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In vivo toxicity of newer insecticides in comparison to conventional insecticides against *Lipaphis erysimi* (Kaltenbach)

Shweta Patel, SK Yadav and CP Singh

Abstract
Field efficacy of newer insecticides in comparison to conventional insecticides against *Lipaphis erysimi* (Kalt.) was evaluated at Norman E. Borlaug Crop Research Center of G.B. Pant University of Agriculture and Technology, Pantnagar (India) during *rabi* season of 2016-17. Results revealed that the treatments of thiamethoxam 25 WG, imidacloprid 17.8, dimethoate 30 EC, oxy-demeton methyl 25 EC, acetamiprid 20 SP, acephate 75 SP and clothianidine 50 WDP proved to be effective against mustard aphid with higher seed yield of 21.69, 21.43, 20.69, 20.41, 20.24, 20.17 and 19.35 q/ha, respectively. The least effective treatment was fipronil 5 SC with lower seed yield of 16.62 q/ha.

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

Introduction
Rapeseed-mustard is a major oilseed crop grown in India next to soybean in terms of production and ranked first in terms of oil yield among all oilseed crops. It is grown on an area of about 6.4 m ha with a production of 8.02 MT and productivity is 1262 kg ha^{-1}. It has an oil content ranging from 35 to 45 percent. It is planted on more than 80 percent of oilseeds. Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana and Gujarat are the leading states for mustard crop accounting for more than 70 percent of the total mustard area in the country. Even after the availability of good production technology mustard crop is unable to give potential yield in the country. This is because *Brassica* crops suffer heavy loss in yield due to various biotic and abiotic factors. Among the biotic constraints, insect-pests are one of the most important biotic factors in reducing the crop yield (Patel and singh, 2017) [2, 3]. Out of many insect pests, mustard aphid, *Lipaphis erysimi* is considered important which causes considerable yield losses. 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 (Patel *et al.*, 2017) [2, 3]. Heavy infestation of aphid depends upon favorable climatic conditions, therefore monitoring is necessary throughout the year. Many controlling measures are adopted to manage the mustard aphid population below economic injury level like chemical, mechanical, physical, cultural, host plant resistance and biological control. Among these, at severe attack, the chemical control is very important and provides significantly control. Therefore, the present study was conducted to determine the toxicity of some insecticides against mustard aphid, L. *erysimi* under field conditions.

Materials and methods
A field experiment was laid out in randomized block design (RBD) to study the efficacy of eight insecticides against mustard aphid, *Lipaphis erysimi* K. on mustard crop during *Rabi* season, 2016-17 at Norman E. Borlaug Crop Research Center of G.B. Pant University of Agriculture and Technology, Pantnagar (India). The insecticides used were fipronil 5 SC, thiamethoxam 25 WG, imidacloprid 17.8 SL, acetamiprid 20 SP, clothianidine 50 WDP, acephate 75 SP, dimethoate 30 EC and oxy-demeton methyl 25 EC along with untreated control and replicated thrice. The crop variety Varuna was sown on 28th 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 500 liters of water/ha. The population of mustard aphid was recorded from 10 cm CSL (central shoot length) 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.

Statistical Analysis

The data were subjected to the analysis of variance using simple randomized block design (RBD) programme by STPR 3 software.

Results and Discussion

Population of L. *erysimi* on mustard in various treatments were recorded one day before and 3rd, 7th and 10th day after insecticide application. Before spray, the mean population of L. *erysimi* ranged from 40.67 to 149.0 aphids per 10 cm central shoot (Table 1). After spray, aphid population was significantly decreased in all the treated plots, while significantly increased in untreated plots. On 3rd day after spray, the L. *erysimi* population was the minimum (0.23 aphids) with dimethoate 30 EC followed by imidacloprid 17.8 SL (0.73 aphids), thiamethoxam 25 WG (0.90 aphids), acetamiprid 20SP (0.93 aphids), oxy-demeton methyl 25 EC (1.77 aphids), clothianidine 50 WDP (2.06 aphids) and acephate 75 SP (2.33 aphids) which were on par with each other's while least toxic treatments harboring highest population was fipronil 5 SC (29.47 aphids).

On 7th day after spray, the aphid population was zero in the treatments of thiamethoxam 25 WG, imidacloprid 17.8 SL, dimethoate 30 EC and clothianidine 50 WDP. They were followed by acetamiprid 20SP (0.23 aphids), oxy-demeton methyl 25 EC (0.40 aphids) and acephate 75 SP (0.80 aphids) while least toxic treatments were again fipronil 5 SC (8.73 aphids).

On 10th day after spray, the aphid population was also zero in the treatments of thiamethoxam 25 WG, imidacloprid 17.8% SL, dimethoate 30 EC, clothianidine 50 WDP, acetamiprid 20SP, acephate 75 SP and oxy-demeton methyl 25 EC. Likewise a previous observation, fipronil 5 SC was once again found to be least effective with high aphid population of 1.17 aphids.

The data on yield (Table 1) indicated that under different insecticidal treatments, it varied significantly from 10.44 to 21.69 q/h. Maximum seed yield (21.69 q/h) was recorded in the plots treated with thiamethoxam 25 WG followed by imidacloprid 17.8 SL (21.43 q/h). The lowest seed yield (16.62 q/h) was recorded with fipronil 5 SC.

The order of efficacy of these treatments was dimethoate 30 EC > imidacloprid 17.8 SL > thiamethoxam 25 WG > acetamiprid 20SP > clothianidine 50 WDP > oxy-demeton methyl 25 EC > acephate 75 SP > fipronil 5 SC. The effectiveness of the aforesaid insecticides in mustard aphid control is in close conformity with the findings of Vekeria and Patel (2000) [6] and Choudhury and Pal (2005) [1].

A number of insecticides have been tested on rapeseed-mustard to determine the efficacy against *Lipaphis erysimi* Kalt. A large number of systemic insecticides were found very effective against sucking pest on various fruit, vegetable and field crops. These are imidacloprid, thiamethoxam, acetamiprid, clothianidin, and dimethoate. Imidacloprid and thiamethoxam were found most effective against mustard aphid in field as reported by Rohilla *et al*. (2004) [5]. Prasad and Dey (2006) [4] found that imidacloprid was significantly superior even after 14 days of treatment. Patel *et al*. (2017) [2, 3] evaluated seven insecticides in the field against mustard aphid. The plots treated with imidacloprid resulted into the maximum mortality of mustard aphid with highest yield (12.36 q ha^{-1}).

Thus, the present study could be concluded that among all the tested insecticides, dimethoate 30 EC, thiamethoxam 25 WG and imidacloprid 17.8 may be recommended for effective management of mustard aphid, *L. erysimi* in mustard crop. As rapeseed-mustard are consumed as vegetables in some parts of the country and also provides edible oils for humans and cakes for cattle, the application of these insecticides on these crops should be need-based.

Table 1: Toxicity of insecticides against mustard aphid, L. *erysimi* (Kalt.) during 2016-17

Treatment	Dosages	Aphid Population (Number)					Yield (q/ha)
		Before spray	After spray				
			3DAS	7 DAS	10 DAS	Mean	
Fipronil 5 SC	2 ml /liter	70.00	29.47	8.73	1.17	13.12	16.62
Thiamethoxam 25 WG	0.25g /liter	61.50	0.90	0.00	0.00	0.30	21.69
Imidacloprid 17.8 SL	0.25ml/liter	45.57	0.73	0.00	0.00	0.24	21.43
Acetamiprid 20SP	0.15g/liter	40.67	0.93	0.23	0.00	0.39	20.24
Clothianidine 50 WDP	0.3 g /liter	149.0	2.06	0.00	0.00	0.69	19.35
Acephate 75 SP	1g/liter	43.50	2.33	0.80	0.00	1.04	20.17
Dimethoate 30 EC	1ml/liter	64.33	0.23	0.00	0.00	0.08	20.69
Oxy-demeton methyl 25 EC	1ml/liter	84.17	1.77	0.40	0.00	0.72	20.41
Control	Water	59.00	84.17	65.73	27.23	59.04	10.44
CD at 5%	-	50.87	43.01	33.22	13.85	-	5.42
Sem	-	11.06	9.35	7.22	3.01	-	1.18
CV	-	48.35	205.99	257.02	286.36	-	18.60

DAS: Day after spray

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