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Evaluation of Newer Insecticide Molecules Aganist Rice Leaf Folder, *Cnaphalocrosis Medinalis* Guenee in Dry Direct Sowing Method of Rice Cultivation.

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ABSTRACT

A field trail was conducted at Agricultural College Farm, Bapatla during *kharif* 2017 to evaluate the efficacy of chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC, flubendiamide 19.92% + thiachloprid 19.92% SC, thiamethoxam 1% + chlorantraniliprole 0.5% GR, flubendiamide 39.35% SC, spinosad 45% SC, chlorantraniliprole 18.5% SC, cartap hydrochloride 50% SP against rice leaf folder in dry direct sowing method of rice cultivation. The data on mean percent leaf damage by leaf folder inferred that flubendiamide 39.35% SC @ 0.3 ml l^{-1} proved to be the most effective insecticide and superior over all other treatments by recording lowest (1.36) mean per cent leaf damage with 63.71 per cent reduction over control. The insecticides chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} and chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} found on par with flubendiamide 39.35% SC in suppressing the pest with 1.62 and 1.68 mean per cent leaf damage and 56.72, 54.80 per cent reduction over control respectively and these three insecticide treated plots recorded the highest grain yield.

Key words: *Dry direct sowing, Leaf folder, Flubendiamide, Rice*

Rice, Oryza sativa is the oldest domesticated grain (~10,000 years) and most widely distributed dietary staple in the world. Half of the world's population rely on *rice.* Different abiotic and biotic constraints effect rice production. Approximately 52% of the global production of rice is lost annually owing to the damage caused by biotic stresses, where 21% is attributed to the attack of insect pests (Yarasi *et al*., 2008). Among the insect pests, rice leaf folder was considered as major leaf feeding pest in the recent past though it was considered as a minor pest (Nanda *et al*., 2000). Every one per cent increase in leaf damage by leaf folder there would be a loss of 0.5 quintal paddy per hectare (Mishra 1995). Total insecticides usage in India for cultivation is around 52 per cent and rice crop alone accounts for 17 per cent of it (Shepard *et al*., 1993). The use of insecticides remains an important component and used as a last resort of Integrated Pest Management (IPM). Due to continuous usage, some of the conventional insecticides became ineffective, and hence continuous efforts should be made to generate information on the field efficacy of new generation low dose molecules with novel mode of action against the major insect pests of rice. Therefore the present investigation was carried out to evaluate new insecticide molecules against rice leaf folder in dry direct sowing method of rice.

MATERIALS AND METHODS

Field experiment was conducted in Agricultural College Farm, Bapatla during *kharif* 2017 in Randomised Block Design (RBD) with eight treatments including untreated control and replicated thrice. The insecticide treatments includes chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC, flubendiamide 19.92% + thiachloprid 19.92% SC, thiamethoxam 1% + chlorantraniliprole 0.5% GR, flubendiamide 39.35% SC, spinosad 45% SC, chlorantraniliprole 18.5% SC, cartap hydrochloride 50% SP along with untreated control.

Most popular variety of rice, BPT 5204 (Samba Mashuri) was sown directly in the main field by using tractor drawn seed drill with a plot of size 20 m^2 at spacing of 20 x 15 cm with recommended package of practices excluding plant protection. Irrigation was given after sowing in dry soil, a flush irrigation was given to wet the soil, from sowing to emergence. The soil was kept moist but not saturated to avoid seed rotting and then after irrigation was given whenever necessary. Sprayings were given by using a hand compression knapsack sprayer during morning hours. The required spray fluid per each plot is one litre. The plot in each treatment was sprayed with respective insecticides ensuring uniform coverage of insecticide. The treatments were imposed as and when the pest crossed ETL. The data on the per cent leaf damage by leaf folder, on 10 randomly selected hills from each plot were recorded at one day before the application of treatments, third, seventh and tenth day after application

of treatments. Finally mean per cent leaf damage per hill was calculated from the data obtained by adopting the following formula.

$$\text{Per cent damage} = \frac{\text{No. of damaged leaves per hill}}{\text{Total number of leaves per hill}} \times 100$$

Data on the per cent leaf damage by leaf folder were transformed into arc sine values. The data subjected to ANOVA in simple RBD analysis, mean values were compared by using DMRT (Duncan, 1951).

RESULTS AND DISCUSSIONS

A total of two sprayings were given at 30 days interval starting from 65 days after sowing as leaf folder reached the ETL. There was no significant difference in per cent leaf damage by rice leaf folder among the treatments before the application of treatments during both sprays. The data regarding the efficacy of insecticide treatments after first spray revealed that (Table 1) at 3 days after first spray flubendiamide 39.35% SC @ 0.3 ml l^{-1} was the most effective insecticide having the lowest (2.00) per cent leaf damage which was on par with chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} and chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} with 2.56 and 2.58 per cent leaf damage respectively. Similar trend was observed at 7 days after first spray flubendiamide 39.35% SC @ 0.3 ml l^{-1} was superior over other treatments having the lowest (1.52) per cent leaf damage and was on par with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} (1.64 per cent leaf damage) chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} (1.81 per cent leaf damage). However at ten days after first spray chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} was found to superior with the lowest (0.83) per cent leaf damage followed by flubendiamide 39.35% SC @ 0.3 ml l^{-1} (0.84%), chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} (0.94%). The mean efficacy after first spray inferred that flubendiamide 39.35% SC @ 0.3 ml l^{-1} was the most effective and superior over all other treatments with the lowest (1.45) mean per cent leaf damage with 65.14 per cent reduction over control and found on par with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1}, chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} which recorded 1.72, 1.73 mean per cent leaf damage and 58.65, 58.41 per cent reduction over control respectively.

The data regarding second spray (Table 2) revealed that at 3 days after second spray flubendiamide 39.35% SC @ 0.3 ml l^{-1} was found to be effective with the lowest (2.10) per cent leaf damage followed by chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} (2.62%) and chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} (2.72%). At 7 days after second spray flubendiamide 39.35% SC @ 0.3 ml l^{-1} was found to be effective with the lowest (1.14) per cent leaf damage which was on par with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} (1.24 per cent leaf damage). However, at ten days after second spray flubendiamide 39.35% SC @ 0.3 ml l^{-1} was superior over other treatments with the lowest (0.55) per cent leaf damage, which was on par with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} (0.68 per cent leaf damage) and chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} (0.70 per cent leaf damage). The mean efficacy after second spray inferred that flubendiamide 39.35% SC @ 0.3 ml l^{-1} was the most effective and superior over all other treatments by recording lowest (1.26) mean per cent leaf damage with 62.27 per cent reduction over control (Fig 4.10) and was on par with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1}, chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} which recorded 1.51, 1.63 mean per cent leaf damage and 54.79, 51.19 per cent reduction over control respectively.

The cumulative efficacy of two sprays (Table 3), inferred that flubendiamide 39.35% SC @ 0.3 ml l^{-1} to be the most effective and superior over all other treatments by recording lowest (1.36) mean per cent leaf damage with 63.71 per cent reduction over control and found on par with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} and chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} which recorded 1.62 and 1.68 mean per cent leaf damage and 56.72, 54.80 per cent reduction over control respectively.

The present observations on superiority of flubendiamide 39.35% SC @ 0.3 ml l^{-1} was in conformity with the findings of Suresh *et al.* (2011) who reported that flubendiamide treatment maintained the lowest per cent damaged leaves (5.31%) at 10 days after spray. Rajkumar (2010) also recorded lesser leaf folder incidence with 73.56 per cent population reduction over control with flubendamide 480 SC @ 0.2 ml l^{-1}. The present findings on chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1} are in corroboration with Swami *et al.* (2017) who reported that chlorantraniliprole 9.6% + lambda cyhalothrin 4.6% at 300 ml ha^{-1} showing lowest population of pod borer larvae with a mean of 3.65, 4.16, 2.25 and 2.16 larvae/ 10 plants at 7 and 14 days after first and second spray respectively. The present findings on chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} are in corroboration with Chanu and Sontakke (2015) who reported that

Table 1 Efficacy of new insecticide molecules against rice leaf folder, *C. medinalis* after first spray

T.NO.	INSECTICIDES	DOSE	Mean per cent leaf damage/hill					Reduction over control (%)
			1 DBS	3 DAS*	7 DAS*	10 DAS*	MEAN	
T1	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC (Ampligo)	0.8 ml l^{-1}	6.26	2.58	1.64	0.94	1.72	58.65
			(15.18)	$(10.69)^{abc}$	$(9.15)^{ab}$	$(7.83)^{a}$	$(9.22)^{a}$	
T2	Flubendiamide 19.92% + Thiachloprid 19.92% SC (Belt Expert)	0.5 ml l^{-1}	5.2	3.5	2.26	1.35	2.37	43.02
			(14.02)	$(12.00)^{bc}$	$(10.21)^{bcd}$	$(8.59)^{ab}$	$(10.27)^{b}$	
T3	Thiamethoxam 1% + Chlorantraniliprole 0.5% GR (Virtako)	2.5 kg ac^{-1}	5.91	3.65	2.63	1.35	2.54	38.94
			(14.76)	$(12.19)^{c}$	$(10.77)^{cd}$	$(8.68)^{ab}$	$(10.55)^{b}$	
T4	Flubendiamide 39.35% SC (Fame)	0.3 ml l^{-1}	5.97	2	1.52	0.84	1.45	65.14
			(14.91)	$(9.77)^{a}$	$(8.90)^{a}$	$(7.66)^{a}$	$(8.77)^{a}$	
T5	Spinosad 45% SC (Tracer)	0.3 ml l^{-1}	6.01	3.53	2.64	1.69	2.62	37.01
			(14.96)	$(12.02)^{bc}$	$(10.79)^{d}$	$(9.26)^{b}$	$(10.69)^{b}$	
T6	Chlorantraniliprole 18.5% SC (Coragen)	0.3 ml l^{-1}	6.03	2.56	1.81	0.83	1.73	58.41
			(15.00)	$(10.61)^{ab}$	$(9.47)^{abc}$	$(7.64)^{a}$	$(9.24)^{a}$	
T7	Cartap Hydrochloride 50% SP (Caldan)	2.0 gm l^{-1}	5.74	3.38	2.55	1.33	2.42	41.82
			(14.66)	$(11.84)^{bc}$	$(10.66)^{cd}$	$(8.62)^{ab}$	$(10.37)^{b}$	
T8	Untreated Control	-	5.74	5.89	3.83	2.76	4.16	-
			(14.64)	$(14.83)^{d}$	$(12.43)^{e}$	$(10.96)^{c}$	$(12.74)^{c}$	
	Fcal		NS	Sig	Sig	Sig	Sig	
	SEm±		0.81	0.51	0.43	0.43	0.31	
	CD (0.05)		2.46	1.56	1.3	1.31	0.93	
	CV (%)		9.51	7.59	7.23	8.62	5.19	

DBS- day before spray DAS*- days after spray
Figures in parentheses are Arc- sine transformed values
Mean with same letter are not significantly different at 5 % level.

Table 2. Efficacy of new insecticide molecules against rice leaf folder, *C. medinalis* after second spray

T.No	INSECTICIDES	DOSE	Mean per cent leaf damage/hill					Reduction over control (%)
			1 DBS	3 DAS*	7 DAS*	10 DAS*	MEAN	
T1	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC	0.8 ml l^{-1}	2.83	2.62	1.24	0.68	1.51	54.79
			(11.20)	$(10.76)^{ab}$	$(8.40)^{a}$	$(7.33)^{a}$	$(8.83)^{a}$	
T2	Flubendiamide 19.92% + Thiachloprid 19.92% SC (Belt	0.5 ml l^{-1}	3.06	2.84	1.94	1.36	2.05	38.62
			(11.39)	$(11.05)^{ab}$	$(9.67)^{bc}$	$(8.64)^{b}$	$(9.79)^{bc}$	
T3	Thiamethoxam 1% + Chlorantraniliprole 0.5% GR	2.5 kg ac^{-1}	3.00	2.9	2.36	1.55	2.27	32.03
			(11.28)	$(11.15)^{ab}$	$(10.37)^{cd}$	$(9.00)^{b}$	$(10.18)^{c}$	
T4	Flubendiamide 39.35% SC (Fame)	0.3 ml l^{-1}	2.75	2.1	1.14	0.55	1.26	62.27
			(10.93)	$(9.88)^{a}$	$(8.26)^{a}$	$(7.05)^{a}$	$(8.40)^{a}$	
T5	Spinosad 45% SC (Tracer)	0.3 ml l^{-1}	3.28	3.07	2.14	1.52	2.24	32.93
			(11.66)	$(11.41)^{b}$	$(10.02)^{bcd}$	$(8.95)^{b}$	$(10.13)^{c}$	
T6	Chlorantraniliprole 18.5% SC (Coragen)	0.3 ml l^{-1}	2.91	2.72	1.48	0.70	1.63	51.19
			(11.16)	$(10.91)^{ab}$	$(8.86)^{bc}$	$(7.37)^{a}$	$(9.05)^{ab}$	
T7	Cartap Hydrochloride 50% SP (Caldan)	2.0 gm l^{-1}	3.21	2.77	2.01	1.39	2.06	38.32
			(11.56)	$(10.99)^{ab}$	$(9.81)^{bc}$	$(8.74)^{b}$	$(9.84)^{c}$	
T8	Untreated Control	-	3.42	4.70	2.95	2.35	3.34	-
			(11.89)	$(13.49)^{c}$	$(11.23)^{d}$	$(10.34)^{c}$	$(11.69^{d}$	
	Fcal		NS	Sig	Sig	Sig	Sig	
	SEm±		0.6	0.48	0.41	0.41	0.25	
	CD (0.05)		1.83	1.44	1.24	1.24	0.75	
	CV (%)		9.18	7.34	7.42	8.39	4.42	

DBS- day before spray DAS*- days after spray
Figures in parentheses are Arc- sine transformed values
Mean with same letter are not significantly different at 5 % level.

Table 3. Cumulative efficacy of new insecticide molecules against rice leaf folder, *C. medinalis*

T.No.	Insecticides	Dose	Mean per cent leaf damage/hill			Reduction over control		
			First spray	Second spray	Cumulative mean	First spray	Second spray	Cumulative mean
T1	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC	0.8 ml l^{-1}	1.72	1.51	1.62	58.65	54.79	56.72
			(9.22)^{a}	(8.83)^{a}	(9.03)^{a}			
T2	Flubendiamide 19.92% + Thiachloprid 19.92% SC (Belt	0.5 ml l^{-1}	2.37	2.05	2.21	43.02	38.62	40.82
			(10.27)^{b}	(9.79)^{bc}	(10.03)^{b}			
T3	Thiamethoxam 1% + Chlorantraniliprole 0.5% GR (Virtako)	2.5 kg ac^{-1}	2.54	2.27	2.41	38.94	32.03	35.49
			(10.55)^{b}	(10.18)^{c}	(10.36)^{b}			
T4	Flubendiamide 39.35% SC (Fame)	0.3 ml l^{-1}	1.45	1.26	1.36	65.16	62.27	63.71
			(8.77)^{a}	(8.40)^{a}	(8.59)^{a}			
T5	Spinosad 45% SC (Tracer)	0.3 ml l^{-1}	2.62	2.24	2.43	37.01	32.93	34.97
			(10.69)^{b}	(10.13)^{c}	(10.41)^{b}			
T6	Chlorantraniliprole 18.5% SC (Coragen)	0.3 ml l^{-1}	1.73	1.63	1.68	58.41	51.19	54.8
			(9.24)^{a}	(9.05)^{ab}	(9.14)^{a}			
T7	Cartap Hydrochloride 50% SP (Caldan)	2.0 gm l^{-1}	2.42	2.06	2.24	41.82	38.32	40.07
			(10.37)^{b}	(9.84)^{c}	(10.11)^{b}			
T8	Untreated Control	-	4.16	3.34	3.75	-	-	-
			(12.74)^{c}	(11.69^{d}	(12.21)^{c}			
	Fcal		Sig	Sig	Sig			
	SEm±		0.31	0.25	0.19			
	CD (0.05)		0.93	0.75	0.59			
	CV (%)		5.19	4.42	3.35			

DBS- day before spray DAS*- days after spray
Figures in parentheses are Arc- sine transformed values
Mean with same letter are not significantly different at 5 % level.

Table 4. Efficacy of new insecticide molecules on grain yield of rice during *kharif* 2017

T.No.	Insecticides	Dose	Yield	Increase over control (%)
T1	Chlorantraniliprole 9.3% + Lambda cyhalothrin 4.6% ZC (Ampligo)	0.8 ml l^{-1}	7688.33^{a}	63.46
T2	Flubendiamide 19.92% + Thiachloprid 19.92% SC (Belt Expert)	0.5 ml l^{-1}	7059.17^{ab}	50.08
T3	Thiamethoxam 1% + Chlorantraniliprole 0.5% GR (Virtako)	2.5 kg ac^{-1}	6296.67^{b}	33.87
T4	Flubendiamide 39.35% SC (Fame)	0.3 ml l^{-1}	7729.17^{a}	64.33
T5	Spinosad 45% SC (Tracer)	0.3 ml l^{-1}	6405.00^{ab}	36.18
T6	Chlorantraniliprole 18.5% SC (Coragen)	0.3 ml l^{-1}	7598.33^{ab}	61.55
T7	Cartap Hydrochloride 50% SP (Caldan)	2.0 gm l^{-1}	6453.33^{ab}	37.2
T8	Untreated Control	-	4703.33^{c}	-
	Fcal		Sig	
	SEm±		440.84	
	CD (0.05)		1337.15	
	CV (%)		11.33	

Sig – Significant, Mean with same letter are not significantly different at 5 % level.

chlorantraniliprole 0.4 G and 18.5 SC @ 50g a.i. ha^{-1} to be the most effective in reducing the damage of leaf folder by 80.27 and 86.12 per cent reduction over control. Kumar (2014) also recorded that chlorantraniliprole @ 30 g a.i. ha^{-1} was superior in controlling leaf folder with more than 95 per cent reduction of leaf folder damage over untreated control.

In case of grain yield (**Table 4**), flubendiamide 39.35% SC @ 0.3 ml l^{-1}, chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% ZC @ 0.8 ml l^{-1}, chlorantraniliprole 18.5% SC @ 0.3 ml l^{-1} and flubendiamide 19.92% + thiachloprid 19.92% SC @ 0.5 ml l^{-1} recorded higher grain yield (7729.17 kg ha^{-1}, 7688.33 kg ha^{-1}, 7598.33 kg ha^{-1} and 7059.17 kg ha^{-1}) with 64.33, 63.46, 61.55 and 50.08 per cent increase over untreated control respectively.

CONCLUSIONS

Among the insecticides tested against rice leaf folder in dry direct sowing method of rice flubendiamide 39.35% SC @ 0.3 ml l^{-1} was found the most effective in reducing the leaf folder damage with 63.71 per cent reduction over control and also recorded 64.33% yield increase over control.

LITERATURE CITED

Chanu N Y and Sontakke B K 2015 Comparative efficacy of chlorantraniliprole and emamectin benzoate against rice leaf folder. *Indian Journal of Entomology*. 77 (3): 221-225.

Duncan D B 1951 A significance test for differences between ranked treatment means in an analysis of variance. *The Virginia Journal of Science*. 2: 171-189.

Kumar B V 2014 Impact of insecticides and botanicals on leaf folder and stem borer in the mid hill rainfed rice agro-ecosystem. *Indian Journal of Plant Protection*. 42 (4): 317-323.

Mishra B K 1995 Management of rice leaf folder in coastal belt of Orissa, Ph.D. Thesis, Orissa University of Agriculture and Technology, Bhubaneshwar, India.

Nanda U K, Mahapatro G K, Sahoo A and Mahapatra S C 2000 Rice Leaf folder: Integrated neem derivatives in its management. *Pestology*. 24 (7): 31-34.

Rajkumar Y 2010 Field efficacy of certain newer insecticides and their combination products against major insect pests of rice and their natural enemies. M.Sc (Ag.) Thesis. Acharya N. G. Ranga Agricultural University, Hyderabad, India.

Shepard B M, Khan Z R, Pathak M D and Heinrichs E A 1993 *Management of insect pests of rice in Asia*. CRC Handbook of Pest Management. CBS Publishers and Distributors., New Delhi. 3: Pp 255-278.

Suresh D K, Mahabaleshwar H, Nayaka G V, Vastrad S, Hugar P S and Basavanagoud K 2011 Evaluation of insecticides and bio-rationals against yellow stem borer and leaf folder on rice crop. *Karnataka Journal of Agricultural Science.* 24 (2): 244-246.

Swami H, Ameta O P and Lekha 2017 Bioefficacy of novel insecticides against pod borer, (*Helicoverpa armigera* Hubner) in pigeonpea. *Legume Research-An International Journal.* 40 (4): 756-761.

Yarasi B, Sadumpati V, Immanni C P, Vudem D R and Khareedu V R 2008 Transgenic rice expressing *Allium sativum* Leaf Agglutinin (ASAL) exhibits high level of resistance against major sap sucking pests. *BMC Plant Biology.* 8:

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