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Short Communication

Evaluation of Some Bio-products Against Mustard Aphid, *Lipaphis erysimi* (Kalt.)

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Mustard aphid, *L. erysimi* is the key pest of rapeseed-mustard crop in India and widely distributed throughout the world on *Brassica* crops. In India, the pest was reported to cause yield loss ranging from 65 to 96% (Bakhetia, 1984) and 15% oil reduction (Verma and Singh, 1987). In the past, number of insecticides were evaluated with some effective in the management of mustard aphid (Singh *et al*., 2007; Singh and Singh, 2009). These insecticides have been found more or less toxic to a number of parasitoids and predators i.e. *Diaeretiella rapae*, *Chrysoperla carnea*, coccinellids and *Syrphis* spp. occurs in mustard crop as natural enemies of aphid (Singh *et al*., 2007). Pesticides are also responsible for environmental pollution, health hazards to human beings, toxic to pollinators, pest resurgence, development of resistance in insect-pests and residue in oil and cake. Keeping the above facts in view in the present investigation was undertaken to evaluate some eco-friendly bio-products were evalutated against mustard aphid.

The present investigation was carried out at Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur, Rajasthan, India, during rabi season of the year 2009-10. The crop (cv. Bio-902) was sown in complete randomized block design with three replications in the plot size of 4.2 m x 3 m having the row to row and plant to plant spacing of 30 cm and 10 cm, respectively. Ten treatments i.e. neem seed kernel extract (NSKE) 5%, neem oil 1%, neem oil 2%, karanj oil 1%, coccinellid beetle @ 5000 beetles ha^{-1}, *Verticillium lecanii* @ 10^8 conidia ml^{-1}, green chilly extract 5% and azadirachtin 1500 ppm @ 0.1% including control (chemical) i.e. dimethoate 30 EC @ 300 g a.i. ha^{-1} and control were applied. Ten plants were randomly selected and tagged for counting the aphid population one day before and 3, 7 and 10 days after application of treatments on 10 cm top central twig per plant and the population of natural enemies and honeybees were also recorded. Yield was recorded from net plot and data were statistically analyzed. For phytotoxicity evaluation, crop injury was observed on visual rating basis using 0-10 scale comprising the observations on temporary or long lasting damage caused to plants on the following symptoms i.e. leaf injury on the tips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty. The incremental cost-benefit ratio (ICBR) was calculated at prevailing market price of mustard seed, cost of insecticides and laborers used with the following formulae:

ICBR = Cost (Total expenditure):Value of increased yield

Significantly low population of mustard aphid was recorded in all the treatments viz., neem seed kernel extract 5%, neem oil 1%, neem oil 2%, karanj oil 1%, coccinellid beetle @ 5000 beetles ha^{-1}, *V. lecanii* @ 10^8 conidia ml^{-1}, green chilly extract 5%, azadirachtin 1500 ppm 0.1% and control (chemical) i.e. dimethoate 30 EC @ 300 g a.i. ha^{-1} over the control at 3, 7 and 10 days after treatment application (Table 1). However, significantly low population of mustard aphid was recorded in control (chemical) i.e. dimethoate 30 EC @ 300 g a.i. ha^{-1} over the treatments i.e. coccinellid beetle @ 5000 beetles ha^{-1} and *V. lecanii* @10^8 conidia ml^{-1} after 3, 7 and 10 days of application. Maximum reduction in aphid population at 10 days after treatment was recorded in control (chemical) i.e. dimethoate (94.03%) followed by neem oil 2% (93.57%), azadirachtin 1500 ppm 0.1% (88.31%), karanj oil 1% (85.56%), neem seed kernel extract 5% (84.22%), neem oil 1% (83.47%), green chilly extract (79.26%), *V. lecanii* @ 10^8 conidia ml^{-1} (78.78%) and coccinellid beetle @ 5000 beetles ha^{-1} (74.93%) (Table 1).

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Table 1. Evaluation of bio-products against mustard aphid, Lipaphis erysimi (Kalt.) and their safety to natural enemies of mustard aphid and honeybees

Treatments	Aphid population per plant on top 10 cm central shoot				Per cent reduction of aphid at 10 days after treatment	Seed yield (kg ha^{-1})	Population of natural enemies of mustard aphid and honeybees (number per plant)		Incremental cost benefit ratio (ICBR)
	Pre-treatment	3 days after treatment	7 days after treatment	10 days after treatment			Pre-treatment	10 DAS	
Neem seed kernel extract 5%	84.30	24.30^{c}	20.40^{bc}	13.30^{bc}	84.22	2120^{b}	0.48*, 0.41** and 0.82***	0.45*, 0.33** and 0.77***	1:8.1
Neem oil 1%	72.60	22.70^{c}	16.80^{bc}	12.30^{bc}	83.47	2060^{b}	0.53*, 0.36** and 0.76***	0.48*, 0.32** and 0.75***	1:2.8
Neem oil 2%	80.90	20.50^{c}	15.83^{bc}	5.20^{bc}	93.57	2240^{b}	0.46*, 0.30** and 0.75***	0.46*, 0.31** and 0.76***	1:2.0
Karanj oil 1%	70.20	23.60^{c}	16.40^{bc}	10.10^{bc}	85.56	2180^{b}	0.56*, 0.30** and 0.79***	0.54*, 0.32** and 0.78***	1:0.8
Coccinelled @ 5000 beetles/ha	81.40	34.33^{b}	22.20^{b}	20.40^{b}	74.93	1880^{a}	0.56*, 0.35** and 0.67***	0.82*, 0.43** and 0.80***	-
Verticillium lecanii @ 10^{8} conidia/ml	77.30	36.40^{b}	22.30^{b}	16.40^{bc}	78.78	1950^{b}	0.66*, 0.38** and 0.78***	0.64*, 0.42** and 0.84***	1:4.9
Green chilly extract 5%	73.80	23.43^{c}	20.13^{bc}	15.30^{bc}	79.26	1970^{b}	0.52*, 0.35** and 0.70***	0.58*, 0.38** and 0.79***	1:8.3
Azadirachtin 1500 ppm 0.1%	78.70	21.70^{c}	15.20^{bc}	9.20^{bc}	88.31	2200^{b}	0.62*, 0.32** and 0.74***	0.56*, 0.38** and 0.75***	1:14
Control (chemical) Dimethoate 30 E C @ 300 g a.i./ha	80.40	16.60^{c}	12.10^{c}	4.80^{c}	94.03	2370^{b}	0.55*, 0.36** and 0.80***	0.50*, 0.32** and 0.73***	1:20.5
Control	78.30	90.30^{a}	126.90^{a}	170.3^{a}	-	1480^{a}	0.58*, 0.32** and 0.89***	0.66*, 0.46** and 1.05***	-
CD (p = 0.05)	NS	11.19	9.92	11.85	-	453	NS	0.21*, 0.21** and 0.30***	-

* = Coccinellids; ** = *Syrphis* spp.; *** = Honeybees.

Significantly high yield of mustard seed was obtained under all the treatments including control (chemical) (1950-2370 kg ha^{-1}) over the control except in coccinellid beetle @ 5000 beetles ha^{-1} (1880 kg ha^{-1}). The highest yield was recorded in dimethoate 30 EC @ 300 g a.i. ha^{-1} (2370 kg ha^{-1}) followed by azadirachtin 1500 ppm 0.1% (2240 kg ha^{-1}), neem oil 2% (2200 kg ha^{-1}), karanj oil 1% (2180 kg ha^{-1}), neem seed kernel extract 5% (2120 kg ha^{-1}), neem oil 1% (2060 kg ha^{-1}), green chilly extract 5% (1970 kg ha^{-1}) and *V. lecanii* @10^8 conidia ml^{-1} (1950 kg ha^{-1}) (Table 1). No phytotoxic symptoms were observed in any treatment. Singh (2007) found that oxy demeton-methyl 0.025% and NSKE 5% were most effective in reducing the aphid population with higher yield. Singh and Lal (2009) found neem seed kernel extract 5%, neem leaf extract 5% and neem oil 2% to be effective in reducing the mustard aphid population. Kumar and Singh (2009) reported that use of *V. lecanii* alone and also in combination with *C. carnea* and oxy-demeton methyl provided good aphid control.

No significant reduction in the population of coccinellids and syrphid fly was observed under any treatment including control (chemical) dimethoate at 10 days after application over the control. The population of coccinelid beetle was significantly high in the treatment of coccinellid bettle @ 5000 beetles ha^{-1} over the other treatments. No significant difference in the population of honeybee was observed at 10 days after application under any treatment except control (chemical) dimethoate (Table 1). Dhingra *et al*. (2006) found the maximum population of coccinellid (*C. septempunctata*) in the treatment of thermo and photostable tetrahydro azadirachtin-A (THA) followed by azadirachtin and lowest in oxy-demeton methyl, neem oil EC and Neemazal.

Most favorable incremental cost benefit ratio was obtained under the control (chemical) i.e. dimethoate (1:20.5) followed by azadirachtin 1500 ppm @ 0.1% (1:14.0), green chilly extract 5% (1:8.3), neem seed kernel extract 5% (1:8.1), *V. lecanii* @10^8 conidia ml^{-1} (1:4.9), neem oil 1% (1:2.8), neem oil 2% (1:2.0) and karanj oil 1% (1:0.8) (Table 1). Akhauri and Singh (2009) found that highest return (1:24.6) was obtained in NSKE 5% followed by dimethoate 30EC (22.7), imidacloprid 17.8 SL (19.4), beta-cyhalothrin (18.1), neem oil (15.9), endosulfan (14.4) and diflubenzuron (9.0) aginst mustard aphid.

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