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Original Research Article

Field Efficacy of Some Insecticides against Mustard Sawfly and their Toxicity to Coccinellid Predators on Indian Mustard

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Keywords

Mustard; *Athalia*; Insecticides; Control; mortality; Sawfly

ABSTRACT

Efficacy of different novel insecticides as foliar application was studied against mustard sawfly, *Athalia proxima* Klug infesting the crop at Pilibhit for two consecutive years during 2018-19 and 2019-20. The insecticides, emamectin benzoate 5 SG (250 g/ha.), indoxacarb 14.5 SC (500 ml/ha.), fipronil 5 SC (1.0 l/ha.), spinosad 45 SC (200 ml/ha) & cartap hydrochloride 50 SP (1.0 kg./ha.), lambda cyhalothrin 5 SC (1.5 lit/ha), , carbosulfan 25 EC (1.0 lit./ha.) & quinalphos 25 EC (1.0 lit./ha.) were sprayed at normal recommended doses and a control plot was also maintained for comparison. Efficacy was assessed by counting the sawflies larval population in mustard field plots. All tested insecticides performed better against sawflies as compared to untreated plots. emamectin benzoate proved as the best with maximum reduction in sawfly larval population followed by indoxacarb, spinosad, fipronil, cartap hydrochloride, lambda cyhalothrin, Carbosulfan 25 EC and Quinalphos as the mean larval population was found to be 1.83, 3.00, 5.33, 4.50, 7.00, 8.17, 8.33 and 12.83, after 15 days of spray in the pooled data of both the years the highest population at this stage was found to be 16.83 which was recorded in control.

Introduction

Among various constraints in the productivity of rapeseed-mustard, infestation of insect-pests is one of the most important limiting factors. About three-dozen insect-pests have been found infesting mustard crop in India (Rai, 1976) in which mustard sawfly, *Athalia proxima* Klug infest the crop during seedling stage and causes damage from 3.4 to 38 %. The peak activity of pest is observed on the crop when it is in the seedling stage at different locations. Initially the larva nibbles the leaves, later it feeds from the margins towards the midrib numerous shot holes and even riddled the entire leaves by voracious feeding. the larva nibbles leaves, later it feeds from the margins towards the midrib. The larvae cause numerous shot holes and even riddle the entire leaves by voracious feeding, they devour the epidermis of the shoot, resulting in drying up of seedlings and failure to bear seeds in older plants. The yield losses up to 5 to 18 %. In severe case at the seedling stage, the crop has to be resown. In case of heavy attack, plants wither resulting in a drastic loss in seed yield and oil contents (Upadhyay *et al.*, 1999). In spite of having certain limitations, in most of the cases the use of chemical insecticides still remains the practically and economically viable to combat this pest. The use of most of the older insecticides causes sudden decrease in the number of natural enemies also. Therefore, the present study was undertaken to test some newer novel insecticides with one older organophosphates and some biopesticides to see their effect on the larval population of sawflies.

Materials and Methods

An experiment was conducted at farmers field in the Terai region of U.P. in Pilibhit district for the two consecutive years during Rabi 2018-19 and 2019-20 in randomized block design with three replications and nine treatments and net plot size of 15 square meter. All the normal agronomic practices prevalent in the area were followed. Eight insecticides viz. emamectin benzoate 5 SG (250 g/ha.), indoxacarb 14.5 SC (500 ml/ha.), fipronil 5 SC (1.0 l/ha.), spinosad 45 SC (200 ml/ha) & cartap hydrochloride 50 SP (1.0 kg/ha.), lambda cyhalothrin 5 SC (1.0 lit/ha), carbosulfan 25 EC (1.0 lit/ha.) & Quinalphos 25 EC (1.0 lit/ha.) and a control (untreated) were tested. These insecticides were sprayed once on Indian mustard crop after the pest appearance with knapsack sprayer. Observations pertaining to sawfly larval number were recorded one day before and after 1, 3, 7 and 15 days of spray. Sawflies larvae population was observed from ten randomly selected plants per plot. The population of sawfly larvae was counted after spraying tabulated and analyzed statistically as suggested by Panse and Sukhatme (1985).

Results and Discussion

After application of insecticides, sawfly larvae populations in all treated plots were drastically reduced as compared to untreated control. The data obtained (Table 1) revealed that emamectin benzoate 5 SG gave the best result as the mean number of sawfly larvae per 10 plants after 15 days of spray was found to be 1.67, 2.00 and 1.83 in the season 2018-19, 2019-20 and pooled data, respectively. The next best treatment was fipronil in which the mean larval population after 15 days of spray was 3.33 and 2.67 during both the years, respectively. The treatments to be followed were spinosad and fipronil in which the mean larval population of mustard sawflies, after 15 days of insecticidal treatment was 4.50 and 5.33 during both the years, respectively when the data were pooled. The findings are supported by Jansson *et al.*, (1996) who proved the supremacy of emamectin in controlling lepifdopterous pests. These findings are also in confirmation with that of Meena (2018) as they also reported insecticides indoxacarb and acetamiprid to be superior in reducing the population of cabbage pests. They also found lambda cyhalothrin 5 SC, carbosulfan 25 EC and quinalphos 25 EC less effective than other chemicals.

As regards the other pesticides the minimum mean number of sawfly larvae, after 15 days of sowing were found to be 7.67 and 8.67 during both the years, respectively with the application of lambda cyhalothrin 5 SC. In this treatment the pooled mean number of both the years at this stage was found 8.17. The least effective pesticides was quinalphos as after its spray 17.00, 15.67 14.30 and 12.67 mean larval population was recorded after 1, 3, 7 and 15 days of application, during 2018-19 while in the year 2019-20 the mean larval population at the same time was 17.67, 14.67, 14.33 and 12.67, respectively. The application of carbosulfan 25 EC gave the reduction in the mean larval population of sawfly which was at par with that of lambda cyhalothrin 5 SC as this number after 15 days of treatment was found to be 8.67 and 8.00 during the year 2018-19 and 2019-20, respectively (Table 2).

Table.1 Effect of insecticides and biopesticides against *Athalia proxima* infesting mustard crop

Insecticides	**Mean larval population / 10 plants**														
	Before spraying			**1 DAA**			**3 DAA**			**7 DAA**			**15 DAA**		
	2018-19	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**
Emamectin benzoate 5 SG	21.67 (4.76)	22.00 (4.76)	21.83 (4.78)	6.33 (2.70)	6.67 (2.76)	6.50 (2.74)	4.67 (2.37)	5.00 (2.44)	4.83 (2.41)	2.33 (1.79)	2.67 (1.88)	2.50 (1.84)	1.67 (1.58)	2.00 (1.72)	1.83 (1.65)
Indoxacarb 14.5 SC	22.00 (4.79)	20.67 (4.64)	21.33 (4.73)	8.00 (2.99)	7.67 (2.94)	7.83 (2.97)	5.67 (2.57)	6.00 (2.63)	5.83 (2.61)	4.33 (2.28)	3.67 (2.13)	4.00 (2.23)	3.33 (2.07)	2.67 (1.88)	3.00 (1.99)
Fipronil 5 SC	20.33 (4.61)	21.67 (4.75)	21.00 (4.69)	9.33 (3.20)	8.67 (3.11)	9.00 (3.15)	7.33 (2.87)	7.67 (2.94)	7.50 (2.91)	6.00 (2.61)	6.67 (2.80)	6.33 (2.70)	5.00 (2.42)	5.67 (2.55)	5.33 (2.51)
Spinosad 45 SC	21.00 (4.67)	21.33 (4.72)	21.17 (4.71)	8.33 (3.05)	8.33 (3.05)	8.33 (3.05)	7.00 (2.83)	6.33 (2.70)	6.67 (2.77)	5.67 (2.58)	5.33 (2.50)	5.50 (2.55)	4.67 (2.36)	4.33 (2.29)	4.50 (2.34)
Cartap hydrochloride 50 SP	21.33 (4.72)	20.33 (4.62)	20.83 (4.67)	10.33 (3.35)	10.33 (3.36)	10.33 (3.36)	8.33 (3.04)	8.67 (3.10)	8.50 (3.07)	6.67 (2.75)	7.33 (2.87)	7.00 (2.81)	6.67 (2.75)	7.33 (2.87)	7.00 (2.81)
Lambda cyhalothrin 5 SC	22.33 (4.82)	21.67 (4.75)	22.00 (4.78)	11.67 (3.55)	11.33 (3.50)	11.50 (3.54)	9.67 (3.24)	11.33 (3.50)	10.50 (3.39)	8.67 (3.10)	10.00 (3.30)	9.33 (3.21)	7.67 (2.94)	8.67 (3.10)	8.17 (3.02)
Carbosulfan 25 EC	21.67 (4.75)	22.33 (4.82)	22.00 (4.80)	12.33 (3.65)	12.00 (3.59)	12.17 (3.63)	10.67 (3.41)	10.67 (3.40)	10.67 (3.41)	9.67 (3.26)	9.33 (3.20)	9.50 (3.25)	8.67 (3.10)	8.00 (2.98)	8.33 (3.05)
Quinalphos 25 EC	22.00 (4.79)	22.33 (4.82)	22.17 (4.81)	17.00 (4.24)	17.67 (4.31)	17.33 (4.28)	15.67 (4.08)	14.67 (3.96)	15.17 (4.02)	14.3 (3.90)	14.33 (3.91)	14.33 (3.91)	12.67 (3.69)	13.00 (3.73)	12.83 (3.71)
Control	21.33 (4.72)	22.33 (4.82)	21.83 (4.77)	22.67 (4.85)	21.67 (4.74)	22.17 (4.80)	24.33 (5.03)	23.33 4.92)	23.83 (4.97)	22.67 (4.85)	22.00 (4.78)	22.33 (4.82)	17.33 (4.28)	16.33 (4.16)	16.83 (4.22)
CD (P=0.05)	N.S.	N.S.	N.S.	0.52	0.58	0.42	0.67	0.58	0.42	0.59	0.66	0.43	0.57	0.61	0.43

Note: Figures in parentheses are square root transformed values, DAA - Days after application.

Table.2 Response of insecticides on the population of lady bird beetle *Coccinella septumpunctata*.

Treatment	Mean No. of Lady bird beetles / Shoot					
	Before Spray	Days After Spray				
		1	2	3	7	10
Emamectin benzoate 5 SG	5.33	5.33 (15.80)	5.33 (15.80)	4.33 (31.60)	5.33 (0.00)	6.33 (-18.76)
Indoxacarb 14.5 SC	5.67	5.33 (5.99)	4.33 (18.76)	4.33 (18.76)	4.67 (12.38)	5.67 (0.00)
Fipronil 5 SC	4.67	3.33 (28.69)	1.33 (71.52)	0.00 (100.00)	0.00 (100.00)	0.00 (100.00)
Spinosad 45 SC	4.67	4.33 (7.28)	3.33 (28.69)	3.67 (21.41)	5.33 (-14.13)	5.67 (-21.41)
Cartap hydrochloride 50 SP	6.33	4.67 (17.64)	2.33 (58.91)	0.67 (88.18)	0.00 (100.00)	0.00 (100.00)
Lambda cyhalothrin 5 SC	5.33	2.67 (49.91)	2.33 (56.29)	0.00 (100.00)	0.00 (100.00)	0.00 (100.00)
Carbosulfan 25 EC	5.67	4.67 (17.64)	2.33 (58.91)	0.67 (88.18)	0.00 (100.00)	0.00 (100.00)
Quinalphos 25 EC	4.67	3.33 (28.69)	1.33 (71.52)	0.00 (100.00)	0.00 (100.00)	0.00 (100.00)
Control	4.67	5.67 (-21.41)	6.33 (-35.55)	8.33 (-78.37)	9.33 (-99.79)	10.33 (-121.20)
CD-@ 5 %	N.S.	N.S.	N.S.	3.27	3.71	5.11

Note: Figures in parentheses are per cent mortality.

Table.3 Pooled data on economics of different insecticide against okra shoot and fruit borer, *E. vitella* Fab.

S. No.	Treatment	Dose/Con. %	Yield q/ha	Increase in yield over control (q/ha)	Value of increased yield (Rs./ha)	Cost of treatments (Rs./ha)	Net income (Rs./ha)	Cost benefit ratio
1.	Emamectin benzoate 5 SG	250 g/ha.	17.23	8.50	42500.00	8320.00	34180.00	5.11
2.	Indoxacarb 14.5 SC	500 ml/ha	16.57	7.84	39200.00	8960.00	30240.00	4.38
3.	Fipronil 5 SC	1000 ml/ha	15.11	6.38	31900.00	8320.00	23580.00	3.83
4.	Spinosad 45 SC	200 ml/ha	16.91	8.18	40900.00	8000.00	32900.00	4.99
5.	Cartap hydrochloride 50 SP	1000 g/ha	14.49	5.76	28800.00	7840.00	20960.00	3.67
6.	Lambda cyhalothrin 5 SC	1000 ml/ha	13.19	4.46	22300.00	8640.00	13660.00	2.58
7.	Carbosulfan 25 EC	1000 ml/ha	13.11	4.38	21900.00	8000.00	12340.00	2.55
8.	Quinalphos 25 EC	1000 ml/ha	12.46	3.73	18650.00	7360.00	11290.00	2.53
9.	Control	-	8.73	-	-	-	-	-

The highest mean larval number after 15 days of treatments was found in untreated control which was 17.33 and 16.33 during both the years, respectively and it came to the tune of 16.83 when the data of both the years was pooled. Chandel and Sengar (2018) reported the effectiveness of lambda cyhalothrin 5 SC. Superiority of profenophos over control is confirmed with the findings of Ramolia *et al.,* (2011). Bagde. (2016) reported that profenophos provided effective control of mustard sawfly on mustard.

As regards mortality of predator beetle, *Coccinella septumpunctata* the safest insecticide was found to be spinosad in which the number of beetles increased by 21.41 per cent after 10 days of spraying followed by emamectin benzoate in which the increase percentage was 18.76. The next safer chemical was indoxacarb wherein the number of beetles was found to be same as pretreatment count. The hazardous chemicals for the predatory beetles were fipronil, cartap hydrochloride, lambda cyhalothrin, carbosulfan and quinalphos which caused 100 percent mortality in them after 10 days of spray. The numbers of predatory beetles increased by 121.20 per cent in untreated control. These findings are supported by Galvan *et al.* (2005) who observed that indoxacarb may have low acute toxicity to many predators at the suggested rates, and even reduced rates, it may reduce *Harmonia axyridis* population growth by affecting survival, development, and reproduction. However, Hetrick *et al.,* (2005) observed that Indoxacarb is considered highly toxic to honeybees by contact.

All the treated plots resulted higher yield ranging between 12.46 to 17.23 q/ha and were proved significantly superior over the control (8.73 q/ha) (Table 3). The highest yield of 17.23 q/ha was obtained from the emamectin benzoate treated plot. The spinosad was the second most effective treatment with yield of 16.91 q/ha followed by indoxacarb, fipronil, cartap hydrochloride, lambda cyhalothrin, carbosulfan and quinalphos with the yield of 16.57, 15.11, 14.49, 13.19, 13.11 and 12.46 q/ha., respectively. The lowest yield (8.73 q/ha) was obtained in control plot. The cost benefit ratio clearly showed that emamectin benzoate ranked first indicating the maximum return of Rs. 5.11 per rupee invested followed by spinosad, indoxacarb, fipronil, cartap hydrochloride, lambda cyhalothrin, carbosulfan, quinalphos with 4.99, 4.38, 3.83, 3.67, 2.58, 2.55 and 2.53 C:B ratio, respectively.

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