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Efficacy of Insecticides Against Yellow Stem Borer (*Scirpophaga incertulas* Walker) and Rice Leaf Folder (*Cnaphaocrocis medinalis* Guenee) and Their Impact on Natural Enemies in Rice Ecosystem

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at AAU-Assam Rice Research Institute, Titabor to test the efficacy of some insecticides against yellow stem borer and rice leaf folder. Out of 8 tested insecticides, Chlorantraniliprole 18.5 SC showed the best result in minimizing yellow stem borer and rice leaf

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folder infestation. The lowest infestation percentage of yellow stem borer (2.10%) was observed on Chlorantraniliprole 18.5 SC treated plots followed by treatment with Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC (2.33 %) at 7 DAT. Similarly, white ear head (0.33%) was also recorded as the lowest on Chlorantraniliprole 18.5 SC treated plots. Chlorantraniliprole 18.5 SC recorded the lowest infestation percentage of rice leaf folder at 7 DAT (3.40 %) and 14 DAT (3.53 %) followed by Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC. While, the highest number of spiders and coccinellids were recorded in Chlorantraniliprole 0.4GR (2.43 spider/plant and 1.33 coccinellids/plant) followed by Thiamethoxam 25WG (2.13 spiders/plant and 1.10 coccinellids/plant). In terms of yield, Chlorantraniliprole 18.5 SC was found to be the best insecticide which provided the highest yield of 5.83t/ha among all the tested insecticides.

Keywords: Efficacy; insecticides; rice; natural enemies; yellow stem borer; leaf folder.

1. INTRODUCTION

Being situated in the centre of origin, The agroclimatic and physiographic conditions of Assam present significant potential for rice cultivation in the state. However, several yield-limiting factors are associated with rice production among which insect pests play a vital role. Though the rice ecosystem is a habitat for several species of herbivores, the potential insect pest of rice in Assam are yellow stem borer (*Scirpophaga incertulas*), white stem borer (*S. innotata*), rice hispa (*Dicladispa armigera*), rice gundhi bug (*Leptocorisa* spp.), leaf folder (*Cnaphalocrocis medinalis*), caseworm (*Nymphula depunctalis*), brown plant hopper (*Nilaparbvata lugens*) and thrips (*Stenchaetothrips biformis*) [1]. Seven pest species viz., *S. incertulas*, *C. medinalis*, *Mythimna separate*, *Leptocorisa* spp., *Nilaparbvata lugens*, *Nephotettix nigropictus*, *Nephotettix virescence* were recorded as major pest of rice out of which *S. incertulas* and *C. medinalis* were found to be the highly abundant and dominant species in Assam [2]. Stem borers attack rice crops from seedling to the maturity stage and it is difficult to manage due to their cryptic behavior and nocturnal habit [3]. In Asia, damages caused by yellow stem borer and striped stem borer (*Chilo suppressalis*) amounted to 5-10 per cent, with local catastrophic outbreaks causing up to 60 percent damage [4, 5]. The second dominant pest, rice leaf folder starts soon after the establishment of the crop in the main field and its occurrence was observed till 105 days after transplanting [6]. Leaf folder infestation leads to as high as 60-70 percent leaf damage inflicting yield loss of upto 80 percent [7].

Though different pest control tactics are available for rice pest management, chemical insecticides play a major role as they are easily available, easy to use, and provide satisfactory results in less time. However, large quantities of insecticide molecules are available in the market. Therefore, the present study was conducted to evaluate the efficacy of some insecticide molecules on the major lepidopteran pest of rice viz., yellow stem borer and rice leaf folder, and to study their impact on natural enemies. Pesticides play a vital role in the management of the yellow stem borer and leaf folder in rice cultivation by offering a direct means of controlling the pest population, thereby substantially mitigating yield losses resulting from the borer's infestation of the rice plant. This, in turn, safeguards crop productivity and secures farmer income. Nonetheless, the use of pesticides requires careful monitoring and integration with other pest management strategies to minimize potential environmental impact. This article provides valuable insights into using effective pesticides to manage the Yellow stem borer and Rice leaf folder and minimizing their impact on natural enemies in the rice ecosystem.

2. MATERIALS AND METHODS

2.1 Experimental Site and Layout

The experiment was conducted in the experimental farm of AAU-Assam Rice Research Institute, Titabor, Jorhat, Assam during the kharif seasons of 2020 and 2021. The experimental site is situated at 26°35′N latitude, 28°10′E longitude having an elevation of 99.4 metres above mean sea level. The climatic condition of Titabar is subtropical humid with a hot summer and cold winter. The experiment was laid out in randomized block design with three replications and 9 treatments including control and the mega rice variety of Assam, Ranjit was taken for the study. Treatments were T_1= Flubendiamide 39.35 SC, T_2= Chlorantraniliprole 18.5 SC, T_3= Chlorantraniliprole 0.4 GR, T_4=

Table 1. Details of treatments

Treatment	Common name	Trade name	ai/ha	Formulation/ha
T_1	Flubendiamide 39.35 SC	Fame	24	50ml
T_2	Chlorantraniliprole 18.5 SC	Coragen	30	150ml
T_3	Chlorantraniliprole 0.4 GR	Ferterra	40	10kg
T_4	Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC	Ampligo	37.5	250ml
T_5	Thiamethoxam (12.6%) + Lambda cyhalothrin (9.5%) ZC	Alika	44	200ml
T_6	Profenofos 40% + Cypermethrin 4% E.C.	Profex Super	440	1000 ml
T_7	Thiamethoxam 25 WG	Actara	30	120g
T_8	Cartap hydrochloride 50SP (Check)	Caldan	500	1000ml
T_9	Control			

Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC, T_5= Thiamethoxam (12.6%) + Lambda cyhalothrin (9.5%) ZC, T_6= Profenofos 40% + Cypermethrin 4% EC, T_7= Thiamethoxam 25 WG, T_8= Cartap hydrochloride 50 SP and T_9=Control (Table 1). The crop was sown on 3rd week of June and transplanting was done on 3rd week of July for both the seasons. Crop was grown by following the recommended package of practices for kharif rice in Assam [8]. The treatments were applied 30 days after transplanting during morning time and only a single spraying was advocated.

2.2 Statistical Analysis and Observations

Observations were recorded by following standard observation procedures at 1 day before treatment (DBT), 3 days after treatment (DAT), 7 DAT and 14 DAT at randomly selected 10 hills to record the pest incidence after treatments. For stem borer, dead heart was counted at tillering stage and white ear head was counted at crop maturity stage.

Stem borer infestation percentage was calculated at by-

Dead heart = Infested tillers / Total tillers × 100

White ear head = No. of White panicles / Total Number of panicles × 100

Similarly, rice leaf folder infestation was calculated by-

Leaf folder infestation percentage = Number of folded leaves / Total number of leaves x 100

The natural enemies viz., spiders and coccinellids were counted on 10 randomly selected plant and their numbers were recorded 1DBT and 5DAT to determine the impact of insecticides on them. Data were analyzed using analysis of variance (ANOVA) with SPSS and treatments means were separated at 5 percent level of significance.

3. RESULTS AND DISCUSSION

3.1 Efficacy of Insecticides Against Yellow Stem Borer and Rice Leaf Folder

The efficacy of 8 insecticides was tested against yellow stem borer and rice leaf folder. Before treatment, stem borer infestation percentage ranged from 4.3 to 5.2 among the treatments. No significant difference was observed at 3DAT. At 7DAT, all insecticides demonstrated a significant reduction in infestation percentage compared to the control (Table 2). The lowest infestation percentage (2.10%) of yellow stem borer was observed on Chlorantraniliprole 18.5SC treated plots followed by treatment with Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC (2.33 %) and Thiamethoxam (12.6%) + Lambda cyhalothrin (9.5%) ZC (2.50 %) at 7DAT. At 14 DAT, the infestation again started to increase in all the treatments. The lowest infestation percentage was observed in Chlorantraniliprole 18.5 SC (2.47 %) followed by Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC (2.60 %) Chlorantraniliprole 0.4GR (2.67%) at 14 DAT. White ear heads (WEH) were recorded at the crop maturity stage and the lowest WEH was recorded on Chlorantraniliprole 18.5 SC (0.33 %), Chlorantraniliprole 0.4GR (0.33%) followed by Chlorantraniliprole 10% +

Lambda Cyhalothrin 5% ZC (0.67 %) and Flubendiamide 39.35 SC (0.67 %). While, pre-treatment count in the case of rice leaf folder, the infestation percentage ranges from 6.10% to 7.63% (Table 3). After treatment, chlorantraniliprole 18.5 SC recorded the lowest infestation percentage at 7 DAT (3.40 %) and 14 DAT (3.53 %) followed by Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC. Chlorantraniliprole 18.5 SC was found to be superior among 5 tested insecticides against stem borer and leaf folder at Pattambi, Kerala [9]. A similar observation was also recorded in Tamil Nadu where Chlorantraniliprole 18.5 SC was recorded as the best insecticide for minimizing rice hispa, whorl maggot, and black bug infestation on rice crops [10]. A minimum yellow stem borer infestation percentage was recorded in treatment with chlorantraniliprole 18.5 SC at Meerut, Uttar Pradesh [10].

Table 2. Effect of insecticides on stem borer incidence

Treatments	Chemicals	Infestation percentage (%)				
		Pre-treatment	3DAT	7DAT	14DAT	WEH
T_1	Flubendiamide 39.35 sc	4.6	4.07	2.67	2.80	0.67
T_2	Chlorantraniliprole 18.5sc	4.7	4.20	2.10	2.47	0.33
T_3	Chlorantraniliprole 0.4GR	5.0	4.30	2.53	2.67	0.33
T_4	Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC	5.2	4.17	2.33	2.60	0.67
T_5	Thiamethoxam (12.6%) + Lambda cyhalothrin (9.5%) ZC	4.5	4.20	2.50	3.37	1.00
T_6	Profenofos 40% + Cypermethrin 4% E.C.	4.9	4.27	3.07	3.80	1.33
T_7	Thiamethoxam 25 WG	5.1	4.67	3.13	3.93	1.67
T_8	Cartap hydrochloride 50SP	4.6	4.23	3.20	3.70	1.33
T_9	Control	4.3	4.63	4.80	5.00	2.00
	C.V.	12.53	10.98	15.16	11.90	68.81
	C.D. at 5%		0.81	0.77	0.69	1.23

Table 3. Effect of insecticides on leaf folder incidence

Treatments	Chemicals	Infestation percentage (%)			
		Pre-treatment	3DAT	7DAT	14DAT
T_1	Flubendiamide 39.35 sc	7.30	5.43	3.80	4.40
T_2	Chlorantraniliprole 18.5sc	7.10	5.20	3.40	3.53
T_3	Chlorantraniliprole 0.4GR	6.83	5.47	4.63	4.93
T_4	Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC	6.87	5.13	3.47	3.70
T_5	Thiamethoxam (12.6%) + Lambda cyhalothrin (9.5%) ZC	6.33	5.33	3.83	4.83
T_6	Profenofos 40% + Cypermethrin 4% E.C.	7.00	5.73	3.90	5.10
T_7	Thiamethoxam 25 WG	6.10	5.77	5.00	5.70
T_8	Cartap hydrochloride 50SP	7.63	5.63	5.23	5.77
T_9	Control	6.80	6.93	7.57	8.00
	C.V.		9.05	6.57	5.08
	C.D. at 5%		0.88	0.52	0.44

Table 4. Effect of insecticides on spiders, coccinellids and grain yield

Treatments	Chemicals	Spiders (Number/hill)		Coccinellids (Number/hill)		Yield (tonnes/ha)
		Pre-treatment	5DAT	Pre treatment	5DAT	
T_1	Flubendiamide 39.35 sc	2.97	1.80	1.73	0.83	5.63
T_2	Chlorantraniliprole 18.5sc	2.53	1.93	1.63	0.93	5.83
T_3	Chlorantraniliprole 0.4GR	2.87	2.43	1.97	1.33	5.70
T_4	Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC	2.43	1.60	1.67	0.87	5.70
T_5	Thiamethoxam (12.6%) + Lambda cyhalothrin (9.5%) ZC	2.10	1.47	1.67	0.77	5.40
T_6	Profenofos 40% + Cypermethrin 4% E.C.	3.07	1.27	2.00	0.73	5.23
T_7	Thiamethoxam 25 WG	2.40	2.13	2.13	1.10	5.07
T_8	Cartap hydrochloride 50SP	2.90	1.33	1.87	0.80	5.03
T_9	Control	2.97	3.10	1.93	2.10	5.00
	C.V.		20.98		13.14	2.56
	C.D. at 5%		0.68		0.24	0.24

3.2 Impact of Insecticides on Natural Enemies and Grain Yield

While considering the natural enemies of rice insect pests, the highest number of spiders and coccinellids among the treatments were recorded in Chlorantraniliprole 0.4GR (2.43 spider/plant and 1.33 coccinellids/plant) followed by Thiamethoxam 25WG (2.13 spiders/plant and 1.10 coccinellids/plant) which was 3.1 spiders/plant and 2.10 coccinellids/plant in the untreated control at 5DAT (Table 4). A similar observation was also recorded in Haryana where Chlorantraniliprole 0.4GR was regarded as a safer insecticide against natural enemies in the rice ecosystem [11, 12]. A minimum reduction of spiders and coccinellids was recorded with Chlorantraniliprole 18.5sc among the tested insecticides in Tamil Nadu [10]. The highest yield was recorded in the treatment with Chlorantraniliprole 18.5sc (5.83 t/ha) followed by Chlorantraniliprole 10% + Lambda Cyhalothrin 5% ZC and Chlorantraniliprole 0.4GR treated plots (5.70 t/ha). Out of 7 tested insecticides, Chlorantraniliprole 18.5sc recorded the highest grain yield at Meerut, Uttar Pradesh [13]. A similar observation was also recorded in Gujrat where out of 6 insecticides, treatment with Chlorantraniliprole 18.5sc recorded the highest grain and straw yield [14].

4. CONCLUSION

The study results revealed that Chlorantraniliprole 18.5 SC has been proven to be a superior insecticide for effectively managing yellow stem borer and rice leaf folder while also increasing yield. The granular formulation of the same molecule (Chlorantraniliprole 0.4GR) was found more cautious against spiders and coccinellids which are major predators of rice insect pests.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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