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Efficacy of Chlorantraniliprole in Combination with Lambdacyhalothrin (Ampligo 150 ZC) Against the Leaf Folder, *Cnaphalocrocis medinalis* (Guenee) in Rice Field

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Rice is a cereal grain and a member of the grass family (Poaceae). One of the challenges faced by rice farmers is the infestation of pests, including the leaf folder (Cnaphalocrocis medinalis). A field experiment was conducted to assess the bio-efficacy of Chlorantraniliprole 9.3 + Lambda cyhalothrin 4.6 ZC against the rice leaf folder *Cnaphalocrocis medinalis* during the kharif season of 2020 and rabi season of 2021. The treatments included Chlorantraniliprole 9.3 + Lambda cyhalothrin 4.6 ZC at rates of 150, 200, and 250 ml per ha, Chlorantraniliprole 18.5 SC at 150 ml per ha, Lambda cyhalothrin 4.9 CS at 250 ml per ha, and Fipronil 5 SC at 1500 ml per ha. Analysis of pooled data revealed that all treatments were effective in controlling leaf folder damage, leading

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to a significant increase in yield. Among the tested chemicals, Chlorantraniliprole 9.3 + Lambda cyhalothrin 4.6 ZC at 250 and 200 ml per ha exhibited the highest reduction in leaf folder population, followed by Chlorantraniliprole 9.3 + Lambda cyhalothrin 4.6 ZC at 150 ml per ha and Chlorantraniliprole 18.5 SC at 150 ml per ha.

Keywords: Chlorantraniliprole 9.3 + lambda cyhalothrin 4.6 ZC; Chlorantraniliprole; fipronil; lambda cyhalothrin; leaf folder; rice.

1. INTRODUCTION

"Rice (*Oryza sativa* L.) is the world's most important cereal crop that belongs to the family Poaceae, providing food for nearly half of the global population" [1]. For centuries, this agricultural produce has been grown, significantly contributing not only to the provision of essential sustenance but also influencing the social and economic development of the nation [2]. The crop faces susceptibility to over 100 insect species, with 15-20 of them capable of inflicting economic damage, as reported by Heong and Hardy [3]. Additionally, research by Arora and Dhaliwal [4] indicates that "these insects contribute to yield losses ranging from 21 to 51 percent". "The main rice pests that cause considerable economic losses are the yellow stem borer *Scirpophaga incertulas* (Walk.), and leaf folder *Cnaphalocrocis medinalis* (Guenee) brown plant hopper *Nilaparvata lugens* (Stal.) and rice gall midge *Orseolia oryzae* (Wood-Mason)" Kumar *et al.,* [5] Seni and Naik, [6]. Rice leaf folder is a major rice pest that is found throughout Asia (such as India, Pakistan, Bangladesh, Sri Lanka, China, Korea, Japan, the Philippines, and Indonesia; Hill, [7]. To mitigate insecticide resistance, it is recommended to use insecticides judiciously and rotate chemicals with distinct modes of action. The incorporation of newer insecticide molecules, featuring diversified modes of action against these pests, will play a crucial role in managing insecticide resistance effectively. Chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC (Ampligo 150 ZC) showed a superior performance on lepidoptera larvae. Ampligo is long lasting and works through ingestion, contact, ovicidal, larvicidal activity, high selectivity and low mammalian toxicity [8]. Considering the above in view, the present investigation was taken up to evaluate the chlorantraniliprole 9.3% + lambda cyahalothrin 4.6% ZC (Ampligo 150 ZC) insecticide against the major pests of rice.

2. MATERIALS AND METHODS

Field experiment was carried out at Kumarakudy village and Eastern block of Agronomy farm of PAJANCOA & RI, Karaikal, Puducherry during *kharif* 2020 and *rabi* 2021 respectively. The experiment was set up using a Randomized Block Design (RBD) with four replications, seven treatments in a 5 × 4 and 4 × 4 square meter plot during *kharif* and *rabi* season respectively. The treatments were chlorantraniliprole 9.3 + lambda cyhalothrin 4.6ZC at 250, 200, 150 ml per ha, chlorantraniliprole 18.5 SC atat150 ml per ha, lambda cyhalothrin 4.9 CS at 250 ml per ha, fipronil 5 SC at 1500 ml per ha and untreated check. Leaf damage caused by the Leaf folder, *C. medinalis* was assessed on ten randomly selected hills per plot. The observations were taken a day before spraying and at 3, 7 and 14 day after treatment (DAT). The per cent leaf damage was calculated. The percentage of leaf damage was calculated by using the formula.

Per cent incidence = Number of damaged leaves / Total number of leaves × 100

The mean data from the two field trials were analyzed statistically by ANOVA using the package AGRISTAT after converting it to arc sine transformation value.

3. RESULTS AND DISCUSSION

The results of the field experiment I conducted during *kharif* 2020, against the leaf folder *C. medinalis* are presented in the Table 1. Before the foliar application, the per cent leaf damage ranged from 9.88 to 11.10 per cent/hill.

"In the first foliar application, at 3 DAT the per cent leaf damage of treated plots ranged from 4.90 to 8.16 per cent/ hill compared to the untreated check (10.55%). Same trend was followed upto 7 DAT. At 14 DAT the per cent leaf damage was in an increasing trend and ranged from 6.09 to 9.20 per cent/hill compared to untreated check (11.61%)" [9]. In the first foliar application, before the foliar application the per the per cent leaf damage ranged from 4.76 to 9.29 per cent/hill in the insecticide treated plots compared to the untreated check (10.55 to 11.61%). The overall mean ranged from 5.25 to

8.47 per cent among the treated plots compared to the untreated check (10.92%). The overall percentage reduction varied between 24.43% and 51.92%, in comparison to the untreated control (Fig. 1 and 2). In the second foliar application, At 3 DAT the per cent leaf damage of treated plots ranged from 4.77 to 7.92 per cent/ hill compared to the untreated check (12.92%). Same trend was followed upto 7 DAT. At 14 DAT the per cent leaf damage was in an increasing trend and ranged from 6.11 to 8.69 per cent/hill compared to untreated check (13.06%). In the second foliar application, the per cent leaf damage ranged from 4.55 to 8.69 per cent/hill in the insecticide treated plots compared to the untreated check (12.09 to 13.06%). The overall mean ranged from 4.97 to 8.11 per cent among the treated plots compared to the untreated check (12.49%). The overall percentage reduction ranged from 35.08% to 60.16%, as compared to the untreated control (Fig. 1 and 2). In the third foliar application, at 3 DAT the per cent leaf damage of treated plots ranged from 3.28 to 7.94 per cent/ hill compared to the untreated check (13.17%). Same trend was followed upto 7 DAT. At 14 DAT the per cent leaf damage was in an increasing trend and ranged from 5.05 to 15.22 per cent/hill compared to untreated check (13.22%). In the third foliar application, the per cent leaf damage ranged from 2.14 to 9.00 per cent/hill in the insecticide treated plots compared to the untreated check (13.17 to 13.21%). The overall mean ranged from 3.49 to 7.83 per cent/hill among the treated plots compared to the untreated check (12.56%). The overall percentage reduction ranged from 43.64% to 74.88%, in comparison to the untreated control (Fig. 1 and 2).

The results of the field experiment II conducted during *rabi* 2021, against the leaf folder *C. medinalis* are presented in the Table 2 before the first foliar application the per cent leaf damage was ranged from 11.10 to 12.69 per cent/ hill. At 3 DAT the per cent leaf damage of treated plots ranged from 6.09 to 9.29 per cent/ hill compared to the untreated check (11.61%). Same trend was followed upto 7 DAT. At 14 DAT the per cent leaf damage was in an increasing trend and ranged from 5.52 to 10.34 per cent/hill compared to untreated check (12.42%). In the first foliar application, the per cent leaf damage ranged from 5.06 to 10.34 per cent/hill in the insecticide treated plots compared to the untreated check (11.61 to 12.42%). The overall mean ranged from 5.55 to 9.50 per cent/hill among the treated plots compared to the untreated check (12.00%). The overall percentage reduction ranged

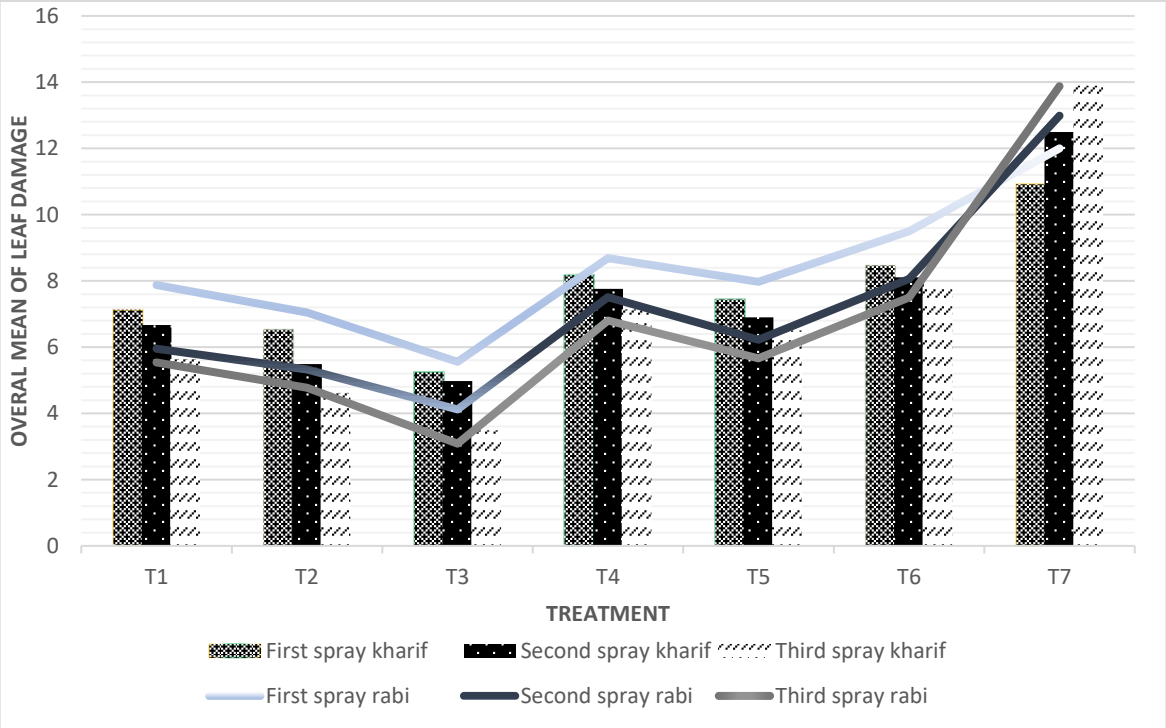

Fig. 1. Effect of newer insecticides against the leaf folder, Cnaphalocrocis medinalis during kharif 2020 & rabi 2021 based on mean leaf damage

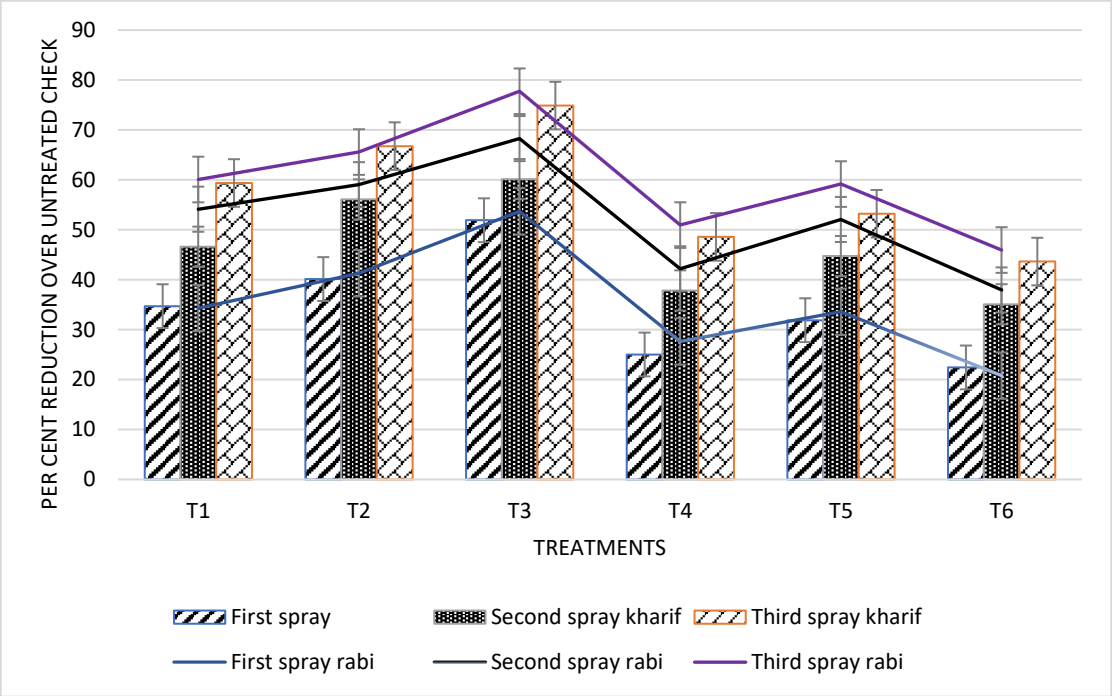

Fig. 2. Effect of newer insecticides against the leaf folder, Cnaphalocrocis medinalis during kharif 2020 & rabi 2021 based on per cent reduction over untreated check

from 20.80 % to 53.69%, in comparison to the untreated control (F%igure 1 and 2). In the second foliar application, at 3 DAT the per cent leaf damage of treated plots ranged from 3.36 to 8.14 per cent/ hill compared to the untreated check (12.80%). Same trend was followed upto 7 DAT. At 14 DAT the per cent leaf damage was in an increasing trend and ranged from 5.78 to 8.20 per cent/hill compared to untreated check (13.19%). In the second foliar application, the per cent leaf damage ranged from 3.22 to 8.20 per cent/hill in the insecticide treated plots compared to the untreated check (12.80 to 13.19%). The overall mean ranged from 4.12 to 8.05 per cent/hill among the treated plots compared to the untreated check (12.99 %). The overall percentage reduction ranged from 38.11% to 68.27% comparison to the untreated control (Fig.1 and 2). In the third foliar application, at 3 DAT the per cent leaf damage of treated plots ranged from 2.16 to 7.50 per cent/ hill compared to the untreated check (13.33%). Same trend was followed upto 7 DAT. At 14 DAT the per cent leaf damage was in an increasing trend and ranged from 4.90 to 7.78 per cent/hill compared to untreated check (14.88%). In the third foliar application, the per cent leaf damage ranged from 1.75 to 7.78 per cent/hill in the insecticide treated plots compared to the untreated check (11.33 to 14.88%). The overall mean ranged from 3.09 to 7.50 per cent/hill among the treated plots compared to the untreated check (13.88%). The overall percentage reduction ranged from 45.95% to 77.75% comparison to the untreated control (Fig. 1 and 2).

Chaudhari *et al*. [10] indicated that rynaxypyr 20 SC at a rate of 150 ml per ha proved to be the most effective treatment in reducing the incidence of the rice leaf folder *C. medinalis* in O. sativa, as compared to other newer insecticides. Subsequent research revealed that the application of spinetoram 0.8 GR at 70 g/ha resulted in complete control of leaf folder *C. medinalis* after 20 days, followed by spinetoram at 60 and 65 g/ha, which were comparable to the efficacy of chlorantraniliprole 0.4 G at 4 kg/ha Kumar *et al.,* [11]. Bhardwaj et al. [12] concluded that Chlorantraniliprole being a systemic insecticide is recommended for the management of the leaf folder, Cnaphalocrocis medinalis. Karthikeyan and Swathy [13] revealed that, the Chlorantraniliprole was the most effective insecticide against major pests of rice with leaf folder exhibiting 1.33% leaf damage. The current study aligns with and supports these previous findings.

Table 1. Effect of newer insecticides against the leaf folder, Cnaphalocrocis medinalis (Guenee) in rice (Kharif 2020)

Treatments	Per cent leaf damage/hill #												
		I Foliar application				II Foliar application				III Foliar application			
	Pre treatment count	3 DAT	7 DAT	14 DAT	Per cent reduction over untreated check	3 DAT	7 DAT	14 DAT	Per cent reduction over untreated check	3 DAT	7 DAT	14 DAT	Per cent reduction over untreated check
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @150 ml/ha	11.10	6.73 (15.02)^{bc}	6.66 (14.95)^{c}	8.00 (16.41)^{bc}	34.91	6.52 (14.79)^{c}	6.30 (14.54)^{b}	7.19 (15.55)^{c}	46.61	5.97 (14.13)^{c}	4.55 (12.31)^{b}	6.41 (14.64)^{c}	60.33
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 200 ml/ha	10.30	6.28 (14.51)^{b}	6.00 (14.16)^{b}	7.33 (15.69)^{b}	40.14	5.36 (13.39)^{b}	4.99 (12.89)^{a}	6.11 (14.30)^{b}	56.08	4.42 (12.12)^{b}	3.81 (11.20)^{b}	5.62 (13.71)^{b}	67.54
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 250 ml/ha	9.88	4.90 (12.77)^{a}	4.76 (12.60)^{a}	6.09 (14.26)^{a}	51.92	4.77 (12.61)^{a}	4.55 (12.31)^{a}	5.61 (13.69)^{a}	60.16	3.28 (10.42)^{a}	2.14 (8.31)^{a}	5.05 (13.04)^{a}	75.46
Lambda cyhalothrin 4.9 CS @ 250 ml/ha	10.77	7.86 (16.25)^{de}	7.84 (16.25)^{de}	8.86 (17.30)^{cd}	25.03	7.47 (15.85)^{de}	7.38 (15.76)^{c}	8.44 (16.88)^{d}	37.86	7.20 (15.55)^{d}	6.73 (15.03)^{cd}	7.50 (15.89)^{e}	49.79
Chlorantraniliprole 18.5 SC @ 150 ml/ha	10.04	7.19 (15.55)^{cd}	7.10 (15.46)^{cd}	8.02 (16.44)^{bc}	31.89	6.74 (15.04)^{cd}	6.49 (14.76)^{b}	7.48 (15.87)^{c}	44.74	6.69 (14.98)^{d}	5.94 (14.09)^{c}	6.87 (15.19)^{d}	54.31
Fipronil 5 SC @ 1500 ml/ha	10.61	8.16 (16.60)^{e}	7.96 (16.39)^{e}	9.29 (17.74)^{d}	22.43	7.92 (16.34)^{d}	7.72 (16.13)^{c}	8.69 (17.14)^{d}	35.08	7.94 (16.36)^{e}	7.50 (15.88)^{d}	8.05 (16.48)^{f}	44.96
Untreated check	10.56	10.55 (18.95)^{f}	10.60 (19.00)^{f}	11.61 (19.92)^{e}	-	12.09 (20.34)^{e}	12.33 (20.55)^{d}	13.06 (21.18)^{e}	-	13.17 (21.28)^{f}	14.29 (22.38)^{e}	15.22 (26.08)^{g}	-
CD (P = 0.05)	NS	0.76**	0.81**	1.07**	-	0.81**	0.63**	0.58**	-	1.08**	1.27**	0.67**	-

*** - Significant at P = 0.01 In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)*
 # Mean of 10 plants, Values in Parentheses are Arc sine transformed values
Mean of 4 replications, DAT – Days after treatment

Table 2. Effect of newer insecticides against the leaf folder, *Cnaphalocrocis medinalis* (Guenee) in rice (*Rabi 2021*)

Treatments	Per cent leaf damage/hill #												
	I Foliar application					II Foliar application				III Foliar application			
	Pre treatment count	3 DAT	7 DAT	14 DAT	Per cent reduction over untreated check	3 DAT	7 DAT	14 DAT	Per cent reduction over untreated check	3 DAT	7 DAT	14 DAT	Per cent reduction over untreated check
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @150 ml/ha	12.69	8.00 (16.41)^{bc}	7.50 (15.89)^{c}	8.14 (16.57)^{c}	34.33	6.03 (14.20)^{c}	5.70 (13.79)^{c}	6.14 (14.34)^{b}	54.13	5.28 (13.27)^{bc}	4.84 (12.69)^{bc}	6.50 (14.76)^{c}	60.08
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 200 ml/ha	12.52	7.33 (15.69)^{b}	6.58 (14.85)^{b}	7.22 (15.58)^{b}	41.30	5.08 (13.01)^{b}	4.77 (12.60)^{b}	6.11 (14.30)^{b}	59.88	4.47 (12.19)^{b}	4.17 (11.74)^{b}	5.69 (13.79)^{b}	65.557
Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC @ 250 ml/ha	11.16	6.09 (14.26)^{a}	5.06 (12.98)^{a}	5.52 (13.58)^{a}	53.69	3.36 (10.55)^{a}	3.22 (10.27)^{a}	5.78 (13.90)^{a}	68.27	2.61 (9.26)^{a}	1.75 (7.50)^{a}	4.90 (11.05)^{a}	77.75
Lambda cyhalothrin 4.9 CS @ 250 ml/ha	12.44	8.86 (17.30)^{cd}	8.36 (16.80)^{cd}	8.83 (17.28)^{d}	27.63	7.22 (15.59)^{d}	7.47 (15.86)^{d}	7.83 (16.24)^{d}	42.20	6.91 (15.23)^{d}	6.49 (14.76)^{de}	7.02 (15.36)^{d}	50.94
Chlorantraniliprole 18.5 SC @ 150 ml/ha	11.45	8.02 (16.44)^{bc}	7.69 (16.80)^{c}	8.20 (16.63)^{c}	33.58	6.25 (14.48)^{c}	6.00 (14.17)^{c}	6.42 (14.67)^{c}	52.08	5.61 (13.69)^{c}	5.39 (13.42)^{cd}	6.00 (14.18)^{c}	59.16
Fipronil 5 SC @ 1500 ml/ha	11.72	9.29 (17.74)^{d}	8.88 (17.33)^{d}	10.34 (18.75)^{e}	20.80	8.14 (16.58)^{e}	7.83 (16.25)^{d}	8.20 (16.57)^{e}	38.11	7.50 (15.87)^{d}	7.22 (15.58)^{e}	7.78 (16.19)^{e}	45.95
Untreated check	11.10	11.61 (19.92)^{e}	11.97 (20.24)^{e}	12.42 (20.63)^{f}	-	12.80 (20.96)^{f}	12.97 (21.11)^{e}	13.19 (21.29)^{f}	-	13.33 (21.41)^{e}	13.42 (21.49)^{f}	14.88 (23.87)^{f}	-
CD (P = 0.05)	NS	1.07**	1.01**	0.54**	-	0.75**	1.17**	0.71**	-	1.08**	1.36**	0.67**	-

** - Significant at P = 0.01 In a column mean followed by a common letter are not significantly different by DMRT (P=0.05)
# Mean of 10 plants, Values in Parentheses are Arc sine transformed values
Mean of 4 replications, DAT – Days after treatment

4. CONCLUSION

It was found that, the higher dose of the insecticidal treatment, chlorantraniliprole 9.3 + lambda cyhalothrin 4.6ZC at 250 ml per ha, effectively reduced the leaf folder population with highest grain yield and cost benefit ratio in with the reasons. It was concluded that the treatment with chlorantraniliprole 9.3 + lambda cyhalothrin 4.6ZC at 250 ml per ha was on par with 200 ml per ha, the dose of 200 ml per ha can recommended against the major pest of rice leaf folder.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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