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Efficacy of insecticides against painted bug *Bagrada cruciferarum* kirkaldy in mustard

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Abstract
Field experiment was conducted from 2014-17 to identify the effective insecticides for the management of painted bug *Bagrada cruciferarum* Kirkaldy inflicting damage to mustard. The results revealed that minimum bug population was observed in treatment triazophos 40 EC @ 1l/ha followed by imidacloprid 17.8 SL @ 150 ml/ha and acephate 75 SP @ 500 g/ha after two sprays. Highest seed yield (17.38 q/ha) was recorded in the acephate 75 SP @ 500 g/ha followed by thiamethoxam 25 WG @100 g/ha (15.80 q/ha), dimethoate 30 EC @1l/ha (15.18 q/ha) and imidacloprid 17.8 SL @ 150 ml/ha (15.00 q/ha). Maximum ICBR was observed in treatment acephate 75 SP @ 500 g/ha (18.78), thiamethoxam 25 WG @100 g/ha (12.32), dimethoate 30 EC @1l/ha (10.33) and imidacloprid 17.8 SL @ 150 ml/ha (9.33).

Keywords: *Bagrada cruciferarum*, mustard, insecticide, management, economics

1. Introduction
India is one of the largest producers of oilseeds in the world and occupies an important position in the Indian agricultural economy. Brassica (rapeseed-mustard) is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country [3]. It is grown on an area of about 6.4 m ha with production of 8.02 mt and productivity is 1262 kg/ha. It has an oil content ranging from 35-45% [5]. Number of biotic and abiotic factors are responsible for low yield of mustard. Amongst these, the incidence of insect-pests is of immense importance [7]. About 50 insect species have been found infesting rapeseed-mustard in India among which, the painted bug *Bagrada cruciferarum* is the most important pest of crucifer crops in India [6, 9]. It causes damage to mustard at the seedling as well as pod formation stage. The losses at seedling stage varied from 26.8 to 70.8 per cent whereas at the pod formation and maturity stages 30.1 per cent losses in yield and 3.4 per cent in oil content has been reported [8]. To prevent the loss caused by this pest, present study was conducted to find out the effective insecticides.

2. Materials and methods
The experiment was conducted at ARS, Jalore during *rabi* seasons of 2014-17 to observe the efficacy of different insecticides against the painted bug. Total seven treatments including control were evaluated which include dimethoate 30 EC @ 1l/ha, acephate 75 SP @ 500 g/ha, thiamethoxam 25WG @100 g/ha, imidacloprid 17.8 SL @ 150 ml/ha, triazophos 40 EC @ 1l/ha, acetamiprid 20% SP @100 g/ha and control. The experiment was laid in randomized block design which was replicated thrice. The variety Bio 902 was used for sowing. Recommended agronomic practices were followed. Crop was sprayed twice and the population of the bug was recorded 7 days after each treatment. At the time of harvesting, seed yield was recorded.The data were subjected to the analysis of variance using simple Randomized block design (R.B.D.). The data recorded for insect population were transformed to square root transformation.

3. Results and Discussion
During *rabi* 2014-17, all the insecticides tested against the painted bug recorded lower population as compared to control. Seven days after the first spray, triazophos 40 EC @1l/ha was found most effective (1.43 bug population/plant) followed by imidacloprid 17.8 SL @150 ml/ha (2.07 bug population/plant) and acephate 75 SP @ 500 g/ha (2.17 bug population/plant) in reducing the test insect while seven days after the second spray, minimum bug population was observed in triazophos 40 EC @1l/ha (0.93) followed by imidacloprid 17.8 SL @150

ml/ha (1.73) and acephate 75 SP @ 500 g/ha (2.00) (Table 1). Maximum mean seed yield (17.38 q/ha) was recorded in the acephate 75 SP @ 500 g/ha followed by thiamethoxam 25 WG @100 g/ha (15.80 q/ha), dimethoate 30 EC @1l/ha (15.18 q/ha) and imidacloprid 17.8 SL @ 150 ml/ha (15.00 q/ha) (Table 1 and 2). These all treatments were found to be significantly superior to all other treatments and having maximum ICBR of 18.78, 12.32, 10.33 and 9.33, respectively (Table 2). The findings are in agreement with study of Choudhary and Pal [2], the highest yield of mustard was obtained in the plots treated with acephate 0.075% (12.31q/ha) followed by thiamethoxam 0.0125% (12.24) and dimethoate 0.03% (11.03). Ahuja and Joshi [1] also reported that among seven tested insecticides against *Bagrada hilaris*, the spray of malathion (0.05%), dimethoate (0.03%) and monocrotophos (0.036%) were found effective for control of this pest. Similiar findings are reported by Singh (2011) [10] who reported that comparatively higher painted bug control and yield was obtained in plots treated with imidacloprid 17.8 SL @ 40 g a.i./ha, spinosad 45 SC @ 75 g a.i./ha, indoxacarb 14.5 SC @ 75 g a.i./ha and acetamiprid 20 SP @ 40 g a.i./ha. Acephate 0.075% (1:14.25), acetamiprid 0.01% (1:11.15), flonicamid 0.015% (1:9.92) and imidacloprid 0.08% (1:9.05) also recorded higher NICBR (Khedkar *et al*) [4].

Table 1: Efficacy of different treatments against painted bug *Bagrada cruciferarum*

S. No.	Treatments	*Mean painted bug population/plant			Seed Yield (q/ha)			
		Pre-treatment	After first spray	After second spray				
			7 DAT	7 DAT	2014-15	2015-16	2016-17	Mean
1.	Dimethoate 30 EC @1L/ha	10	2.23(4.00)	2.00(3.00)	14.00	13.00	18.54	15.18
2.	Acephate 75 SP @ 500g/ha	9	1.78(2.17)	1.73(2.00)	16.33	15.33	20.47	17.38
3.	Thiamethoxam 25 WG @100 g/ha	11	1.85(2.42)	1.87(2.50)	14.27	13.27	19.86	15.80
4.	Imidacloprid 17.8 SL @150 ml/ha	7	1.75(2.07)	1.65(1.73)	14.00	13.00	17.99	15.00
5.	Triazophos 40 EC @ 1 L/ha	11	1.56(1.43)	1.39(0.93)	13.43	12.43	17.71	14.52
6.	Acetamiprid 20% SP @100 g/ha	9	2.23(4.00)	2.16(3.67)	11.08	10.08	14.42	11.86
7.	Control	10	3.16(9.00)	3.08(8.50)	10.05	9.05	14.08	11.06
SE(m)±			0.007	0.01	0.65	0.62	1.02	-
C.D. at 5%			0.021	0.03	1.92	1.92	3.13	-

*Mean of five plants
*Original values are given in parenthesis

Table 2: Mustard Yield and Economics of the treatments

Treatments	Mean yield (q/ha)	Gross return income (Rs/ha)	Additional Return Rs/ha)	Treatment Cost (Rs/ha)	Net Return (Rs/ha)	ICBR Ratio
Dimethoate 30 EC @1L/ha	15.18	55103	14955.60	1320	13635.60	10.33
Acephate 75 SP @ 500g/ha	17.38	63089	22941.60	1160	21781.60	18.78
Thiamethoxam 25 WG @100 g/ha	15.80	57354	17206.20	1292	15914.20	12.32
Imidacloprid 17.8 SL @150 ml/ha	15.00	54450	14302.20	1360	12942.20	9.52
Triazophos 40 EC @ 1 L/ha	14.52	52707	12559.80	1480	11079.80	7.49
Acetamiprid 20% SP @100 g/ha	11.86	43051	2904.00	1000	1904.00	1.90
Control	11.06	40147	-	-	-	-
SE(m)±	0.23	969.6				
C.D. at 5%	0.73	2987.8				

*ICBR- Incremental Cost Benefit Ratio

4. Conclusion

In the present study, minimum bug population and highest seed yield (17.38 q/ha) were observed in treatment triazophos 40 EC @ 1 l/ha and acephate 75 SP @ 500 g/ha. Maximum ICBR (18.78) was observed in treatment acephate 75 SP @ 500 g/ha.

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