ISSN 0258-7122 (Print), 2408-8293 (Online)
Bangladesh J. Agril. Res. 42(3): 563-570, September 2017

EFFECT OF SOME NEW GENERATION INSECTICIDES ON THE POPULATION ABUNDANCE OF APHID AND DIFFERENT BENEFICIAL INSECTS IN MUSTARD CROP

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Abstract

The present study evaluated the efficacy of some new generation insecticides namely Clothianidin 48 SC, Fenpyroximate 5 SC, Pyridaben 20 WP and Methoxyphenozide 24 SC along with a synthetic pyrethroid insecticide, Fenpropathrin 20 EC against mustard aphid and their effects on beneficial insects i.e. syrphid flies and foraging honeybees during 2015 - 2016 in Bangladesh Agricultural Research Institute, Gazipur, Bangladesh. Tested six treatments were: Clothianidin 48 SC 1ml l^{-1}, Fenpyroximate 5 SC 0.25 ml l^{-1}, Pyridaben 20 WP 1g l^{-1}, Methoxyphenozide 24 SC 1ml l^{-1} , Fenpropathrin 20 EC 1ml l^{-1} and an untreated control, replicated three times in RCBD. It was found that, Methoxyphenozide 24 SC was found to be the most effective against aphid offering lower aphid population (1.42/ top 10 cm central twig) at 7 days after spraying (DAS) which was statistically identical to Clothianidin 48 SC (1.50/top 10 cm central twig). Among the insecticides, Methoxyphenozide 24 SC was also found to be safer to the populations of syrphid flies revealing flight activity of 6.85 adults (plot/5 min) and honeybees of 8.82 workers (plot/5 min), respectively at 7 DAS. Whereas, Clothianidin 48 SC and Pyridaben 25 WP treated plots were found to be highly toxic to these beneficial insects. Consequently, the highest yield was obtained from Methoxyphenozide 24 SC (1.55 t/ha) followed by Fenpyroximate 5 SC (1.42 t/ha) treated plots.

Keywords: New generation insecticides, aphid, beneficial insects, mustard crop.

Introduction

In Bangladesh, Rapeseed-mustard (*Brassica rapa*) is an important oil yielding crop. But its production is seriously hampered due to attack of various insect-pests. Among them mustard aphid, *Lipaphis erysimi* (Kalt.) is the most destructive pest in all the mustard growing regions of the country. Aphid population and rate of infestation are very much dependent on sowing time (Islam *et al*., 1991). Aphid sucks the cell sap from the stems, twigs, buds, flowers and developing siliqua causing a significant loss in yield. On the other hand, aphid produces honey dew which facilitates the growth of the fungus that makes the plant parts black (Awasthi, 2002). *Lipaphis erysimi* may cause upto 96 %

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yield loss (Bakhetia and Sekhon 1989, Bakhetia and Arora 1986) and 15 per cent oil loss ((Verma and Singh1987) of mustard.

Currently, growers rely heavily on conventional and broad spectrum insecticide use to suppress attack of mustard aphid. The pesticidal sprays have become a threat to mustard ecosystem causing resurgence of pest and threat to natural enemy fauna. Indiscriminate use of insecticides has many side effects, such as development of insecticide resistance in insect pests, adverse effects on friendly organisms, environmental pollution and accumulation of toxic elements in food and ultimately pesticide residue-induced diseases in human beings (Ambethger, 2009). Against this backdrop, the use of new generation insecticides could be considered as possible alternative for controlling aphid.

Syrphid fly (*Allograpta obliqua*) larva are generally important predators of aphid and adults are considered important agents in the cross pollination of mustard. Honeybees are primary pollinators of mustard crop and hence they are important to increase productivity of mustard crop (Hayter and Cresswell, 2006). Coccinellid beetles (Lady bird beetle), *Coccinella septempunctata* are important entomophagous predators upon many species of aphids and observed as an efficient and mightiest predator of *L. erysimi* in field conditions (Singh and Singh 2013). However, there are scanty information about the adverse effects of the new generation insecticides on these predatory arthropods and pollinating agents.

Keeping the above points under consideration, the present studies were undertaken to evaluate the effect of certain new generation insecticides on the population abundance of aphid and the predator syrphid fly and the pollinator honeybee.

Materials and Method

Experimental design and treatments

The experiment was carried out in the research field of Bangladesh Agricultural Research Institute (BARI) during 2015-16. The experiment was laid out in a randomized complete block design (RCBD) with 3 replications having plot size of 4 × 3m and spacing between row to row and plant to plant as 30 cm and 10 cm, respectively. The mustard cultivar BARI- Sarisha 14 was sown on November 16, 2015. There were six treatments including control. Four new generation insecticides, Clothianidin 48 SC @ 1 ml/ litre water, Fenpyroximate 5 SC @ 0.25 ml/ litre water, Pyridaben 20 WP @ 1 g/ litre water and Methoxyphenozide 24SC @ 1 ml/ litre water along with a synthetic pyrethroid insecticide, Fenpropathrin 20EC @ 1 ml/ litre water were applied to evaluate their effectiveness against mustard aphid and relative toxicity to predator syrphid fly and foraging honeybee.

In the present investigation coccinellid beetle population was very low throughout the cropping season. Hence, toxicity of the tested insecticides to coccinellid beetle could not be studied.

The test insecticides were sprayed twice with the help of an air compression high volume sprayer at spray volume rate of 500 litres/ha. The first spray of insecticides was given when the aphid population reached ETL (50 aphids / plant) and second after an interval of 10 days. During application care was taken to maintain the distance around 25 cm between the nozzle and plant parts. The whole plant was thoroughly covered by spray fluid. Adequate safety measures were taken during spraying. Necessary agronomic practices were done to raise a good crop.

Recording of data

The data on different parameters were recorded following Dutta *et al*. 2016. The aphid population was recorded on 10 randomly selected plants per plot. On each plant, 10 cm top central twigs were observed to record aphid. The data on surviving aphid population was recorded. Population of foraging honeybee and syrphid fly were counted seperately from whole plot during peak foraging time for 5 minutes and was recorded as mean population per plot.

Pre-count observation of aphid, syrphid fly and honeybee were recorded one day before spraying and subsequent post count data at 3 and 7 days after spraying (DAS) were also recorded. Three species (*Apis mellifera*, *A. dorsata and A. cerena indica*) of honey bee were noticed but data were taken together as honeybees. The seed yield of mustard was taken

from the each treated and untreated control plot.

Statistical analysis

Data were analyzed by using MSTAT-C software for analysis of variance and treatment means were separated by applying Duncan’s Multiple Range Test (DMRT) at 1 % level of significance.

Results and Discussion

Result

Population reduction of aphids as influenced by different insecticidal treatments: It is evident from Table 1 that all the insecticidal treatments were significantly superior to untreated control in reducing aphid population. At 3 days after spraying (DAS), methoxiphenozide showed lowest population with 3.20 aphids/ top 10 cm in central twig as against 25.68 aphids/ top 10 cm in central twig of untreated control plot. But Efficacy of methoxiphenozide was statistically similar to clothianidin. Similarly, percent reduction of aphid population over pretreated at 7 DAS was recorded highest from methoxiphenozide (94.83%) followed by clothianidin (94.48%), while this was lowest in untreated control (3.18%) were only water was sprayed.

Table 1. Effect of different on the population reduction of aphid in mustard crop.

Treatments	Mean Aphid population/ top 10 cm central twig of plant			Per cent reduction of aphid population over pretreated at 7 DAS
	1 DBS	3DAS	7 DAS	
Clothianidin 48SC	27.15	3.86d	1.50d	94.48
Fenpyroximate 145SC	27.42	6.50c	3.62c	86.79
Pyridaben25WP	27.22	6.56c	3.98c	85.37
Methoxyphenozide 24SC	27.45	3.20d	1.42d	94.83
Fenpropathrin 20EC	28.21	10.25b	6.21b	77.98
Untreated control (water spray only)	28.25	25.68a	27.35a	3.18
CV%	8.95	11.02	12.65	-

Means having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT. DBS= Day before spray; DAS= Day after Spray

Population of adult syrphid fly as influenced by different insecticidal treatments: The results presented in Table 2 indicated that there were significant variations in syrphid fly population in different treatments. At 3DAS, among the insecticides, significantly the highest population of syrphid fly was observed in plots treated with Methoxyphenozide (7.35 flies/ plot / 5 min) which was followed by Fenpyroximate (4.95 flies/ plot / 5 min). The similar result was found at 7 DAS. Among the insecticides , the syrphid fly population reduction over pretreated at 7 DAS was found highest (83.31%) in clothanidin while this was the lowest in methoxiphenozide (44.08%) treated plots.

Population of foraging honey bee as influenced by different insecticidal treatments: The results presented in Table 3 indicated that population of foraging bee was significantly different among the treatments after insecticidal applications at both 3 DAS and 7 DAS. At 3 DAS, among the tested insecticides Methoxiphenozide recorded the maximum bee population (8.32 bees/plot/5 min) which was followed by Fenpyroximate (6.43 bees/plot/5 min). The lowest bee population (3.43 bees/plot/5 min) was obtained from Clothianidin treated plots. A similar trend was also observed at 7 DAS. Consequently, Clothianidin recorded highest decrease of honey bee population over pretreatment at 7 DAS (86.44%) indicating its higher toxicity to bee pollinators followed by Pyridaben (83.54%). However, in control plots bee population remained almost same showing a little increase (2.43%) at 7 days after spray.

Table 2. Effect of different insecticides on the population of adult syrphid fly in mustard crop.

Treatments	Mean syrphid fly population/plot/5 min			Per cent decrease(-) / increase (+) of syrphid fly population over pre treatment at 7 DAS
	1 DBS	3DAS	7 DAS	
Clothianidin 48SC	12.05	2.25d	2.01d	(-)83.31
Fenpyroximate 145SC	12.84	4.95c	4.87c	(-)62.07
Pyridaben 25WP	11.82	2.01d	2.42d	(-)79.53
Methoxyphenozide 24SC	12.25	7.35b	6.85b	(-)44.08
Fenpropathrin 20EC	11.65	4.62c	4.04c	(-)65.32
Untreated control (water spray only)	12.12	12.25a	12.45a	(+)2.72
CV(%)	8.55	10.15	11.65	-

Means having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT. DBS= Day before spray; DAS= Day after Spray

Table 3. Effect of different insecticides on the population of foraging honeybee in mustard crop.

Treatments	Mean honey bee population/plot/5 min			Per cent decrease(-) / increase (+) of honey bee population over pre treatment at 7 DAS
	1 DBS	3DAS	7 DAS	
Clothianidin 48SC	16.60	3.43d	2.25d	(-)86.44
Fenpyroximate 145SC	15.32	6.43b	6.07bc	(-)60.74
Pyridaben25WP	16.10	3.13d	2.65d	(-)83.54
Methoxyphenozide 24SC	15.02	8.32c	8.82b	(-)41.28
Fenpropathrin 20EC (water spray only)	16.23	5.62bc	5.64b	(-)65.25
Untreated control	15.64	15.95a	16.02a	(+)2.43
CV(%)	6.85	11.24	10.26	-

Means having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT. DBS= Day before spray; DAS= Day after Spray

Seed yield of mustard as influenced by different insecticidal treatments: Table 4 indicated that there were significant variations of seed yield of mustard due to spraying of different insecticides. Significantly the highest yield was obtained from Methoxyphenozide (1.55 t/ha) and this was followed by Fenpyroximate (1.42 t/ha) treated plots. However, the lowest yield was obtained from untreated control plots (1.02 t/ha) followed by clothainidin treated plots (1.25 t/ha). Similarly, Methoxyphenozide treated plots offered the highest (51.56%) yield increase over control followed by Fenpyroximate (38.86%) treated plots. On the contrary, Clothianidin 48SC provided significantly the lowest (22.36%) yield increase over control followed by Pyridaben 25WP (24.51%).

Table 4. Effect of different insecticides on seed yield of mustard crop

Treatments	Seed yield (t/ha)	% Yield increase over control
Clothianidin 48SC	1.25b	22.36
Fenpyroximate 145SC	1.42ab	38.86
Pyridaben25WP	1.28b	24.51
Methoxyphenozide 24SC	1.55a	51.56
Fenpropathrin 20EC	1.41ab	37.30
Untreated control (water spray only)	1.02c	-
CV (%)	7.52	-

Means having same letter(s) in a column are not significantly different at P> 0.01 followed by DMRT.

Discussion

Over the years many insecticide groups having diverse mode of action has been studied to control mustard aphid. Chandra *et al.* (2014) evaluated different insecticides for the management of aphid and found imidacloprid 17.8 SL to be most effective followed by acetamiprid 20 SP. However, Rajesh *et al.* (2013) obtained maximum protection of mustard crop and highest yield by applying thiamethoxam 25% WDG @100 g/ha. Youn *et al*. (2003) also observed that Thiamethoxam was most effective in controlling *L. erysimi* population.

Maula *et al*. (2010) found that Oxydemeton methyl 25EC was most effective among the three insecticides causing the highest mortality of mustard aphid followed by Dimethioate 40EC. But they observed lowest mortality of *Coccinella septempunctata* in Dimethoate 40EC treated plots. Singh and Lal (2011) also found Oxydemeton methyl 25 EC @ 0.05% as the most effective against mustard aphid resulting in significantly higher yield as compared to other tested insecticides. Rajagopal and Kareen (1984), and Tripathi *et al.* (1988) observed that Dimethoate was relatively safe to the predator.

Kumar and Kumar (2016) studied the efficacy of several biopesticides and chemical insecticides against mustard during Rabi season 2012-2015 in Allahabad, India and obtained significantly higher seed yield and net return with spraying of dimethoate 30 EC followed by malathion 50 EC and neem oil (0.5%), respectively.

Dutta *et.al*. (2016) evaluated some new generation insecticides and a botanical against mustard aphid and assessed the effect of insecticides on the abundance of coccinellid predators and foraging honeybees. They observed Buprofezin 40 SC and Diafenthiuron 500SC were most effective against aphids while Azadiractin 1EC appeared to be safest to coccinellid beetles and foraging honeybees. They also reported that the Indoxacarb 145SC was most toxic against honeybees.

The findings of the present study reveal that, Methoxyphenozide insecticide showed higher effectiveness in controlling mustard aphid and provided higher seed yield as compared to other tested products. In view of safety to syrphid fly and honeybees Methoxyphenozide proved to be relatively safest insecticide. On the other hand, clothaianidin and pyridaben was highly toxic to both syrphid fly and foraging honeybees. The highest yield was also obtained from Methoxyphenozide treated plots. More effective and safer insecticides must be introduced for aphid management in mustard to provide alternatives to conventional insecticides. So, from the present study, it could be concluded that, Methoxiphenozide might be a viable component in mustard aphid IPM program. Widespread adoption of Methoxiphenozide among mustard IPM programs across the country will benefit producers by reducing total insecticide applications and subsequent costs for aphid control, as well as limiting further resistance development in pest populations. However, the efficacy of Methoxiphenozide across different locations with varied ecology in Bangladesh should be evaluated.

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