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EFFICACY OF BIOPESTICIDES AND INSECTICIDES AGAINST MUSTARD APHID *LIPAPHIS ERYSIMI* (KALT.)

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ABSTRACT

A field experiment on the efficacy of biopesticides and newer insecticides against mustard aphid, *Lipaphis erysimi* (Kalt.) was conducted during 2016-17 and 2017-18. The treatment dimethoate 30%EC was found to be the most effective followed by pyriproxyfen 10%EC and buprofezin 25%SC. The maximum seed yield was obtained with dimethoate 30%EC (13.31 q ha^{-1}) followed by pyriproxyfen 10%EC (13.07 q ha^{-1}), buprofezin 25%SC (12.83 q ha^{-1}) and pymetrozine 50%WG (11.79 q ha^{-1}). The maximum net return was obtained with dimethoate 30%EC (₹21,231.00 ha^{-1}) followed by buprofezin 25%SC (₹18,661.00 ha^{-1}) and pyriproxyfen 10%EC (₹17,756.00 ha^{-1}), of which dimethoate 30%EC adversely affected the predator *Coccinella septempunctata* L.

Key words: Biopesticides, insecticides, *Lipaphis erysimi*, dimethoate, pyriproxyfen, buprofezin, pymetrozine, *Coccinella septempunctata*, predator, safety, seed yield, net return

Mustard *Brassica juncea* (L.) Czern and Coss is an important oilseed crop globally, and *Brassica* (rapeseed mustard) is the second most important edible one in India after groundnut with 6.2 million ha and productivity of 1281 kg ha^{-1} (Anonymous, 2016). Insect pests are one of the major limiting factors in mustard, and among the various insect pests, mustard aphid, *Lipaphis erysimi* (Kalt.) is the major one. The nymphs and adults of the aphid suck cell sap from the leaves, inflorescences and immature pods resulting in very poor pod setting and yield (Awasthi, 2002). Control measures with insecticides are the most important for mustard pest management, though some bioagents provide ecofriendly measures (Singh and Lal, 2012). Considering the adverse effect of insecticides, biological control is encouraged, and entomopathogenic fungi are gaining importance, along with some insect growth regulators, as these are safe (Riddiford and Truman, 1978). Recently, some pesticides of plant origin are extensively used as an alternative as they are effective against target pests, safe to man and are easily biodegradable. Various botanicals are found to be effective against insects and among them neem provides promise (Schmutterer, 1990; Strak and Waiter, 1991). The present study is find out safer insecticides to manage the aphid *L. erysimi* in mustard.

MATERIALS AND METHODS

The field experiment was laid out in a randomized block design (RBD) with eleven treatments including untreated control and replicated thrice. The variety Varuna (T- 59) recommended for this region was sown, with plot size was 5.0 x 3.6 m^2, keeping row to row and plant to plant spacing of 30 cm and 10 cm, respectively. The crop was sown on 28th October and 30th October in 2016-17 and 2017-18. The treatments included were *Beauveria bassiana* 1.15%WP (1g/ l), *Verticillium lecanii* 1.15%WP (1g/ l), *Metarhizium anisopliae* 1.15%WP (1g/ l), neem seed kernel extract (NSKE) [5.0%], emamectin benzoate 5%SG (0.005%), pyriproxyfen 10%EC (0.015%), buprofezin 25%SC (0.025%), vertimec 1.9%EC (0.00095%), pymetrozine 50%WG (0.05%), dimethoate 30%EC (0.03%) and untreated control. NSKE 5% solution was prepared following standard procedure. Two foliar sprays were given at an interval of 15 days, first spray was done when the pest population crossed ETL and second after 15 days. The incidence of aphid was recorded on 10 cm terminal central shoot/ plant and natural enemies on whole randomly selected tagged plant. Pretreatment population was recorded one day before treatment and post treatment data after 1, 3, 7 and 15 days after treatment. The data was used to compute the % reduction in incidence following Henderson and Tilton (1955). The data were statistically analysed by after transforming the data into angular transformed values (Bliss, 1937). The net profit and benefit cost ratio were worked out taking yield into account, and

Table 1. Efficacy of biopesticides and insecticides against *L. erysimi* and their economics on mustard (Pooled, 2016-17, 2017-18)

Treatments	% reduction in aphids (days after spray)										Yield (q ha^{-1})	Increase in yield over control (q ha^{-1})	Gross returns (Rs ha^{-1})*	Total expenditure (Rs ha^{-1})**	Net returns (Rs ha^{-1})	Benefit cost ratio
	First spray					Second spray										
	One	Three	Seven	Fifteen	Mean	One	Three	Seven	Fifteen	Mean						
Beauveria bassiana 1.15%WP 1g/ l	47.12* (43.35)**	60.10 (50.83)	75.26 (60.17)	38.61 (38.42)	55.27 (48.03)	48.78 (44.30)	59.80 (50.65)	73.85 (59.25)	39.44 (38.91)	55.47 (48.14)	9.74		9253.00	1815.00	7438.00	4.1
Verticillium lecanii 1.15%WP 1g/ l	49.36 (44.63)	61.85 (51.85)	73.74 (59.17)	35.59 (36.62)	55.13 (47.95)	48.87 (44.35)	61.48 (51.64)	72.39 (58.30)	37.42 (37.71)	55.04 (47.89)	9.57		8560.50	1791.00	6769.50	3.8
Metarhizium anisopliae 1.15%WP 1g/ l	45.06 (42.16)	60.07 (50.81)	72.97 (58.68)	35.51 (36.58)	53.40 (46.95)	46.45 (42.96)	59.52 (50.49)	71.87 (57.97)	37.26 (37.62)	53.77 (47.16)	9.36		7764.50	1779.00	5985.50	3.4
NSKE 5%	51.65 (45.95)	65.90 (54.27)	59.78 (50.64)	48.08 (43.90)	56.35 (48.65)	53.55 (47.04)	65.74 (54.17)	59.82 (50.66)	48.59 (44.19)	56.93 (48.98)	10.28		11312.00	1812.00	9500.00	5.2
Emamectin benzoate 5%SG 0.005%	60.39 (51.00)	79.28 (62.92)	64.26 (53.29)	55.32 (48.06)	64.81 (53.62)	62.89 (52.47)	78.65 (62.48)	64.11 (53.20)	55.82 (48.34)	65.37 (53.95)	11.28		15192.50	7119.00	8073.50	1.1
Pyriproxyfen 10%EC 0.015%	74.03 (59.36)	90.70 (72.24)	76.76 (61.18)	70.61 (57.17)	78.02 (62.04)	75.53 (60.35)	90.37 (71.92)	75.88 (60.59)	72.61 (58.44)	78.60 (62.44)	13.07	5.7	22085.00	4329.00	17756.00	4.1
Buprofezin 25%SC 0.025%	70.18 (56.90)	87.46 (69.26)	75.38 (60.25)	65.31 (53.91)	74.58 (59.72)	72.34 (58.27)	87.28 (69.11)	74.07 (59.39)	67.14 (55.02)	75.21 (60.14)	12.83	5.5	21178.00	2517.00	18661.00	7.4
Vertimec 1.9%EC 0.00095%	61.09 (51.41)	76.91 (61.28)	62.67 (52.34)	53.34 (46.92)	63.50 (52.83)	62.66 (52.33)	76.22 (60.81)	62.22 (52.07)	53.98 (47.28)	63.77 (52.99)	10.78	3.4	13241.50	4659.00	8582.50	1.8
Pymetrozine 50%WG 0.05%	61.74 (51.79)	79.10 (62.79)	64.40 (53.37)	54.88 (47.80)	65.03 (53.75)	64.03 (53.15)	78.51 (62.38)	63.79 (53.01)	55.44 (48.12)	65.44 (54.00)	11.79	4.4	17172.50	8559.00	8613.50	1.0
Dimethoate 30%EC 0.03%	78.24 (62.19)	93.09 (74.76)	83.96 (66.39)	74.55 (59.71)	82.46 (65.24)	80.08 (63.49)	92.94 (74.59)	84.09 (66.49)	76.22 (60.81)	83.33 (65.90)	13.31	6.0	23010.50	1779.00	21231.50	11.9
Untreated control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	7.35	-	-	-	-	-
S.Em.±	1.53	0.92	1.57	1.67	0.96	1.48	1.16	1.44	1.35	0.89						
CD (p= 0.05%)	4.51	2.72	4.63	4.92	2.82	4.37	3.43	4.24	3.97	2.62						

*Mean of three replications, **figures in parentheses angular transformed values; *Cost of mustard seed=Rs. 3850.00 q^{-1} *It includes cost of insecticides and labour charges safety to the predator *Coccinella septempunctata* L. was also evaluated.

RESULTS AND DISCUSSION

The pooled data on the incidence reveal that dimethoate 30%EC is significantly more effective against *L. erysimi* (93.09 and 92.94% reduction after three days in first and second treatment, respectively) followed by pyriproxyfen 10%EC and buprofezin 25%SC. Gaikwad et al. (2014), Choudhary and Singh (2015), Dutta et al. (2016) and Sharma et al. (2017) also observed that dimethoate 30%EC is more effective. With pyriproxyfen 10%EC, buprofezin 25%SC, emamectin benzoate 5%SG and pymetrozine 50%WG reduction in incidence ranged from 90.70- 79.10% with first, and 90.37- 78.51% with second spray, respectively, after three days of spray. The results of Konar et al. (2013), Gaikwad et al. (2014) and Patil et al. (2016) agree with the present ones on emamectin benzoate 5%SG with *Aphis gossypii* (Glover). Maximum seed yield was obtained with dimethoate 30%EC (13.31 q ha^{-1}) followed by pyriproxyfen 10%EC (13.07 q ha^{-1}), buprofezin 25%SC (12.83 q ha^{-1}) and pymetrozine 50%WG (11.79 q ha^{-1}). Yadav and Singh (2015) also observed maximum seed yield (1485.0 kg ha^{-1}) with dimethoate 30%EC. Maximum net return (₹21,231.50 ha^{-1}) was obtained with dimethoate 30%EC, followed by buprofezin 25SC and pyriproxyfen 10EC where the net return was ₹18,661 ha^{-1} and ₹17,756 ha^{-1}, respectively. These results corroborate with those of Kumar and Kumar (2016) on seed yield and net returns with dimethoate 30%EC. The maximum benefit cost ratio was recorded in the treatment of dimethoate 30%EC (11.9) followed by buprofezin 25%SC (7.4) (Table 1). Meena et al. (2013), Yadav and Singh (2015), Sharma et al. (2017) also found that dimethoate 30%EC was highly cost effective. The pooled data indicate that all the treatments significantly and adversely affect *C. septempunctata*; and dimethoate 30%EC results in maximum reduction (Table 2). These observations are in line with those of Varghese and Mathew (2013) who observed that dimethoate 30%EC was found to

Table 2. Effects of biopesticides and insecticides on *C. septempunctata* (Pooled, 2016-17, 2017-18)

Treatments	% reduction in occurrence days after spray									
	First spray					Second spray				
	One	Three	Seven	Fifteen	Mean	One	Three	Seven	Fifteen	Mean
Beauveria bassiana	25.77*	29.26	30.83	21.93	26.95	26.81	30.76	32.28	24.11	28.49
1.15%WP 1g/ l	(30.50)**	(32.75)	(33.73)	(27.92)	(31.27)	(31.19)	(33.68)	(34.62)	(29.41)	(32.26)
Verticillium lecanii	25.97	29.09	32.66	23.29	27.76	28.33	30.97	34.28	25.46	29.76
1.15%WP 1g/ l	(30.65)	(32.64)	(34.85)	(28.86)	(31.79)	(32.16)	(33.81)	(35.84)	(30.30)	(33.06)
Metarhizium	27.80	30.64	32.21	23.12	28.44	29.63	32.10	34.24	25.29	30.31
anisopliae	(31.82)	(33.61)	(34.58)	(28.74)	(32.23)	(32.98)	(34.51)	(35.81)	(30.19)	(33.41)
1.15%WP 1g/ l										
NSKE 5%	22.91	27.05	25.58	19.84	23.85	24.58	29.05	27.38	21.65	25.67
	(28.60)	(31.34)	(30.38)	(26.45)	(29.23)	(29.72)	(32.61)	(31.55)	(27.73)	(30.44)
Emamectin	51.41	55.41	52.43	48.08	51.83	53.24	59.26	54.91	49.58	54.25
benzoate 5%SG	(45.81)	(48.11)	(46.39)	(43.90)	(46.05)	(46.86)	(50.34)	(47.82)	(44.76)	(47.44)
0.005%										
Pyriproxyfen	54.75	59.75	56.89	52.79	56.04	55.75	63.55	59.39	54.11	58.20
10%EC 0.015%	(47.72)	(50.62)	(48.96)	(46.60)	(48.47)	(48.30)	(52.86)	(50.41)	(47.35)	(49.72)
Buprofezin 25%SC	50.09	52.76	46.28	41.14	47.57	47.52	55.85	52.59	47.26	50.80
0.025%	(45.05)	(46.58)	(42.87)	(39.89)	(43.61)	(43.58)	(48.36)	(46.48)	(43.43)	(45.46)
Vertimec 1.9%EC	45.35	53.18	48.96	44.54	48.01	52.55	55.11	53.10	47.55	52.08
0.00095%	(42.33)	(46.83)	(44.41)	(41.87)	(43.86)	(46.46)	(47.93)	(46.78)	(43.60)	(46.19)
Pymetrozine	48.07	51.95	46.79	43.01	47.46	51.76	54.08	52.72	44.11	50.67
50%WG 0.05%	(43.89)	(46.12)	(43.16)	(40.98)	(43.54)	(46.01)	(47.34)	(46.56)	(41.62)	(45.38)
Dimethoate 30%EC	71.65	80.54	70.69	60.50	70.85	75.00	82.52	72.60	62.38	73.14
0.03%	(57.83)	(63.83)	(57.22)	(51.06)	(57.32)	(60.00)	(65.28)	(58.45)	(52.16)	(58.78)
Untreated control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
S.Em.+	1.38	1.49	1.58	1.50	1.03	1.49	1.47	1.58	1.20	1.01
CD (p= 0.05%)	4.08	4.38	4.66	4.42	3.03	4.39	4.33	4.66	3.55	2.98

*Mean of three replications, **figures in parentheses angular transformed values.

be unsafe to natural enemies; Zala et al. (2015) also observed such adverse effects. NSKE, *B. bassiana, V. lecanii* and *M. anisopliae* led to least adverse effects, The present results are in agreement with those of Chakraborti (2001) on the neem-based formulations being safe to predatory coccinellids; and Meena et al. (2013) also observed similar results.

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