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Evaluation of insecticides for their field efficacy against turnip aphid, *Lipaphis erysimi* (Kaltenbach) on Indian mustard

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Abstract

A field study was carried out to evaluate the field efficacy of some insecticides against turnip aphid (*Lipaphis erysimi*) on Indian mustard (*Brassica juncea* L.). Different treatments were found effective in reducing the aphid population but with variable efficacy. Among them, the spray of thiamethoxam 25 WG @ 0.2 g/ litre water was found to be best treatment followed by imidacloprid 17.8 SL @ 0.25 ml/litre water over check. Thus, for effective management of turnip aphid, crop can be sprayed with either of these insecticides whenever the aphid population reaches economic threshold level.

***Keywords*:** *Clothianidine, imidacloprid, insecticides, mustard aphid, thiamethoxam*

Introduction

In the coming years the biggest challenge for oilseed Brassica researchers will be to produce more from limited land and other resources to fulfill the ever increasing demand for edible oils. At present more than half of the domestic requirement is met through imports. Thus, there is immediate need to increase production of oilseeds to meet demand and cut imports. In India, a wide range of oilseed crops viz. rapeseed-mustard, groundnut, soybean, sunflower, sesame, safflower, niger, castor, linseed, coconut, oil palm and a number of forest trees which yield oil are grown. Among these, rapeseed-mustard is an important group of winter season oilseed crops in many parts of the country. However, it has been observed that the full yield potential of these crops is not being harnessed in most parts of the growing regions. One of the ways to increase yield is to reduce the losses caused by insect-pests and diseases.

Among the different insect-pests, that confront this crop, turnip aphid *Lipaphis erysimi* (Kaltenbach) (Homoptera: Aphididae) is the most serious pest not only in India but in adjoining countries as well. It is the key pest of rapeseed-mustard which causes losses in the range of 9 to 96 per cent (Bakhetia, 1983; Singh and Sharma, 2012; Kumar and Sangha, 2013; Kumar and Singh, 2015) and if timely control interventions are not taken up, then there may be a complete crop loss. It is a phloem feeder and the nymphs and adults suck large quantities of plant sap resulting in yellowing and curling of leaves, flower buds, flowers and buds. The prolific breeding and short generation time allows this pest to multiply at a very fast rate resulting in colossal yield losses (Blackman and Eastop, 2000).

Host plan resistance is an ideal solution for sustainable pest management. But at present, there is no cultivar available that offers high levels of resistance to *L. erysimi*. Thus, chemical control is and would continue to be the first line of defense against this pest particularly under outbreak situations. A number of synthetic insecticides are available which have high efficacy against aphid pests. In the present studies some of the new insecticides were evaluated for their field efficacy against *L. erysimi*.

Materials and Methods

The present study was carried out at Oilseeds Research Farm, Department of Plant Breeding and Genetics, PAU, 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 6 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: imidacloprid 17.8 SL @ 0.25 ml/ litre water, T_2: thiamethoxam 25 WG @ 0.2 g/ litre water, T_3: acetamiprid 20 SP @ 0.1 g/ litre water, T_4: dimethoate 30 EC @ 1 ml/ litre water, T_5: clothianidine 50 WDG @ 0.12 g/ litre water and T_6: control. 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, all the treatments were effective in controlling the turnip aphid with aphid population significantly lower than that in the control. After 3-days of spray, the minimum aphid population of 14.9/ plant was recorded in thiamethoxam 25 WG @ 0.2 g/ litre water. It was followed by imidacloprid 17.8 SL @ 0.25 ml/ litre water (15.5 aphids/ plant), clothianidine 50 WDG @ 0.12 g/ litre water (17.4 aphids/ plant), acetamiprid 20 SP @ 0.1 g/ litre (23.5 aphids) and dimethoate 30 EC @ 1 ml/ litre (27.1 aphids) (Table 1). After 7 days of spray, again the minimum aphid population of 1.3/ plant was recorded in thiamethoxam 25 WG. It was followed by imidacloprid 17.8 SL @ 0.25 ml/ litre (1.4 aphids/ plant), clothianidine 50 WDG @ 0.12 g/ litre (1.5 aphids/ plant), acetamiprid 20 SP @ 0.1 g/ litre (13.1 aphids/ plant) and dimethoate 30 EC @ 1 ml/ litre (16.7 aphids/ plant). Almost similar trend was recorded after 10 and 14 days of spray.

Table 1: Bioefficacy of newer insecticides against mustard aphid at Ludhiana during 2018-19

Treatment	No of aphids/ 10 cm central twig				
	BS*	3 DAS	7 DAS	10 DAS	14 DAS
Imidacloprid 17.8 SL @ 0.25 ml/l	47.1	15.5	1.4	1.2	10.9
Thiamethoxam 25 WG @ 0.2 g/l	54.1	14.9	1.3	1.4	9.5
Acetamiprid 20 SP @ 0.1 g/l	49.7	23.5	13.1	14.3	19.4
Dimethoate 30 EC @ 1 ml/l	46.8	27.1	16.7	19.3	26.2
Clothianidine 50 WDG @ 0.12 g/l	47.9	17.4	1.5	1.2	6.9
Control	41.9	51.4	71.1	77.5	88.4
LSD (p<0.05)	NS	12.3	9.9	9.4	10.4

* BS: Before spray, DAS: Days after spray

In 2019-20 crop season, the *L. erysimi* population was generally lower than that observed during 2018-19. Aphid population in all the treatments was significantly lower than that in the control. After 3-days of spray, the minimum aphid population of 13.2 per plant was recorded in thiamethoxam 25 WG @ 0.2 g/ litre (Table 2). It was followed by imidacloprid 17.8 SL @ 0.25 ml/ litre (15.2 aphids/ plant), clothianidine 50 WDG @ 0.12 g/ litre (15.9 aphids/ plant), acetamiprid 20 SP @ 0.1 g/ litre (21.2 aphids/ plant) and dimethoate 30 EC @ 1 ml/ litre (24.9 aphids/ plant). After 7 days of spray, the three treatments viz.

Table 2: Bioefficacy of newer insecticides against mustard aphid at Ludhiana during 2019-20

Treatment	No of aphids/ 10 cm central twig				
	BS*	3 DAS	7 DAS	10 DAS	14 DAS
Imidacloprid 17.8 SL @ 0.25 ml/l	56.7	15.2	0.0	0.0	0.0
Thiamethoxam 25 WG @ 0.2 g/l	64.6	13.2	0.0	0.0	0.0
Acetamiprid 20 SP @ 0.1 g/l	49.7	21.2	16.5	19.0	11.7
Dimethoate 30 EC @ 1 ml/l	57.1	24.9	19.5	16.1	20.9
Clothianidine 50 WDG @ 0.12 g/l	55.6	15.9	0.0	0.0	0.0
Control	62.3	72.7	74.5	78.6	53.6
LSD (p<0.05)	NS	7.8	8.3	4.4	11.9

* BS: Before spray, DAS: Days after spray

thiamethoxam 25 WG, imidacloprid 17.8 SL and clothianidine 50 WDG resulted in complete control of aphid which did not develop further. Similar trend was observed after 10 and 14-days of spray.

From the pooled data of two years it is evident that all the treatments were very effective in controlling the aphid population but with varying efficacy. Among the different treatments, spray of thiamethoxam 25 WG showed maximum efficacy against *L. erysimi* followed by imidacloprid 17.8 SL, clothianidine 50 WDG, acetamiprid 20 SP and dimethoate 30 EC (Table 3).

Table 3: Bioefficacy of newer insecticides against mustard aphid at Ludhiana (two years Pooled data)

Treatment	No of aphids/ 10 cm central twig				
	BS*	3 DAS	7 DAS	10 DAS	14 DAS
Imidacloprid 17.8 SL @ 0.25 ml/l	51.9	15.4	0.7	0.6	5.5
Thiamethoxam 25 WG @ 0.2 g/l	59.4	14.1	0.7	0.7	4.8
Acetamiprid 20 SP @ 0.1 g/l	49.7	22.4	14.8	16.7	15.6
Dimethoate 30 EC @ 1 ml/l	52.0	26.0	18.1	17.7	23.6
Clothianidine 50 WDG @ 0.12 g/l	51.8	16.7	0.8	0.6	3.5
Control	52.1	62.1	72.8	78.1	71.0
LSD (p<0.05)	NS	17.4	4.7	5.1	20.6

* BS: Before spray, DAS: Days after spray

Seed yield

In 2018-19, maximum and significantly high yield of 2030.6 kg/ ha was obtained in the treatment clothianidine 50 WDG @ 0.12 g/litre which was 31.2 per cent higher than that in the control (1547.2 kg/ha) (Table 4). It was followed by thiamethoxam 25 WG @ 0.2 g/litre water (2022.2 kg/ha) and imidacloprid 17.8 SL @ 0.25 ml/litre (2005.6) which were 30.7 and 29.6 per cent higher than control, respectively. However in 2019-20, maximum and significantly high yield of 1827.8 kg/ha was obtained in the treatment thiamethoxam 25 WG @ 0.2 g/litre which was 45.2% higher than control (1258.3 kg/ha). It was followed by clothianidine 50 WDG @ 0.12 g/ litre (1791.7 kg/ha, 42.3% higher than control), imidacloprid 17.8 SL @ 0.25 ml/litre (1788.9 kg/ha, 42.1% higher than control) and acetamiprid 20 SP @ 0.1 g/litre (1544.4 kg/ha, 22.7% higher than control). From the pooled data of two years, it is evident that thiamethoxam 25 WG @ 0.2 g/litre resulted in maximum and significantly higher seed yield of 1925.0 kg/ha which was 37.2% higher than control (1402.8 kg/ha).

Table 4: The resultant yield and IBCR in different treatments in both the years

Treatment	Yield (kg/ha)			Per cent increase over control			IBCR*	
	2018-19	2019-20	Pooled mean	2018-19	2019-20	Pooled mean	2018-19	2019-20
Imidacloprid 17.8 SL @ 0.25 ml/l	2005.6	1788.9	1897.3	29.6	42.1	35.2	41.6	45.5
Thiamethoxam 25 WG @ 0.2 g/l	2022.2	1827.8	1925.0	30.7	45.2	37.2	38.9	49.6
Acetamiprid 20 SP @ 0.1 g/l	1733.3	1544.4	1638.9	12.0	22.7	16.8	17.3	28.3
Dimethoate 30 EC @ 1 ml/l	1647.2	1488.9	1568.1	6.4	18.3	11.7	7.8	19.9
Clothianidine 50 WDG @ 0.12 g/l	2030.6	1791.7	1911.2	31.2	42.3	36.2	21.3	26.1
Control	1547.2	1258.3	1402.8	-	-		-	-
LSD (p<0.05)	347.5	275.5	182.2					

* Incremental Benefit-Cost Ratio

It was followed by clothianidine 50 WDG @ 0.12 g/ litre (1911.2 kg/ha, 36.2% higher than control), imidacloprid 17.8 SL @ 0.25 ml/litre (35.2 kg/ha, 35.2% higher than control) and acetamiprid 20 SP @ 0.1 g/litre (1638.9 kg/ha, 16.8% higher than control). During 2018-19, imidacloprid 17.8 SL resulted in maximum IBCR of 41.6 followed by thiamethoxam 25 WG (38.9). However during 2019-20, maximum IBCR of 49.6 was obtained in thiamethoxam 25 WG followed by imidacloprid 17.8 SL (45.5). Lal *et al.* (2018) reported imidacloprid 17.8 SL @ 300 ml/ha to be the most effective insecticide against *L. erysimi* along with NSKE 5% followed by thiamethoxam 25 WG @ 100 g/ha. Similarly, Sen *et al.* (2017) reported imidacloprid 17.8 SL @ 20 g a.i./ha, thiamethoxam 25 WG @ 25 g a.i./ha and

diafenthiuron 50 WP @ 50 g a.i./ha to be effective against mustard aphid. Patel *et al*. (2020) recorded maximum seed yield in mustard plots sprayed with thiamethoxam 25 WG (21.69 q/ha) followed by imidacloprid 17.8 SL (21.43 q/ha) as against 10.44 q/ ha in untreated plots. Among the seven insecticides (imidacloprid, acephate, chlorpyriphos, fipronil, thiamethoxam, dimethoate and pymetrozine) tested against *L. erysimi* on mustard in Meerut, thiamethoxam 25 WG @ 100 g/ha was found to be most effective treatment with highest yield of 17.15 q/ha (Maurya *et al*., 2018).

Conclusion

From the present study, it can be concluded that all the test insecticides successfully controlled mustard aphid but with varying efficacy. Among these, thiamethoxam 25 WG @ 0.2 g/ litre water and imidacloprid 17.8 SL @ 0.25 ml/ litre water were both effective as well as economical to use for the management of *L. erysimi* on rapeseed-mustard.

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