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Evaluation of bio-rational products against turnip aphid, *Lipaphis erysimi* (Kaltenbach) on Indian mustard

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Abstract

Studies were conducted to evaluate some biorational products against *Lipaphis erysimi* (Kalt.) infesting Indian mustard (*Brassica juncea* L.). Although, chemical insecticide dimethoate 30 EC @ 1 ml/ litre water was the most effective treatment, the spray of azadirachtin 3000 ppm @ 5 ml/ litre water and azadirachtin followed by spray of *Beauveria bassiana* were the next best treatments. Maximum seed yield of 1911.1 kg/ha was obtained in dimethoate 30 EC with 39.2% yield increase over control (pooled data of two years). It was followed by azadirachtin 3000 ppm @ 5 ml/ litre water (1762.5 kg/ha, 28.4% increase over control) and azadirachtin followed by *B. bassiana* @ 2g/ litre water (1673.5 kg/ha, 21.9% increase over control) as compared to 1372.3 kg/ha in control. Thus, it can be concluded from the present study that azadirachtin 5000 ppm @ 5 ml/ litre water and azadirachtin followed by *B. bassiana* @ 2g/ litre water can be used as non-chemical options for the management of *L. erysimi.*

Keywords**:** *Azadirachtin, Beauveria bassiana, eco-friendly products, mustard aphid, Verticillium lecanii*

Introduction

Rapeseed-mustard is an important group of winter season oilseed crops. Like many other oilseed crops these energy rich crops in India are under energy deprived conditions with little inputs mostly by marginal farmers. In addition to this, a number of biotic and abiotic factors add up in preventing the realization of full yield potential of these crops. Among the various biotic constraints, turnip aphid, *Lipaphis erysimi* (Kaltenbach) is an important pest of oilseed Brassica in Indian subcontinent. Yield losses due to this pest can range from as low as 9 per cent to as high as 96 per cent (Bakhetia, 1983, Singh and Sharma, 2012, Kumar and Sangha, 2013, Kumar and Singh, 2015). Damage is caused by both adults and nymphs that draw large quantities of sap from the phloem which leads to yellowing, curling and crinkling.

At present there is no cultivar available which offers high levels of host plant resistance against aphids. Thus, this pest is primarily controlled by the use of synthetic systemic insecticides which have their own adverse effects such as development of insecticide resistance, resurgence and environment pollution besides pesticide residues in oil and cake. Given the adverse effects associated with the use of synthetic insecticides, there is a need for alternate pest management solutions. In the present study, an attempt has been made to evaluate some eco-friendly biorational products against *L. erysimi*.

Materials and Methods

The present study was carried out at Oilseeds Research Farm, Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana, India during *Rabi* 2018-19 and 2019-20 crop seasons. *Brassica juncea* var. PBR 357 was grown in plots of size 4.2 x 3.0 m following randomized block design with 7 plots each in three blocks. Sowing was deliberately delayed to second week of November as late sown crop is reported to be attacked more by this pest (Kular and Kumar, 2011, Kumar, 2011). At the time of sowing a uniform dose of nitrogen and phosphorous was applied. After three weeks of sowing, thinning was done in each plot and a plant to plant distance of 15 cm was maintained followed by manual weed removal. All the recommended package of practices for raising a good crop was followed except spray of insecticides (PAU, 2018).

Treatments were applied when the aphid population reached economic threshold level of 50-60 aphids per top 10 cm central twig of the plant (PAU, 2018). The different treatments involved: T_1: Azadirachtin 3000 ppm @ 5 ml/ litre of water followed by its second spray after 10 days, T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2 g/ litre, T_3: *Beauveria bassiana* followed by its second application after 10 days, T_4: Azadirachtin followed by application of *Verticillium lecanii* @ 2 g/ litre water, T_5: *Verticillium lecanii* @ 2g/ litre followed by

second application after 10 days, T_6: Dimethoate 30 EC @ 1 ml/litre followed by its second application after 10 days and T_7: control (water spray). Data on aphid population were recorded from top 10 cm central twig of the plant before spray, 3, 5, 7 and 10 days after spray from 10 plants selected at random from each plot. Yield data were recorded at harvest of the crop.

Statistical Analysis

Data on aphid population at different time intervals and yield data at harvest were subjected to Analysis of Variance (ANOVA) using statistical software OPSTAT (Sheoran *et al*., 1998). When the differences among means were significant (P<0.05), means were separated by LSD.

Results and Discussion

Aphid population

During 2018-19 crop season, aphid population in all the treatments was significantly lower than that in the control. After 3 days of spray, minimum aphid population of 28.4 per plant was recorded in treatment T_6: spray of dimethoate 30 EC @ 1 ml/litre water as against 59.7 aphids/ plant in control (Table 1). It was followed by T_1: azadirachtin 3000 ppm @ 5 ml/ litre water (33.2 aphids/ plant), T_2: azadirachtin followed by *Beauveria bassiana* @ 2 g/litre water (39.5 aphids/ plant). Almost similar trend was observed after 5 days of spray. After seven days of spray, an increasing trend in aphid population was

Table 1: Effect of different treatments on population of turnip aphid at Ludhiana during 2018-19

Treatment	Aphid population/ plant (days after spray)				
	Before spray	3	5	7	10
T_1: Azadirachtin 3000 ppm @ 5 ml/ litre water followed by its second spray after 10 days	48.9	33.2	27.2	33.8	41.7
T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2g/litre water	50.6	39.5	33.7	37.5	46.5
T_3: *Beauveria bassiana* followed by its second application after 10 days	53.6	42.1	40.9	46.1	57.2
T_4: Azadirachtin followed by application of *Verticillium lecanii* @ 2g/litre water	50.7	43.6	37.6	41.3	53.5
T_5: *Verticillium lecanii* @ 2g/litre water followed by its second application after 10 days	43.5	45.1	36.3	39.4	56.1
T_6: Dimethoate 30 EC @ 1 ml/litre water followed by its second application after 10 days	49.1	28.4	19.6	13.7	24.4
T_7: Control (Water spray)	45.9	59.7	66.9	70.6	75.7
LSD (p<0.05)	NS	12.0	9.7	8.5	9.6

Table 2: Effect of different treatments on population of turnip aphid at Ludhiana during 2019-20

Treatment	Aphid population/ plant (days after spray)				
	Before spray	3	5	7	10
T_1: Azadirachtin 3000 ppm @ 5 ml/ litre water followed by its second spray after 10 days	55.7	40.3	32.1	38.6	51.9
T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2g/litre water	51.3	45.3	38.1	43.5	52.8
T_3: *Beauveria bassiana* followed by its second application after 10 days	48.5	48.2	44.5	51.4	65.8
T_4: Azadirachtin followed by application of *Verticillium lecanii* @ 2g/litre water	48.9	55.7	41.1	45.3	56.5
T_5: *Verticillium lecanii* @ 2g/litre water followed by its second application after 10 days	53.8	56.9	40.1	44.3	63.6
T_6: Dimethoate 30 EC @ 1 ml/litre water followed by its second application after 10 days	51.4	21.1	16.4	12.9	34.7
T_7: Control (Water spray)	48.3	79.1	87.1	93.5	79.5
LSD (p<0.05)	NS	9.7	10.6	11.7	7.6

Table 3: Effect of different treatments on population of turnip aphid at Ludhiana (Pooled data of two years)

Treatment	Aphid population/ plant (days after spray)				
	Before spray	3	5	7	10
T_1: Azadirachtin 3000 ppm @ 5 ml/ litre water followed by its second spray after 10 days	52.3	36.8	29.7	36.2	46.8
T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2g/litre water	51.0	42.4	35.9	40.5	49.7
T_3: *Beauveria bassiana* followed by its second application after 10 days	51.1	45.2	42.7	48.8	61.5
T_4: Azadirachtin followed by application of *Verticillium lecanii* @ 2g/litre water	49.8	49.7	39.4	43.3	55.0
T_5: *Verticillium lecanii* @ 2g/litre water followed by its second application after 10 days	48.7	51.0	38.2	41.9	59.9
T_6: Dimethoate 30 EC @ 1 ml/litre water followed by its second application after 10 days	50.3	24.8	18.0	13.3	29.6
T_7: Control (Water spray)	47.1	69.4	77.0	82.1	77.6
LSD ($p<0.05$)	NS	14.5	12.5	13.1	5.1

observed in treatments T_1 to T_6 and in all the treatments after 10 days. Thus, all the eco-friendly products remained effective for maximum of up to 5 days after spray while dimethoate 30 EC remained effective for up to 7 days.

In 2019-20 crop season, a trend similar to what was observed in 2018-19 (Table 2). From the pooled data of two seasons, it is evident that all the treatments were effective in reducing the aphid population for up to 5 days after spray except dimethoate 30 EC which was effective up to 7 days (Table 3). After 3 days of spray, minimum aphid population of 24.8 per plant was recorded in the treatment T_6: dimethoate 30 EC. It was followed by T_1: azadirachtin 3000 rpm @ 5 ml/ litre water (36.8 aphids/ plant) and T_2: azadirachtin followed by *B. bassiana* (42.4 aphids/ plant). Almost similar trend was observed after 5 days of spray, thereafter an increase in aphid population was observed (Table 3).

Seed yield

During 2018-19 crop season, maximum seed yield of 2033.3 kg/ ha was recorded in the treatment T_6: dimethoate 30 EC which was significantly higher than that in the control (1427.8 kg/ha) (42.4 per cent yield increase over control) (Table 4). It was followed by T_1: azadirachtin 3000 ppm (1794.4 kg/ha, 25.6% yield increase over control) and T_2: azadirachtin followed by application of *B. bassiana* (1688.9 kg/ha, 18.2% yield increase). Similar trend was

Table 4: Effect of different treatments on the resultant yield

Treatment	Yield (kg/ ha)Per cent increase in yield over control					
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1: Azadirachtin 3000 ppm @ 5 ml/ litre water followed by its second spray after 10 days	1794.4	1730.6	1762.5	25.6	31.4	28.4
T_2: Azadirachtin followed by application of *Beauveria bassiana* @ 2g/litre water	1688.9	1658.0	1673.5	18.2	25.9	21.9
T_3: *Beauveria bassiana* followed by its second application after 10 days	1577.8	1616.7	1597.3	10.5	22.7	16.3
T_4: Azadirachtin followed by application of *Verticillium lecanii* @ 2g/litre water	1652.8	1588.9	1620.9	15.7	20.6	18.1
T_5: *Verticillium lecanii* @ 2g/litre water followed by its second application after 10 days	1544.4	1658.3	1601.4	8.1	25.9	16.6
T_6: Dimethoate 30 EC @ 1 ml/litre water followed by its second application after 10 days	2033.3	1788.9	1911.1	42.4	35.8	39.2
T_7: Control (Water spray)	1427.8	1316.7	1372.3	-	-	-
LSD ($p<0.05$)	326.4	263.0	199.8	-	-	-

observed in 2019-20 crop season. From the pooled data of two seasons, it is evident that treatment T_6: dimethoate 30 EC resulted in maximum seed yield of 1911.1 kg/ ha which was significantly and 39.2% higher than control (1372.3 kg/ha). It was followed by treatment T_1: azadirachtin 3000 ppm (1762.5 kg/ha, 28.4% increase over control) and T_2: azadirachtin followed by *B. bassiana* (1673.5 kg/ha, 21.9% increase over control).

A number of plant derived compounds are known to possess pest control properties. There are a number of plant species which possess insecticidal, antifeedant, repellent, attractant and growth inhibiting properties (Puri, 1999). Plant extracts of *Azadirachta indica*, *Lantana camara, Melia azedarach* and many other have proved toxic to turnip aphid (Pandey et al., 1977, Ali et al., 2010). Dhingra et al. (2006) reported superior control of mustard aphid with tetrahydroazadirachtin-A besides being safe to natural enemies. Kumar (2011) evaluated neem seed kernel extract (5%), neem oil (2%), azadirachtin 1500 ppm and *Verticillium lecanii* alone and in various combinations and found them to be effective in reducing the aphid population under field conditions. Pal et al. (2020a,b) have also reported dimethotate 30 EC @ 1 ml/ litre water to be the most effective treatment followed by spray of azadirachtin 3000 ppm @ 5 ml/ litre water against mustard aphid. Similarly, Kumar et al. (2020) reported dimethoate 30 EC to be the most effective against mustard aphid followed by azadirachtin 10000 ppm @ 1 ml/ litre water and azadirachtin 1500 ppm @ 1 ml/ litre water.

Conclusion

Although, chemical insecticide dimethoate 30 EC provided maximum efficacy against turnip aphid, the spray of azadirachtin 3000 ppm @ 5 ml/ litre water and *B. bassiana* @ 2g/ litre water were the next best treatments which provided effective control of aphid for up to 5 days after spray. Thus, they can be used as alternative options for the management of turnip aphid.

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