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Bio-efficacy of insecticides against *Lipaphis erysimi* (Kalt.) in mustard ecosystem

Shweta Patel, Sunil Kumar Yadav and Chandra Pal Singh

Abstract
A Field study was conducted at Pantnagar (India) to determine the effectiveness of seven insecticides *viz*., quinalphos 25 EC, thiamethoxam 25 WG, malathion 50 EC, fenvalerate 20 EC, chlorpyrifos 20 EC, dimethoate 30 EC and imidacloprid 17.8 SL against mustard aphid, *Lipaphis erysimi* Kalt. The observations were recorded at 3, 7 and 10 days after spraying of insecticides. The results revealed that thiamethoxam 25 WG was the most effective among the seven insecticides showing the minimum numbers of *L. erysimi* Kalt followed by imidacloprid and dimethoate. The maximum seed yield (12.36 q/ha) was obtained from the treatment of imidacloprid which remained on par with the treatments of thiamethoxam (10.0 q/ha) and quinalphos (9.31 q/ha). The lowest seed yield was obtained from untreated plots (6.04 q/ha). So neonicotinoid insecticides (thiamethoxam and imidacloprid) could be used in mustard ecosystem to control mustard aphid, *Lipaphis erysimi* with high yield.

Keywords: *Lipaphis erysimi,* insecticides, bio-efficacy, mustard aphid, mustard

1. Introduction
Rapeseed-mustard is a group of the major oilseed crops grown in India next only to soybean in terms of production and ranked first in terms of oil yield. It is grown on an area of about 6.4 m ha with production of 8.02 mt and productivity is 1262 kg/ha. It has an oil content ranging from 35-45% [16]. In India, rapeseed-mustard crops include traditional indigenous species, namely toria (*Brassica campestris* L. var. toria), brown sarson (*Brassica campestris* L. var. brown sarson), yellow sarson (*Brassica campestris* L. var. yellow sarson), Indian mustard (*Brassica juncea*), black mustard (*Brassica nigra*) and taramira (*Eruca sativa*), which have been growing since about 3,500 BC together with non-traditional species such as gobhi sarson (*Brassica napus*) and karan rai (*Brassica carinata*) [23]. In India, rapeseed–mustard is grown in diverse agro-climatic conditions ranging from north-eastern/north-western hills to down south under irrigated/rainfed, timely/late sown and mixed cropping [24]. Several biotic and abiotic factors are responsible for reducing the yield. Among them, insect pests cause a considerable loss. About 50 insect species have been found infesting rapeseed-mustard in India out of which about a dozen species are considered as major pests [21]. Among the several insects infesting the mustard, mustard aphid, *Lipaphis erysimi* (Kalt.) is the most serious insect-pest of rapeseed-mustard [9]. It may cause a yield losse ranging from 35.4 to 96% in favourable conditions [18] and can reduce 5-6% oil content [22]. Both nymph and adult suck the cell sap from various parts of plant like leaves, inflorescence, tender stem and pods and cause economic damage. Due to heavy infestation, the symptoms of yellowing, curling and then drying of leaves appear, resulting in development of feeble pods and small seeds in the pods. It also secretes the honeydew which is responsible for development of sooty mould and reduces the photosynthetic rate [2]. Thus, it is mandatory to monitor mustard crop regularly during the favorable period of aphid breeding. At severe attack, the chemical control is the only choice to deal with the outbreak of the mustard aphid. Therefore, the present investigation was undertaken to evaluate the bio-efficacy of some insecticides against mustard aphid, *Lipaphis erysimi* Kalt.

2. Material and methods
A field experiment was laid out in randomized block design (RBD) to study the efficacy of some insecticides against mustard aphid, *Lipaphis erysimi* K. on mustard crop during *Rabi* season, 2015-16 at Crop Research Center of G.B. Pant University of Agriculture and Technology, Pantnagar (India) with seven treatments *viz*., quinalphos 25 EC, thiamethoxam 25

WG, malathion 50 EC, fenvalerate 20 EC, chlorpyrifos 20 EC, dimethoate 30 EC and imidacloprid 17.8 SL and untreated control, and replicated three times. The crop variety Varuna was sown on 23th October with plot size of 4.2m x 3m and distance between row to row and plant to plant was 30cm and 10cm, respectively. The recommended agronomic practices were followed. Foliar spray of different treatments was made in 600 ltr of water/ha. The population of mustard aphid was recorded from 10 cm top portion of the terminal shoot on 10 randomly selected plants from each plot one day prior and 3, 7 and 10 days after insecticide application. The yield in each treatment was recorded and expressed in q/ha.

2.1 Statistical analysis
The data were subjected to the analysis of variance using simple randomized block design (RBD) programme.

3. Results
The population of *Lipaphis erysimi*, on mustard in various treatments were recorded one day before and 3rd, 7th and 10th day after insecticide application during the crop season 2015-16. before spray, the mean population of *L. erysimi* ranged from 173.67 to 234.17 aphids per 10 cm terminal shoot (Table 1). Subsequent to spray, aphid population was significantly decreased in all the treated plots, while significantly increased in untreated plots. Data recorded on 3rd day after spray, the *L. erysimi* population was the minimum (0.23 aphids) with thiamethoxam 25 WG followed by dimethoate 30 EC (0.33 aphids) while least toxic treatments harboring highest population were fenvalerate 20EC (15.9 aphids) and malathion 50 EC (13.47 aphid). At 7th day after spray, the aphid population was again recorded minimum (0.00 aphids) with thiamethoxam 25 WG. It was then followed by imidacloprid 17.8% SL (0.20 aphids) and dimethoate 30 EC (0.67 aphids). While least toxic treatments were again malathion 50 EC (31.57 aphids) and fenvalerate 20EC (30.7 aphids).

At 10th day after spray, the aphid population was once again recorded minimum (0.00 aphids) with thiamethoxam 25 WG and imidacloprid 17.8% SL followed by dimethoate 30 EC (0.67 aphids), chlorpyriphos 20 EC (9.17 aphids), quinalphos 25 EC (37.9 aphids). Likewise previos observations, malathion 50 EC and Fenvalerate 20 EC were once again found to be least effective with high aphid population of 55.5 aphids and 47.83 aphids, respectively.

The insecticide treatments were found to be more toxic up to 3rd day after spay carrying lowest number of aphids. After that the aphid population was gradually increased and continued up to 10th day after spray (Fig. 1).

The data on yield (q/ha) (Table 1) indicated that under different insecticidal treatments, it varied significantly from 6.04 to 12.36 q/h. Maximum seed yield (12.36 q/h) was recorded from plots treated with imidacloprid 17.8 SL followed by thiamethoxam 25 WG (10 q/h). The lowest seed yield (7.22 q/h) was recorded with dimethoate 30 EC.

Table 1: Bio-efficacy of insecticides against mustard aphid, *Lipaphis erysimi* Kalt. during 2015-16.

Treatment	Dosages	Aphid Population (Number)				Yield (q/h)
		Before spray	After spray			
			3 DAS	7 DAS	10 DAS	
Quinalphos 25 EC	1ml /liter	173.67	9.87	19.27	37.9	9.31
Thiamethoxam 25 WG	0.25g/liter	178.67	0.23	0.00	0.00	10.00
Imidacloprid 17.8 SL	1ml /liter	197.5	0.43	0.20	0.00	12.36
Fenvalerate 20EC	1.5 ml/ liter	213.67	15.9	30.07	47.83	8.82
Malathion 50 EC	1 ml/ liter	205.5	13.47	31.57	55.5	7.57
Dimethoate 30 EC	1 ml/liter	210.17	0.33	0.67	0.67	7.22
Chlorpyriphos 20EC	0.10 ml/liter	234.17	3.50	4.07	9.17	8.89
Control		214.83	265	352	466.07	6.04
CD at 5%		21.30	7.70	16.45	28.19	2.91
Sem		19.86	6.72	14.35	24.59	1.92
CV		0.097	1.07	1.17	1.13	0.21

DAS: Day after spray

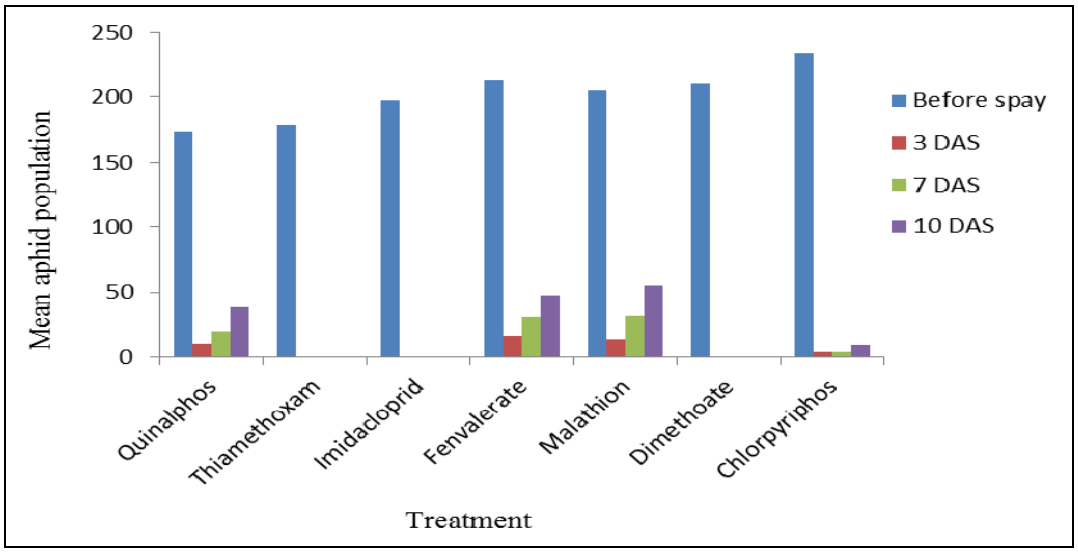

Fig 1: Effect of different treatments on the population of mustard aphid.

4. Discussion

Chemical control of aphid is the most effective and quick method specially when the population is plentiful. Newer insecticides are required in less quantity and more effective to control insect pests as compared to conventional insecticides [19]. A number of insecticides have been tested on rape-seed mustard to determine the efficacy against *Lipaphis erysimi* K. A new class of insecticide *i.e*. neonicotinoid consists of systemic insecticides which prove very effective against sucking pest on various fruit, vegetable and field crops. These are imidacloprid, thiamethoxam, acetamiprid, clothianidin, nitenpyram, nithiazine and thiacloprid. In present study, two neonicotinoid insecticides *viz*., imidacloprid and thiamethoxam were tested with some conventional insecticides against *Lipaphis erysimi* and found to be the most effective treatments in controlling the same with highest crop yield. The similar results are also found by [25, 29, 27, 5, 20, 19, 13, 17, 14, 15, 3, 1] and reported that imidacloprid and thiamethoxam are superior to other insecticides and give maximum crop yield. However, in some studies, they are found to be less effective against mustard aphid than the conventional insecticides. For example, thiamethoxam and imidacloprid are less effective against mustard aphid than acephate [4]; imidacloprid is less effective in reducing the *Lipaphis erysimi* than oxydemeton methyl on 1st and 3rd day after spay [10]; thiamethoxam and imidacloprid are less effective against mustard aphid and give less yield than difenthiuron [12]; chorpyriphos and mixture of chlorpyriphos + cypermethrin are more effective to control *Lipaphis erysimi* than thiamethoxam and imidacloprid [11]; imidacloprid is moderately toxic to *Aphis craccivora* Koch, *Aphis gossypii* Glover, *Myzus persicae* Sulzer and *Lipaphis erysimi* kaltenbach while cypermethin is the most toxic[8]; dimethoate is the most effective followed by imidacloprid and thiamethoxam against *Lipaphis erysimi* [6].

5. Conclusion

In the present study, in case of conventional insecticides, dimethoate gave the considerable control of *Lipaphis erysimi* as compared to the other conventional insecticides tested. Several researchers also reported dimethoate to be most effective against mustard aphid than the other conventional insecticieds [18, 7]. Moreover, entomopathogenic fungi (*Verticillium lecanii*) can perform well in regulating mustard aphid when applied after dimethoate [30]. Chlorpyriphos is moderately toxic to mustard aphid but more toxic than quinalphos when applied in the form of EC formulation and less toxic when applied in the form of dust on rape-seed crop [26, 28]. Malathion was the nearly least effective insecticide but it can be recommended to control mustard aphid as neonicotinoid insecticides are supposed to affect bee pollination in mustard ecosystem [13].

6. Acknowledgement

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