table 3 & Fig.1).

Among the entire insecticidal treatments efficacy against Yellow stem borer, Imidacloprid 17.8SL (4.20%) and Thiamethoxam 25SL (4.94%) was found to be most effective in reducing deadheart incidence over the standard check Monocrotophos 36SL (5.49%). The treatment Sulfoxaflor 24SC (7.20%) found significantly at par with the check. but rest of the treatments viz. Acephate 75SP (7.60%), Trizophos 40EC (8.01%), Buprofezin 25SC (9.17%) and Dinotefuron 20SG (9.95%) found least effective and significantly lower than the check (Table 3). However, the highest deadheart per cent was recorded in untreated control check (16.02%). Similar have reported by DRR (2009), Prasad S.S. and Gupta P.K (2011) and Rath *et al.* (2015) the application of Monocrotophos 36 SL, Thiamethoxam 25SL, Imidacloprid 17.8SL found superior over control in reducing the deadheart and white earhead percent.

Among the entire insecticidal treatments efficacy against Pink stem borer, Imidacloprid 17.8SL (1.37%) and Thiamethoxam 25SL (1.69%) was found to be most effective in reducing deadheart incidence over the standard check Monocrotophos 36SL (1.95%). The treatment Sulfoxaflor 24SC (2.15%) found significantly at par with the check. but rest of the treatments viz. Acephate 75SP (2.38%), Trizophos 40EC (2.75%), Buprofezin 25SC (2.95%) and Dinotefuron 20SG (3.53%) found least effective and significantly lower than the check (Table 3). However, the highest deadheart per cent was recorded in untreated control check (4.42%). (Table 3).

Among the entire insecticidal treatments efficacy against White stem borer, Imidacloprid 17.8SL (1.33%) and Thiamethoxam 25SL (1.51%) was found to be most effective in reducing deadheart incidence over the standard check Monocrotophos 36SL (1.68%). The treatment Sulfoxaflor 24SC (2.10%) found significantly at par with the check. but rest of the treatments viz. Acephate 75SP (2.71%), Trizophos 40EC (3.18%), Buprofezin 25SC (3.35%) and Dinotefuron 20SG (3.58%) found least effective and significantly lower than the check (Table 3). However, the highest deadheart per cent was recorded in untreated control check (6.19%). (Table 3).

Among the entire insecticidal treatments efficacy against Dark headed stem borer, Imidacloprid 17.8SL (1.62%) and Thiamethoxam 25SL (1.84%) was found to be most effective in reducing deadheart incidence over the standard check Monocrotophos 36SL (2.18%). The treatment Sulfoxaflor 24SC (2.68%) found significantly at par with the check. but rest of the treatments viz. Acephate 75SP (3.40%), Trizophos 40EC (4.10%), Buprofezin 25SC (4.65%) and Dinotefuron 20SG (5.10%) found least effective and significantly lower than the check (Table 3). However, the highest deadheart per cent was recorded in untreated control check (6.372%). (Table 3). Similar have reported by Sharanappa *et al.* (2017)

Among all treatments Imidacloprid 17.8SC and (8.58%) Thiamethoxam 25WG (9.33%) recorded lowest white earhead per cent, which was significantly superior over all treatment and followed by Trizophos 40EC (13.13%) and Sulfoxaflor 24SC (13.94%) were found at par with standared check Monocrotophos 36SL (112.86%). Rest of the treatments, Acephate 75SP (15.01%), Buprofezin 25SC (16.98%) and Dinotefuron 20SG (18.13%) were found lest effective among all treatments. However the highest white earhead percent was recorded in untreated control check (23.06%). (Table 3). Similar result was reported by Rath P.C (2015).

Table 1: Efficacy of newer insecticides against different Rice stem borers in rice cv. Rajendra Bagawati, during *Kharif*, 2016.

Treatment	Deadheart (%)																White earhead
	Yellow stem borer				Pink stem borer				White stem borer				Dark headed stem borer				
	1st Spray	2nd Spray	3rd Spray	Mean	1st Spray	2nd Spray	3rd Spray	Mean	1st Spray	2nd Spray	3rd Spray	Mean	1st Spray	2nd Spray	3rd Spray	Mean	
T1 Imidacloprid	4.66	5.46	3.31	4.47	0.97	2.80	0.66	1.47	1.10	2.10	1.01	1.40	1.56	2.11	1.51	1.72	8.89
T2 Thiamethoxam	5.32	6.06	4.16	5.18	1.50	2.93	1.13	1.85	1.28	2.28	1.11	1.55	1.66	2.64	1.63	1.97	9.86
T3 Sulfoxaflor	8.32	8.69	5.46	7.49	2.50	3.10	1.16	2.25	1.94	3.08	1.68	2.23	2.35	3.78	2.17	2.76	14.57
T4 Triazophos	9.07	9.87	6.46	8.46	3.23	3.93	1.93	3.03	3.05	3.81	2.98	3.28	4.04	5.18	3.57	4.26	13.77
T5 Dinotefuron	11.20	11.82	7.95	10.32	3.96	4.63	2.73	3.77	3.59	4.13	2.95	3.55	5.22	6.09	4.47	5.26	18.52
T6 Buprofezin	10.19	10.94	7.22	9.45	3.63	3.86	1.70	3.06	3.50	4.24	2.72	3.48	4.70	5.67	4.14	4.83	17.30
T7 Monocrotophos	7.79	8.08	5.29	7.05	1.86	2.93	1.93	2.24	1.31	2.67	1.20	1.72	2.03	2.68	1.96	2.22	13.22
T8 Acephate	8.77	9.30	5.92	7.99	2.90	3.13	1.60	2.54	2.58	3.56	2.02	2.72	3.25	4.18	2.88	3.43	15.43
T9 Untreated control	18.46	20.10	11.81	16.79	5.16	6.06	3.46	4.89	6.63	7.18	5.05	6.28	6.70	7.38	5.20	6.42	23.98
CD (<0.05)	1.28	1.33	1.70	1.43	0.98	0.68	0.57	0.74	0.76	0.55	0.64	0.65	0.72	0.81	0.69	0.74	1.80
SEm (±)	0.42	0.44	0.56	0.47	0.32	0.22	0.19	0.24	0.25	0.18	0.21	0.21	0.24	0.26	0.22	0.24	0.59
CV (%)	7.91	7.63	15.21	10.25	19.64	10.82	18.39	16.28	15.58	8.59	16.10	13.42	11.86	10.50	13.15	11.83	6.85

Table 2: Efficacy of newer insecticides against different Rice stem borers in rice cv. Rajendra Bagawati, during *Kharif*, 2017.

Treatment	Deadheart (%)																White earhead
	Yellow stem borer				Pink stem borer				White stem borer				Dark headed stem borer				
	1st Spray	2nd Spray	3rd Spray	Mean	1st Spray	2nd Spray	3rd Spray	Mean	1st Spray	2nd Spray	3rd Spray	Mean	1st Spray	2nd Spray	3rd Spray	Mean	
T1 Imidacloprid	3.94	4.76	3.12	3.94	0.83	2.50	0.50	1.27	0.99	1.91	0.92	1.27	1.36	2.09	1.13	1.52	8.27
T2 Thiamethoxam	4.46	5.66	4.00	4.70	1.01	2.58	1.03	1.54	1.16	2.17	1.11	1.48	1.58	2.21	1.36	1.71	8.80
T3 Sulfoxaflor	7.79	7.87	5.10	6.92	2.03	2.93	1.23	2.06	1.56	3.03	1.32	1.97	2.29	3.35	2.16	2.60	13.30
T4 Triazophos	8.18	8.55	5.98	7.57	2.56	3.33	1.53	2.47	2.96	4.07	2.26	3.09	4.08	4.10	3.62	3.94	12.70
T5 Dinotefuron	10.62	11.03	7.14	9.59	3.26	4.23	2.40	3.29	3.40	4.54	2.89	3.61	5.15	5.58	4.14	4.95	17.75
T6 Buprofezin	9.80	10.10	6.81	8.90	3.23	3.56	1.76	2.85	3.02	4.11	2.57	3.23	4.64	5.15	3.64	4.47	16.67
T7 Monocrotophos	6.93	7.56	4.78	6.42	1.33	2.63	1.06	1.67	1.23	2.54	1.16	1.64	2.06	2.51	1.86	2.14	12.50
T8 Acephate	8.05	8.35	5.26	7.22	2.33	3.03	1.30	2.22	2.32	3.79	2.00	2.70	3.13	4.10	2.91	3.38	14.59
T9 Untreated control	16.13	19.41	10.26	15.26	4.53	4.13	3.23	3.96	6.40	7.11	4.80	6.10	6.49	7.29	5.19	6.32	22.14
CD (<0.05)	1.29	1.08	0.88	1.08	0.60	0.91	0.23	0.58	0.69	0.85	0.67	0.73	1.10	0.89	0.74	0.91	1.53
SEm (±)	0.42	0.36	0.27	0.35	0.19	0.30	0.07	0.18	0.23	0.28	0.22	0.24	0.36	0.29	0.24	0.29	0.50
CV (%)	8.78	6.73	8.18	7.90	14.62	15.73	8.54	12.96	15.53	13.18	18.25	15.65	18.45	12.06	14.56	15.02	6.22

Table 3: Efficacy of newer insecticides against different Rice stem borers in rice cv. Rajendra Bagawati. (Pooled mean of *Kharif*, 2016 and 2017).

Treatments	Dose (g or ml/ha	Yelow Stem Borer	Pink stem borer	White Stem Borer	Dark headed stem borer	White ear head
		DH (%)	DH (%)	DH (%)	DH (%)	(%)
T1 Imidacloprid 17.8 SC	110	4.20	1.37	1.33	1.62	8.58
T2 Thiamethoxam 25 WG	100	4.94	1.69	1.51	1.84	9.33
T3 Sulfoxaflor 24 SC	150	7.20	2.15	2.10	2.68	13.94
T4 Triazophos 40 EC	700	8.01	2.75	3.18	4.10	13.23
T5 Dinotefuron 20 SG	200	9.95	3.53	3.58	5.10	18.13
T6 Buprofezin 25 SC	700	9.17	2.95	3.35	4.65	16.98
T7 Monocrotophos 36 SL	1250	6.73	1.95	1.68	2.18	12.86
T8 Acephate 75 SP	800	7.60	2.38	2.71	3.40	15.01
T9 Untreated control	400-700L/ha	16.02	4.42	6.19	6.37	23.06
CD (<0.05)		1.16	1.25	0.66	0.69	0.82
SEm±		0.37	0.41	0.21	0.22	0.62
CV (%)		8.37	9.07	14.62	14.53	13.42

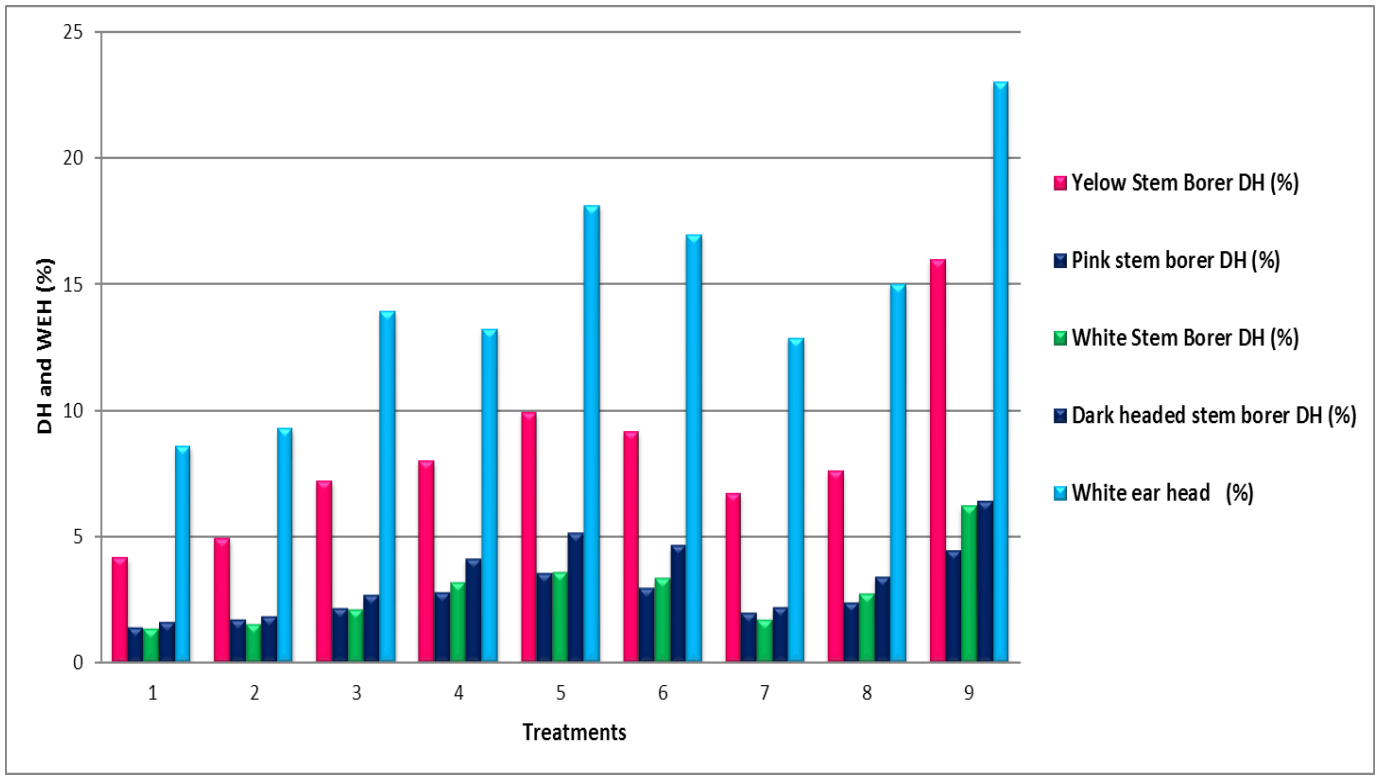

Fig 1: Efficacy of newer insecticides against different Rice stem borers in rice cv. Rajendra Bagawati. (Pooled mean of *Kharif*, 2016 and 2017).

4. Conclusion

Overall performance of all insecticidal treatments were superior in reducing the deadheart and white earhead in all borers overs the untreated control check. Among all treatments Imidacloprid 17.8SC, Thiamethoxam 25WG and Monocrotophos 36SL found most effective in reducing per cent deadheart and white earhead of all borers. The treatments Sulfoxafor 24SC, Acephate 75SP Trizophos 40EC and Buprofenzin 25SC were also found effective against all the borers to reducing deadheart and white earhead per cent over the untreated control check but among all the treatments Dinotefuron 20SG found least effective against borers.

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