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Efficacy of insecticides against rice leaf folder, *Cnaphalocrocis medinalis* (Guenee)

MB Zala and SA Sipai

Abstract
Field experiments were carried out to evaluate the efficacy of different insecticides at different doses against leaf folder, *Cnaphalocrocis medinalis* (Guenee) infesting paddy at Agricultural Research Station, Anand Agricultural University, Sansoli (Gujarat) during *kharif*, 2018 and 2019. The application of flubendiamide 20 WG @ 25 g a.i./ ha recorded the lowest (12.51% leaf damage) incidence of *C. medinalis* and it was at par with thiodicarb 75 WP @ 783.33 g a. i. /ha (13.27%) in controlling the pest which also reflected on grain and straw yield of paddy and did not have any significant effect on the spiders population in the paddy field when applied at evaluated doses.

Keywords: paddy, *Cnaphalocrocis medinalis*, flubendiamide, emamectin benzoate, thiodicarb, yield

Introduction
Rice (*Oryza sativa* L.) is one of the most important cereal crops of India and is staple food of more than 65 per cent of its population. In order to increase rice production, farmers are using modern varieties of rice, along with intensive use of fertilizers, pesticides, water and other technologies which have changed the ecology and escalated pest proliferation (Parveen, 2010) [7]. The rice crop can be attacked by more than 100 species of insects and 20 of them can cause serious economic loss (Heinrichs *et al*., 2017) [5]. Yield loss due to insect pests of rice has been estimated about 25% (Dhaliwal *et al*., 2010) [4]. Leaf folder, *Cnaphalocrocis medinalis* (Guenee) is one of the major devastator which is responsible for economic crop losses as this pest attack the crop from the seedling to the harvesting stage and thus causes considerable qualitative and quantitative yield losses. Outbreak of this pest habitually leads to entire loss of the rice crop, if no effectual control measures are taken up. Rice leaf folder is a lepidopteran insect pest and caterpillar is the only damaging stage. The young larvae feed on open leaves but later feed inside the rolled leaf formed by folding the leaf longitudinally with a sticky substance. The larvae scrape the green tissues of the leaves and cause scorching and leaf drying. Each larva is capable of destroying several leaves by its feeding. This activity disturbs the photosynthesis and plant growth and ultimately yield is reduced (Shaki *et al*., 2020) [10].
Chemical control is still considered as the first line of defense in rice pest management. Use of insecticides has a positive impact on rice yields and insecticides are often highly effective, fast-acting, convenient and economical, making them the most powerful tools in pest management (Chakraborty, 2012; Abro *et al*., 2013) [2, 1]. Farmers, due to inadequate knowledge habitually apply hazardous insecticides in high quantum without any concern to the actual level of field requirement. Such injudicious input, consequences like insecticide resistance, resurgence, secondary pest outbreak, environmental contamination, persistent residual toxicity and reduction in the biodiversity of natural enemies are observed in many cases. Considering above consequences, a study was conducted to assess the efficacy of different insecticides at different doses against *C. medinalis* infesting paddy.

Materials and Methods
In order to study the efficacy of different insecticides at different doses on *C. medinalis* infesting paddy, field experiments were conducted at Agricultural Research Station, Anand Agricultural University, Sansoli (Gujarat) during *kharif*, 2018 and 2019. The experiment was laid down in Randomized Block Design with eight treatments including control and three replications.

Treatment details

Tr. No.	Treatments	Conc. (%)	g a. i. /ha	Dose (g/ha)
T_1	Emamectin benzoate 5 SG	0.0019	9.5	190
T_2	Emamectin benzoate 5 SG	0.0025	12.66	253.20
T_3	Emamectin benzoate 5 SG	0.0031	15.83	316.60
T_4	Thiodicarb 75 WP	0.093	470	625
T_5	Thiodicarb 75 WP	0.12	626.66	832.32
T_6	Thiodicarb 75 WP	0.15	783.33	1041.66
T_7	Flubendiamide 20 WG	0.005	75	375
T_8	Control	-	-	-

Rice variety GR 11 was raised by following standard agronomical practices with a spacing of 20 cm between two rows and 15 cm within the row in gross and net area of 7.50 x 4.00 m and 7.20 x 3.60 m, respectively. The spray application of respective insecticides was given at 30 and 45 days of transplanting. The leaf folder damaged and healthy leaves were counted from 5 randomly selected hills from each net plot prior and 3, 7 and 10 days of spray. The observations on spiders were also recorded on 5 randomly selected hills/ net plot prior and 3, 7 and 10 days of spray.

The grain and straw yield were recorded from each net plot and converted into q/ha. The data obtained thus, were subjected to statistical analysis after appropriate transformation to draw valid conclusion as per Steel and Torrie (1980) [11].

Results and Discussion

Leaf damage (%) due to leaf folder, *C. medinalis*

First year (2018)

Pooled over periods and sprays results indicated that all the insecticidal treatments found significantly superior to untreated control (Table 1). The lowest (12.24 % leaf damage) *C. medinalis* incidence was found in the plots treated with flubendiamide 20 WG @ 25 g a.i./ ha followed by thiodicarb 75 WP @ 783.33 g a. i. /ha (13.28 % leaf damage). The plots treated with emamectin benzoate 5 SG @ 9.5 g a. i. /ha and emamectin benzoate 5 SG @ 12.66 g a. i. /ha found relatively less effective in controlling the *C. medinalis* incidence by recording higher leaf damage, 17.24 and 16.18%, respectively.

Second year (2019)

Pooled over periods and sprays results indicated that all the insecticidal treatments found significantly superior to untreated control (Table 2). The plots treated with flubendiamide 20 WG @ 25 g a.i./ ha recorded lowest (12.78 % leaf damage) *C. medinalis* incidence followed by thiodicarb 75 WP @ 783.33 g a. i. /ha (13.27 % leaf damage). The plots treated with emamectin benzoate 5 SG @ 9.5 g a. i. /ha (18.53%) and emamectin benzoate 5 SG @ 12.66 g a. i. /ha (18.18 %) recorded the highest *C. medinalis* incidence and proved most inferior treatments in controlling the pest.

Pooled over years

Pooled over periods, sprays as well as years results indicated that the plots treated with flubendiamide 20 WG @ 25 g a.i./ ha recorded the lowest (12.51% leaf damage) incidence of *C. medinalis* and it was at par with thiodicarb 75 WP @ 783.33 g a. i. /ha (13.27%) in controlling the pest (Table 2). Emamectin benzoate 5 SG @ 15.83 g a. i. /ha, thiodicarb 75 WP @ 470 g a. i. /ha and thiodicarb 75 WP @ 626.66 g a. i. /ha were found mediocre in terms of effectiveness against the pest. Of the evaluated insecticides, emamectin benzoate 5 SG @ 9.5 g a. i. /ha (17.87%) and emamectin benzoate 5 SG @ 12.66 g a. i. /ha (17.12%) were found most inferior treatments by recording the highest *C. medinalis* incidence.

The present findings are in agreement with the results of Sekh *et al*. (2007) [9], Kulagod *et al*. (2011) [6], Sandhu and Dhaliwal (2016) [8] and Chhavi *et al*. (2018) [3] opined that flubendiamide proved to be highly effective against paddy leaf folder. Kulagod *et al*. (2011) [6] reported moderate efficacy of thiodicarb 75 WP against paddy leaf folder.

Spiders

The insecticidal treatments had no any significant effect on spiders as the population of predatory spiders was found more or less same in untreated and treated plots in pooled over periods, sprays and years results as treatment difference was non-significant (Table 3 and 4).

Table 1: Effect of different insecticides against leaf folder, *C. medinalis* in rice (*Kharif*, 2018)

Tr. No.	Treatments	Leaf damage (%) days after spray										
		Before spray	First spray				Before spray	Second spray				Pooled over periods and sprays
			3	7	10	Pooled over periods		3	7	10	Pooled over periods	
1	Emamectin benzoate 5 SG @ 9.5 g a. i. /ha	16.35 (7.92)	19.00^{a} (10.60)	20.51^{b} (12.28)	21.82^{c} (13.82)	20.44^{d} (12.20)	26.27 (19.59)	27.70^{c} (21.61)	28.55^{d} (22.84)	29.61^{c} (24.41)	28.62^{e} (22.94)	24.53^{e} (17.24)
2	Emamectin benzoate 5 SG @ 12.66 g a. i. /ha	15.88 (7.49)	18.51^{a} (10.08)	19.62^{ab} (11.27)	21.15^{bc} (13.02)	19.76^{cd} (11.43)	25.64 (18.72)	26.67^{bc} (20.15)	27.98^{cd} (22.01)	28.41^{bc} (22.64)	27.69^{de} (21.59)	23.72^{de} (16.18)
3	Emamectin benzoate 5 SG @ 15.83 g a. i. /ha	17.13 (8.68)	17.59^{a} (9.13)	18.37^{ab} (9.93)	19.09^{abc} (10.70)	18.35^{abc} (9.91)	24.14 (16.73)	24.64^{ab} (17.38)	25.30^{abc} (18.26)	26.10^{ab} (19.35)	25.35^{bc} (18.33)	21.85^{bc} (13.85)
4	Thiodicarb 75 WP @ 470 g a. i. /ha	16.91 (8.46)	18.11^{a} (9.66)	19.26^{ab} (10.88)	20.29^{abc} (12.03)	19.22^{bcd} (10.84)	25.20 (18.13)	26.06^{bc} (19.30)	26.88^{bcd} (20.44)	27.74^{bc} (21.67)	26.89^{d} (20.46)	23.00^{d} (15.27)
5	Thiodicarb 75 WP	17.04	17.87^{a}	18.81^{ab}	19.98^{abc}	18.89^{bcd}	24.74	25.51^{bc}	26.62^{bcd}	27.44^{bc}	26.52^{cd}	22.76^{cd}

	@ 626.66 g a. i. /ha	(8.59)	(9.42)	(10.40)	(11.68)	(10.48)	(17.51)	(18.55)	(20.08)	(21.24)	(19.94)	(14.97)
6	Thiodicarb 75 WP @ 783.33 g a. i. /ha	16.34 (7.92)	17.13^{a} (8.68)	17.69^{ab} (9.23)	18.32^{ab} (9.88)	17.71^{ab} (9.25)	23.94 (16.47)	24.38^{ab} (17.04)	25.08^{ab} (17.97)	25.62^{ab} (18.70)	25.03^{b} (17.90)	21.37^{ab} (13.28)
7	Flubendiamide 20 WG @ 25 g a. i. /ha	16.61 (8.17)	16.91^{a} (8.46)	17.21^{a} (8.75)	17.81^{a} (9.36)	17.31^{a} (8.85)	22.87 (15.10)	23.20^{a} (15.52)	23.64^{a} (16.08)	24.13^{a} (16.71)	23.66^{a} (16.10)	20.48^{a} (12.24)
8	Control	16.48 (8.05)	22.72^{b} (14.92)	24.42^{c} (17.09)	26.21^{d} (19.51)	24.45^{e} (17.13)	29.41 (24.11)	30.70^{d} (26.07)	32.03^{e} (28.13)	33.20^{d} (24.77)	31.98^{f} (28.05)	28.21^{f} (22.34)
S. Em.±	Treatment (T)	1.14	1.08	1.06	1.06	0.56	1.48	0.87	0.94	0.99	0.47	0.38
	Period (P)	-	-	-	-	0.38	-	-	-	-	0.33	0.24
	Spray (S)	-	-	-	-		-	-	-	-	-	0.19
	T x P	-	-	-	-	1.07	-	-	-	-	0.93	0.67
	T x S	-	-	-	-	-	-	-	-	-	-	0.55
	P x S	-	-	-	-	-	-	-	-	-	-	0.34
	T x P x S	-	-	-	-	-	-	-	-	-	-	0.95
C. V. %		11.90	10.16	9.54	8.91	9.59	10.12	7.78	8.01	8.18	8.00	7.11

Note: 1. Figures in parenthesis are retransformed values; those outside are arc sine transformed values.
2. Treatment mean(s) with the letter(s) in common are not significant by DNMRT at 5% level of significance.
3. Significant parameters and its interactions: T, P, S, T x P and T x S

Table 2: Effect of different insecticides against leaf folder, *C. medinalis* in rice (*Kharif*, 2019)

Tr. No.	Treatments	Leaf damage (%) days after spray											Pooled over sprays and years
		Before spray	First spray			Pooled over periods	Before spray	Second spray			Pooled over periods	Pooled over periods and sprays	
			3	7	10			3	7	10			
1	Emamectin benzoate 5 SG @ 9.5 g a. i. /ha	14.89^{a} (6.60)	16.29^{a} (7.87)	19.55^{b} (11.20)	20.96^{b} (12.80)	18.93^{b} (10.52)	29.33^{a} (23.99)	30.75^{c} (26.14)	31.50^{b} (27.30)	34.00^{c} (31.27)	32.08^{d} (28.21)	25.50^{d} (18.53)	25.01^{c} (17.87)
2	Emamectin benzoate 5 SG @ 12.66 g a. i. /ha	14.77^{a} (6.50)	16.25^{a} (7.83)	19.45^{b} (11.09)	20.63^{b} (12.41)	18.78^{b} (10.36)	28.70^{a} (23.06)	30.42^{bc} (25.64)	31.23^{b} (26.88)	33.48^{c} (30.43)	31.71^{cd} (27.63)	25.24^{d} (18.18)	24.44^{c} (17.12)
3	Emamectin benzoate 5 SG @ 15.83 g a. i. /ha	15.35^{a} (7.01)	15.98^{a} (7.58)	16.69^{ab} (8.25)	17.75^{ab} (9.29)	16.81^{a} (8.36)	26.45^{a} (19.84)	27.66^{abc} (21.55)	27.87^{ab} (21.85)	31.83^{c} (27.82)	29.11^{b} (23.67)	22.96^{bc} (15.22)	22.40^{b} (14.52)
4	Thiodicarb 75 WP @ 470 g a. i. /ha	15.43^{a} (7.08)	15.43^{a} (7.08)	16.95^{ab} (8.50)	18.70^{ab} (10.28)	17.02^{a} (8.57)	27.68^{a} (21.58)	28.64^{abc} (22.97)	29.09^{ab} (23.64)	30.72^{bc} (26.10)	29.49^{bc} (24.23)	23.26^{c} (15.59)	23.13^{b} (15.43)
5	Thiodicarb 75 WP @ 626.66 g a. i. /ha	15.23^{a} (6.90)	16.23^{a} (7.81)	16.87^{ab} (8.42)	18.01^{ab} (9.56)	17.04^{a} (8.59)	28.84^{a} (23.27)	28.00^{ab} (22.04)	28.34^{ab} (22.53)	31.43^{c} (27.19)	29.26^{b} (23.89)	23.15^{c} (15.46)	22.95^{b} (15.20)
6	Thiodicarb 75 WP @ 783.33 g a. i. /ha	16.62^{a} (8.18)	15.92^{a} (7.52)	16.21^{a} (7.79)	16.91^{a} (8.46)	16.34^{a} (7.92)	25.95^{a} (19.15)	26.14^{ab} (19.41)	26.34^{a} (19.69)	26.67^{ab} (20.15)	26.38^{a} (19.74)	21.36^{ab} (13.27)	21.36^{a} (13.27)
7	Flubendiamide 20 WG @ 25 g a. i. /ha	15.75^{b} (7.37)	15.83^{a} (7.44)	16.15^{a} (7.74)	16.82^{a} (8.37)	16.26^{a} (7.84)	25.23^{a} (18.17)	25.39^{a} (18.39)	25.57^{a} (18.63)	25.93^{a} (19.12)	25.63^{a} (18.71)	20.95^{a} (12.78)	20.71^{a} (12.51)
8	Control	15.55^{a} (7.19)	20.49^{b} (12.25)	22.40^{b} (14.52)	24.29^{c} (16.92)	22.39^{c} (14.51)	30.99^{b} (26.51)	33.36^{d} (30.24)	33.15^{c} (29.90)	39.46^{d} (40.39)	35.32^{e} (33.42)	28.86^{e} (23.30)	28.53^{d} (22.81)
S. Em.±	Treatment (T)	0.73	0.95	0.89	1.03	0.53	1.50	1.28	1.36	1.36	0.74	0.45	0.33
	Period (P)	-	-	-	-	0.32	-	-	-	-	0.45	0.28	0.20
	Spray (S)	-	-	-	-	-	-	-	-	-	-	0.23	1.58
	Year (Y)	-	-	-	-	-					-	-	0.16
	T x P	-	-	-	-	0.92	-	-	-	-	1.28	0.78	0.57
	T x S	-	-	-	-	-	-	-	-	-	-	0.64	0.46
	P x S	-	-	-	-	-	-	-	-	-	-	0.39	0.28
	T x Y	-	-	-	-	-	-	-	-	-	-	-	0.46
	P x Y	-	-	-	-	-	-	-	-	-	-	-	0.28
	S x Y	-	-	-	-	-	-	-	-	-	-	-	0.23
	T x P x S	-	-	-	-	-	-	-	-	-	-	1.11	0.80
	T x S x Y	-	-	-	-	-	-	-	-	-	-	-	0.65
	P x S x Y	-	-	-	-	-	-	-	-	-	-	-	0.40
	T x P x Y	-	-	-	-	-	-	-	-	-	-	-	0.80
	T x P x S x Y	-	-	-	-	-	-	-	-	-	-	-	1.13
C. V. %		8.24	9.97	8.58	9.22	8.85	9.41	7.69	8.09	7.43	7.41	8.04	8.36

Note: 1. Figures in parenthesis are retransformed values; those outside are arc sine transformed values.
2. Treatment mean(s) with the letter(s) in common are not significant by DNMRT at 5% level of significance.
3. Significant parameters and its interactions: T, P, S, T x S and S x Y

Table 3: Effect of different insecticides on spiders in rice (Kharif, 2018)

Tr. No.	Treatments	No. of spiders/5 hills days after spray										
		Before spray	First spray			Pooled over periods	Before spray	Second spray			Pooled over periods	Pooled over periods and sprays
			3	7	10			3	7	10		
1	Emamectin benzoate 5 SG @ 9.5 g a. i. /ha	1.40 (1.46)	1.39 (1.43)	1.44 (1.57)	1.50 (1.75)	1.44 (1.57)	1.52 (1.81)	1.52 (1.81)	1.54 (1.87)	1.57 (1.96)	1.54 (1.87)	1.49 (1.72)
2	Emamectin benzoate 5 SG @ 12.66 g a. i. /ha	1.40 (1.46)	1.38 (1.40)	1.42 (1.52)	1.49 (1.72)	1.43 (1.54)	1.53 (1.84)	1.52 (1.81)	1.53 (1.84)	1.56 (1.93)	1.54 (1.87)	1.48 (1.69)
3	Emamectin benzoate 5 SG @ 15.83 g a. i. /ha	1.39 (1.43)	1.34 (1.30)	1.39 (1.43)	1.43 (1.54)	1.39 (1.43)	1.49 (1.72)	1.48 (1.69)	1.49 (1.72)	1.50 (1.75)	1.49 (1.72)	1.44 (1.57)
4	Thiodicarb 75 WP @ 470 g a. i. /ha	1.39 (1.43)	1.37 (1.38)	1.41 (1.49)	1.47 (1.66)	1.41 (1.49)	1.47 (1.66)	1.46 (1.63)	1.46 (1.63)	1.48 (1.69)	1.47 (1.66)	1.44 (1.57)
5	Thiodicarb 75 WP @ 626.66 g a. i. /ha	1.38 (1.40)	1.36 (1.35)	1.40 (1.46)	1.45 (1.60)	1.40 (1.46)	1.51 (1.78)	1.49 (1.72)	1.50 (1.75)	1.52 (1.81)	1.51 (1.78)	1.46 (1.63)
6	Thiodicarb 75 WP @ 783.33 g a. i. /ha	1.39 (1.43)	1.34 (1.30)	1.37 (1.38)	1.41 (1.49)	1.37 (1.38)	1.46 (1.63)	1.43 (1.54)	1.44 (1.57)	1.46 (1.63)	1.44 (1.57)	1.41 (1.49)
7	Flubendiamide 20 WG @ 25 g a. i. /ha	1.40 (1.46)	1.33 (1.27)	1.36 (1.35)	1.39 (1.43)	1.36 (1.35)	1.44 (1.57)	1.42 (1.52)	1.44 (1.57)	1.44 (1.57)	1.43 (1.54)	1.40 (1.46)
8	Control	1.41 (1.49)	1.41 (1.49)	1.46 (1.63)	1.48 (1.69)	1.45 (1.60)	1.55 (1.90)	1.54 (1.87)	1.56 (1.93)	1.59 (2.03)	1.56 (1.93)	1.50 (1.75)
S. Em.± Treatment (T)		0.07	0.07	0.06	0.05	0.03	0.05	0.06	0.06	0.06	0.04	0.04
Period (P)		-	-	-	-	0.02	-	-	-	-	0.03	0.01
Spray (S)		-	-	-	-		-	-	-	-		0.01
T x P		-	-	-	-	0.06	-	-	-	-	0.06	0.02
T x S		-	-	-	-	-	-	-	-	-	-	0.04
P x S		-	-	-	-	-	-	-	-	-	-	0.03
T x P x S		-	-	-	-	-	-	-	-	-	-	0.06
C. V. %		8.15	8.45	6.79	6.50	7.26	5.60	6.73	7.02	7.31	7.03	7.01

Note: Figures in parenthesis are retransformed values; those outside are $\sqrt{x + 0.5}$ transformed values. All the parameters and its interactions are non-significant.

Table 4: Effect of different insecticides on spiders in rice (*Kharif*, 2019)

Tr. No.	Treatments	No. of spiders/5 hills days after spray										Pooled over sprays and years
		Before spray	First spray			Pooled over periods	Before spray	Second spray			Pooled over periods and sprays	
			3	7	10			3	7	10		
1	Emamectin benzoate 5 SG @ 9.5 g a. i. /ha	1.32 (1.24)	1.31 (1.22)	1.40 (1.46)	1.40 (1.46)	1.37 (1.38)	1.46 (1.63)	1.45 (1.60)	1.45 (1.60)	1.46 (1.63)	1.45 (1.60)	1.41 (1.49)	1.45 (1.60)
2	Emamectin benzoate 5 SG @ 12.66 g a. i. /ha	1.36 (1.35)	1.32 (1.24)	1.38 (1.40)	1.40 (1.46)	1.37 (1.38)	1.44 (1.57)	1.43 (1.54)	1.44 (1.57)	1.45 (1.60)	1.45 (1.60)	1.41 (1.49)	1.45 (1.60)
3	Emamectin benzoate 5 SG @ 15.83 g a. i. /ha	1.33 (1.27)	1.30 (1.19)	1.33 (1.27)	1.36 (1.35)	1.33 (1.27)	1.40 (1.46)	1.38 (1.40)	1.41 (1.49)	1.44 (1.57)	1.41 (1.49)	1.37 (1.38)	1.41 (1.49)
4	Thiodicarb 75 WP @ 470 g a. i. /ha	1.28 (1.14)	1.28 (1.14)	1.33 (1.27)	1.35 (1.32)	1.32 (1.24)	1.40 (1.46)	1.39 (1.43)	1.41 (1.49)	1.44 (1.57)	1.41 (1.49)	1.36 (1.35)	1.40 (1.46)
5	Thiodicarb 75 WP @ 626.66 g a. i. /ha	1.24 (1.04)	1.24 (1.04)	1.30 (1.19)	1.35 (1.32)	1.30 (1.19)	1.39 (1.43)	1.38 (1.40)	1.40 (1.46)	1.43 (1.54)	1.40 (1.46)	1.35 (1.32)	1.41 (1.49)
6	Thiodicarb 75 WP @ 783.33 g a. i. /ha	1.26 (1.09)	1.25 (1.06)	1.30 (1.19)	1.34 (1.30)	1.30 (1.19)	1.35 (1.32)	1.34 (1.30)	1.35 (1.32)	1.43 (1.54)	1.37 (1.38)	1.33 (1.27)	1.37 (1.32)
7	Flubendiamide 20 WG @ 25 g a. i. /ha	1.26 (1.09)	1.25 (1.06)	1.30 (1.19)	1.34 (1.30)	1.30 (1.19)	1.32 (1.24)	1.31 (1.22)	1.34 (1.30)	1.43 (1.54)	1.36 (1.35)	1.33 (1.27)	1.37 (1.38)
8	Control	1.32 (1.24)	1.34 (1.30)	1.42 (1.52)	1.42 (1.52)	1.39 (1.43)	1.44 (1.57)	1.44 (1.57)	1.45 (1.60)	1.49 (1.72)	1.46 (1.63)	1.42 (1.52)	1.46 (1.63)
S. Em.±	Treatment (T)	0.07	0.06	0.04	0.04	0.04	0.06	0.05	0.06	0.06	0.04	0.03	0.03
	Period (P)	-	-	-	-	0.03	-	-	-	-	0.03	0.02	0.01
	Spray (S)	-	-	-	-	-	-	-	-	-	-	0.01	0.01
	Year (Y)	-	-	-	-	-	-	-	-	-	-	-	0.03
	T x P	-	-	-	-	0.05	-	-	-	-	0.06	0.04	0.02
	T x S	-	-	-	-	-	-	-	-	-	-	0.03	0.02
	P x S	-	-	-	-	-	-	-	-	-	-	0.02	0.04
	T x Y	-	-	-	-	-	-	-	-	-	-	-	0.03

	P x Y	-	-	-	-	-	-	-	-	-	-	-	0.02
	S x Y	-	-	-	-	-	-	-	-	-	-	-	0.04
	T x P x S	-	-	-	-	-	-	-	-	-	-	0.05	0.02
	T x S x Y	-	-	-	-	-	-	-	-	-	-	-	0.03
	P x S x Y	-	-	-	-	-	-	-	-	-	-	-	0.04
	T x P x Y	-	-	-	-	-	-	-	-	-	-	-	0.02
	T x P x S x Y	-	-	-	-	-	-	-	-	-	-	-	0.07
C. V. %		9.07	7.70	6.03	6.33	5.99	7.44	6.86	7.36	7.60	7.09	6.60	6.76

Note: Figures in parenthesis are retransformed values; those outside are $\sqrt{x + 0.5}$ transformed values. All the parameters and its interactions are non-significant.

Grain yield

Pooled over years results indicated that all the insecticidal treatments recorded significantly higher grain yield than the control. The highest (54.01 q/ ha) grain yield was noticed in the treatment of flubendiamide 20 WG @ 25 g a.i./ ha followed by thiodicarb 75 WP @ 783.33 g a. i. /ha (52.93 q/ha). The lowest (42.57 q/ha) grain yield was recorded in the treatment of emamectin benzoate 5 SG @ 9.5 g a. i. /ha (Table 5).

Straw yield

Pooled over years results indicated that all the insecticidal treatments recorded significantly higher straw yield than the control. The highest (60.44 q/ ha) straw yield was recorded in the treatment of flubendiamide 20 WG @ 25 g a.i./ ha followed by thiodicarb 75 WP @ 783.33 g a. i. /ha (58.55 q/ha). The lowest straw yield found in the plots treated with emamectin benzoate 5 SG @ 9.5 g a. i. /ha (45.12 q/ ha) (Table 5).

Table 5: Effect of different insecticides on grain and straw yield of rice

Tr. No.	Treatments	Yield (q/ha)					
		2018		2019		Pooled over years	
		Grain	Straw	Grain	Straw	Grain	Straw
1	Emamectin benzoate 5 SG @ 9.5 g a. i. /ha	44.83^{a}	47.20^{cd}	40.32^{c}	43.03^{c}	42.57^{d}	45.12^{e}
2	Emamectin benzoate 5 SG @ 12.66 g a. i. /ha	47.37^{a}	48.13^{bc}	42.99^{c}	46.24^{bc}	45.18^{cd}	47.19^{de}
3	Emamectin benzoate 5 SG @ 15.83 g a. i. /ha	51.47^{a}	56.73^{abc}	46.67^{bc}	50.72^{b}	49.07^{abc}	53.73^{bc}
4	Thiodicarb 75 WP @ 470 g a. i. /ha	48.43^{a}	51.40^{abc}	44.60^{c}	48.22^{bc}	46.51^{cd}	49.81^{cde}
5	Thiodicarb 75 WP @ 626.66 g a. i. /ha	50.73^{a}	54.00^{abc}	45.63^{c}	50.55^{b}	48.18^{bcd}	52.27^{cd}
6	Thiodicarb 75 WP @ 783.33 g a. i. /ha	52.67^{a}	58.40^{ab}	53.20^{ab}	58.70^{a}	52.93^{ab}	58.55^{ab}
7	Flubendiamide 20 WG @ 25 g a. i. /ha	54.53^{a}	61.77^{a}	53.49^{a}	59.12^{a}	54.01^{a}	60.44^{a}
8	Control	35.40^{b}	37.80^{d}	33.27^{d}	36.03^{d}	34.33^{e}	36.92^{f}
S. Em.± Treatment(T)		3.20	3.23	2.00	2.12	1.75	1.78
Year(Y)		-	-	-	-	0.94	0.96
T x Y		-	-	-	-	2.67	2.73
C. D. at 5% T		9.70	9.78	6.06	6.43	5.02	5.10
Y		-	-	-	-	2.51	2.56
T x Y		-	-	-	-	NS	NS
C. V. %		11.50	10.76	7.69	7.48	9.91	9.36

Note: Treatment mean(s) with the letter(s) in common are not significant by DNMRT at 5% level of significance.

Conclusion

It can be deduced from the present investigation that the spray application of flubendiamide 20 WG 0.005% (2.5 g per 10 litre of water) or thiodicarb 75 WP 0.15% (20 g per 10 litre of water) at 30 and 45 days after transplanting was found effective in controlling leaf folder, *C. medinalis* infesting rice.

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