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Evaluation of efficacy of bio-pesticide and Insecticide combinations against mustard aphid, *Lipaphis erysimi* Kalt

Amit Kumar, RKS Tomar, Archana Kerketta, Dinesh Pandey, NK Chaure and AK Awasthi

Abstract

The present investigation was carried out at Research Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh) during *Rabi*, 2021-2022 in RBD with 3 replications and 11 treatments including untreated control. Insecticide Thiamethoxam 25 WG @ 0.2 g/lit. was found best treatment against mustard aphid, as lowest 6.81 aphid/plant were observed with highest mustard yield 1701.96 kg/ha and benefit cost ratio 2.47:1. The second best treatment against mustard aphid was Dinotefuran 20 SG @ 0.25 g/lit. with 10.62 aphid/plant, 1628.62 kg/ha mustard yield and 2.24:1 benefit cost ratio followed by *Beauveria bassiana* 1.15 WP (1x10^8 CFU/ml) + 50% Thiamethoxam 25 WG @ 10 ml + 0.1 g/lit. with 12.03 aphid/plant, 1581 kg/ha yield and 2.36:1 benefit cost ratio.

Keywords: Mustard, biopesticide, insecticide, significantly, combinations

Introduction

Mustard is an important oilseed crop which is grown in subtropical as well as tropical countries in the world. India is the second largest producer of this crop in the World (Dwivedi *et al.*, 2019) [13]. Indian mustard, *Brassica juncea* L. belongs to the Family: Brassicaceae (Cruciferae) is an important oilseed crop next to sunflower. Mustard is commonly known as rai. Out of six cultivated oilseed species of genus *Brassica* more than 80% of total area occupied by Indian mustard, (Chandrashekhar *et al.*, 2013) [14]. Mustard, *B. juncea* Mustard is a most important edible oilseed crop in Northern India. Mustard is the main oilseed crop sown during the rabi season, in India Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana and Gujarat are the leading states for mustard crop accounting for more than 70% of total mustard area of the country.

The seed and oil are used as condiment in the preparation of pickles, curries, vegetables, hair oils, medicines and manufacture of greases. The oil cake is used as cattle feed and manure. The leaves of young plants are used as green vegetables and green stem and leaves are a good source of green fodder for cattle. In the tanning industry, mustard oil is used for softening leather.

Among the various factors responsible for the low yield of mustard, damage inflicted by various insect pests is an important factor, About50 species have been found infesting rapeseed-mustard in India. Out of many insect pests, aphids belong to the Aphididae family, order Hemiptera. *Lipaphis erysimi* is a popular pest of mustard and other species of the Brassicaceae. The pest breed parthenogenetically and the female may give birth to hundreds of nymphs. About 45 generations are completed in a year (Israr, 1986) [15]. Both the nymph and adult suck the cell sap from all green parts of the plant and have special preferences for the inflorescence.

Materials and Methods

The experiment was conducted at Instructional Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh), during *Rabi* 2021-22.

The experiment was laid out in randomized block design, replicated thrice with four bio-pesticides combination with two insecticide, two sole insecticide and one untreated control. Observation on no. of mustard aphid was taken weekly on 10 cm terminal twig. 10 plants was randomly selected and then tagged for the purpose. Observation was recorded 1 day before, 3, 7 and 12 days after treatment. When the crop attained maturity net plot was harvested and pods were also being separated to record the yield in different treatments.

Results and Discussion

In the present studies, bio-pesticide and insecticide combinations were evaluated for their relative efficacy and cost benefit ratio against mustard aphid. The overall mean of mustard aphid data presented in Table 1 revealed that the bio-pesticides and insecticide treatments recorded significantly superior over untreated control. Thiamethoxam 25 WG @ 0.2 g/lit. was considered best treatment as lowest 6.81 aphid/plant was observed. The second best treatment Dinotefuran 20 SG @ 0.25 /lit. (10.62 ahid/plant) which was followed by *Beauveria bassiana* 1.15 WP (1x10^{8} CFU/ml) + 50% Thiamethoxam 25 WG @ 10 ml + 0.1 g/lit. (12.03 aphid/plant), *Bacillus thuringiensis* 1.15 WP (1x10^{9} CFU/ml) + 50% Thiamethoxam 25 WG @ 10 ml + 0.1 g/lit. (12.67 aphid/plant), *Lecanicillium lecanii* 1.15 WP (1x10^{8} CFU/ml) + 50% Thiamethoxam 25 WG @ 10ml + 0.1 g/lit. (12.87 aphid/plant), *Metarhizium anisopliae* 1.15 WP (1x10^{8} CFU/ml) + 50% Thiamethoxam 25WG @ 10ml+0.1 g/lit. (13.06 aphid/plant). Bio-pesticide combinations with Dinotefuran 20 SG @ 0.125 g/lit and bio-pesticides @ 10 ml/lit. were recorded less effective with aphid population varied from 14.57-16.62 plant. The highest population 43.50 aphid/plant recorded in untreated control.

These results regarding Thiamethoxam 25% WG are in close agreement with those of Sharma *et al.*, (2020) [11] Patel *et al.*, (2017) [8] and regarding Dinotefuran 20% SG reported by Ahmed *et al.*, (2018) [1].

Yield of mustard and B:C Ratio in biopesticide and insecticide combinations.

The yield of different treatment are given below Table 2. The highest yield of mustard 1701.96 kg/ha and 2.47:1 benefit cost ratio was obtained from the treatment Thiamethoxam 25 WG @ 0.2 g/lit., the second best treatment Dinotefuran 20 SG 0.25 g/lit with 1628.62 kg/ha. In case of biopesticide 1581 kg/ha yield and 2.36:1 benefit cost ratio was recorded in *treatment Beauveria bassiana* + 50% Thiamethoxam 1.15 WP (1x10^{8} CFU/ml) + 25 WG @ 10 ml + 0.1 g/lit, next *Bacillus thuringiensis* + 50% Thiamethoxam @ 10 ml +0.1 g/lit with 1530.95 kg/ha. The other treatment yield obtained in downward order. The lowest yield recorded in untreated control plot.

Table 1: Efficacy of bio-pesticide and insecticide combinations against mustard aphid during *Rabi* 2021-2022

S. No.	Treatments	Formulation	Dose (g/ml/lit. of water)	Mean aphid population per plant (10cm twig) 1st spray				Mean aphid population per plant (10cm twig) 2nd spray				Overall mean aphid population/ plant
				PTO	3 DAT	7 DAT	12 DAT	PTO	3 DAT	7 DAT	12 DAT	
T_1	*B. bassiana* + 50% Thiamethoxam 25 WG	1.15 WP (1x10^{8} CFU/ml) + 25 WG	10 ml+0.1 g	40.40 (6.35)	15.73 $(3.95)^{bc}$	12.20 $(3.47)^{c}$	12.80 $(3.55)^{de}$	37.53 (6.09)	14.13 $(3.75)^{b}$	10.10 $(3.16)^{c}$	7.23 $(2.78)^{c}$	12.03 $(3.52)^{de}$
T_2	*L. lecanii* + 50% Thiamethoxam 25 WG	1.15 WP (1x10^{8} CFU/ ml) + 25 WG	10 ml+0.1 g	51.67 (7.17)	16.10 $(4.01)^{bc}$	12.00 $(3.45)^{c}$	12.63 $(3.52)^{de}$	33.47 (5.75)	14.83 $(3.85)^{b}$	11.60 $(3.40)^{bc}$	10.07 $(3.25)^{b}$	12.87 $(3.65)^{cde}$
T_3	*M. anisopliae* + 50% Thiamethoxam 25 WG	1.15 WP (1x10^{8} CFU/ ml) + 25 WG	10 ml+0.1 g	52.10 (7.20)	15.73 $(3.95)^{bc}$	12.30 $(3.49)^{c}$	14.53 $(3.79)^{cde}$	35.10 (5.91)	15.07 $(3.87)^{b}$	11.47 $(3.38)^{bc}$	9.27 $(3.12)^{bc}$	13.06 $(3.67)^{cde}$
T_4	*B. thuringiensis* + 50% Thiamethoxam 25 WG	1.15 WP (1x10^{9} CFU/ ml) + 25 WG	10 ml+0.1 g	51.67 (7.18)	16.70 $(4.08)^{bc}$	12.07 $(3.46)^{c}$	13.03 $(3.59)^{de}$	36.63 (6.04)	14.57 $(3.81)^{b}$	10.20 $(3.19)^{c}$	9.43 $(3.15)^{b}$	12.67 $(3.61)^{de}$
T_5	*B. bassiana* + 50% Dinotefuran 20 SG	(1x10^{8} CFU/ml) + 20 SG	10 ml+0.125 g	52.93 (7.27)	18.13 $(4.26)^{bc}$	14.47 $(3.80)^{bc}$	17.13 $(4.14)^{bcd}$	39.37 (6.26)	15.43 $(3.92)^{b}$	12.33 $(3.51)^{bc}$	10.63 $(3.33)^{b}$	14.69 $(3.88)^{bcd}$
T_6	*L. lecanii* + 50% Dinotefuran 20 SG	(1x10^{8} CFU/ml) + 20 SG	10 ml+0.125 g	57.70 (7.60)	19.27 $(4.38)^{b}$	14.67 $(3.83)^{bc}$	16.47 $(4.06)^{bcd}$	33.33 (5.76)	17.13 $(4.13)^{b}$	12.77 $(3.56)^{bc}$	11.53 $(3.46)^{b}$	15.31 $(3.96)^{bc}$
T_7	*M. anisopliae* + 50% Dinotefuran 20 SG	(1x10^{8} CFU/ml) + 20 SG	10 ml+0.125 g	48.37 (6.95)	18.13 $(4.25)^{bc}$	17.07 $(4.08)^{b}$	22.07 $(4.67)^{b}$	34.47 (5.87)	17.50 $(4.18)^{b}$	14.47 $(3.79)^{b}$	10.47 $(3.28)^{b}$	16.62 $(4.11)^{b}$
T_8	*B. thuringiensis* + 50% Dinotefuran 20 SG	(1x10^{9} CFU/ml) + 20 SG	10 ml+0.125 g	52.50 (7.24)	20.10 $(4.48)^{b}$	12.93 $(3.58)^{bc}$	18.90 $(4.34)^{bc}$	36.80 (6.06)	14.73 $(3.84)^{b}$	11.20 $(3.34)^{bc}$	9.57 $(3.16)^{b}$	14.57 $(3.85)^{bcd}$
T_9	Thiamethoxam 25WG	25 WG	0.20 g	69.90 (8.29)	13.80 $(3.71)^{c}$	6.77 $(2.59)^{d}$	6.50 $(2.52)^{f}$	45.40 (6.70)	9.83 $(3.13)^{c}$	3.93 $(1.98)^{d}$	0.00 $(0.71)^{d}$	6.81 $(2.53)^{f}$
T_{10}	Dinotefuran 20 SG	20 SG	0.25 g	50.80 (7.12)	15.53 $(3.93)^{bc}$	12.13 $(3.48)^{c}$	10.47 $(3.21)^{e}$	38.23 (6.15)	13.43 $(3.65)^{bc}$	9.43 $(3.07)^{c}$	2.70 $(1.76)^{d}$	10.62 $(3.26)^{e}$
T_{11}	Un treated Control	-	-	51.00 (7.10)	49.03 $(6.98)^{a}$	51.03 $(7.13)^{a}$	54.40 $(7.38)^{a}$	36.60 (6.02)	40.23 $(6.32)^{a}$	35.07 $(5.91)^{a}$	31.23 $(5.63)^{a}$	43.50 $(6.60)^{a}$
SEm±				0.35	0.20	0.18	0.22	0.18	0.19	0.17	0.15	0.12
CD (0.05)				NS	0.60	0.54	0.67	NS	0.57	0.52	0.45	0.36

Table 2: Yield of mustard in different biopesticide and insecticide combinations during *rabi* 2021-2022

Sl. No.	Treatments	Seed yield (kg/ha)	Increase in yield over control (kg/ha)	% Increase in yield over control	Percent avoidable losses	Total cost of cultivation (Rs/ha)	Gross Income (Rs/ha)	Net Income (Rs/ha)	Benefit over control (Rs/ha)	B:C ratio
T_1	*Beauveria bassiana* + 50% Thiamethoxam 25 WG	1581.97	572.56	56.72	7.05	23801	79889.49	56088.49	27281.28	2.36:1
T_2	*Lecanicillium lecanii* + 50% Thiamethoxam 25 WG	1455.09	445.68	44.15	14.50	23801	73482.05	49681.05	20873.84	2.09:1
T_3	*Metarhizium anisopliae* + 50% Thiamethoxam 25 WG	1417.39	407.98	40.41	16.72	23801	71578.19	47777.19	18969.98	2.00:1
T_4	*Bacillus thuringiensis* + 50% Thiamethoxam 25 WG	1530.95	521.54	51.67	10.04	23801	77312.97	53511.97	24704.76	2.25:1
T_5	*Beauveria bassiana* + 50% Dinotefuran 20 SG	1394.47	385.06	38.15	18.06	24276	70420.73	46144.73	17337.52	1.90:1
T_6	*Lecanicillium lecanii* + 50% Dinotefuran 20 SG	1369.63	360.22	35.69	19.53	24276	69166.31	44890.31	16083.1	1.85:1
T_7	*Metarhizium anisopliae* + 50% Dinotefuran 20 SG	1312.12	302.71	31.94	22.90	24276	66262.06	41986.06	13178.85	1.73:1
T_8	*Bacillus thuringiensis* + 50% Dinotefuran 20 SG	1422.74	413.33	29.98	16.41	24276	71848.37	47572.37	18765.09	1.98:1
T_9	Thiamethoxam 25 WG	1701.96	692.55	68.60	-	24768	85948.98	61180.98	32373.77	2.47:1
T_{10}	Dinotefuran 20 SG	1628.62	619.21	61.34	4.31	25376	82245.31	56869.31	28062.10	2.24:1
T_{11}	Control	1009.41	-	-		22168	50975.21	28807.21	-	-
SEm±		80.61	-	-	-					
CD(0.05)		239.47	-	-	-					

Labour rate /day = Rs.304/labour (2 labour required for spraying in one hectare/day), Cost of seed = Rs. 5050/quintal,

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