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Efficacy of some newer insecticides against mustard aphid *Lipaphis erysimi* Kalt. in cauliflower

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Abstract
A field experiment on cauliflower *var*. Pusa Snowball-16 was conducted during Rabi season of year 2014-15 at CSAUA&T, Kanpur. Among the various insecticides evaluated against the mustard aphid, *Lipaphis erysimi* Kalt, imidacloprid 17.8 SL @ 0.2 g/litre showed highest reduction. Imidacloprid 17.8 SL @ 0.2 g/litre reduce the 87.53 % incidence of mustard aphid followed by fipronil 5 SC @ 1.0 ml/litre 83.56 % reduction at 7 days after Ist spray, respectively. Similarly same trend was noticed after 15 days of spraying in which both the chemicals registered 83.86 % and 78.90 %. The experiment was repeated after 15 days to check the aphid population and it was observed that imidacloprid 17.8 SL @ 0.2 g/litre was found best followed by fipronil 5 SC @ 1.0 ml/litre and neem oil 2 % @ 2.0 ml/litre, when the data was recorded after 7 and 15 DAS.

Keywords: Cauliflower, efficacy, *Lipaphis erysimi*, newer insecticides

1. Introduction
Cauliflower, *Brassica oleracea var. botrytis* L. is one of the most important winter vegetable cole crops in our country. India is the second largest producer of cauliflower in the world after China [1]. It shares near about 4.6 percent of the total area under vegetables and 5.3 per cent of total production. It is rich in minerals and also good source of vitamin A and B1. This is an important cruciferous vegetable subjected to attack by a large number of insect-pests throughout its growth phase, which act as limiting factor in the profitable cultivation of these crops [2]. The insect pests *viz*., aphid (*Lipaphis erysimi* Kalt. and *Brevicoryne brassicae* L.), diamond back moth, (*Plutella xylostella* L.), cabbage borer (*Hellula undalis* Fabr.), cabbage looper (*Trichoplusiani* Hb.), leaf webber (*Crocidolomia binotalis* Zell.), painted bug (*Bagrada cruciferarum* Kirk.) and cabbage butterfly (*Pieris brassicae* L.), tobbaco caterpillar (*Spodoptera litura* Fab.) etc., are having more significance on cauliflower which affect the yield and quality throughout the country [3].
Among the insect pests, mustard aphid, *L. erysimi* (Aphididae: Hemiptera) are the most important pests causing severe yield loss to cauliflower every year and it plays a prominent role in reducing the yield ranging from 50 to 80 % [4-5].
The major concern in chemical control is the development of insecticidal resistance, resurgence, pest outbreak etc., against most of the commonly used broad spectrum insecticides in the field. This has necessitated the use of alternative eco-friendly insecticides to sustain the management of insect-pests and the development of resistance against these traditional insecticides can be easily breakdown by using the newer group of molecules. The substitution of older recommendations or other conventional insecticides with newer safer insecticidal molecules have reduced the hazards effect on natural enemies.In this context, the present study was carried out to the efficacy of few newer insecticides under field condition for their comparative efficacy against mustard aphid.

2. Materials and Methods
The efficacy of newer insecticides was evaluated against mustard aphid, *L. erysimi*. at Student Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during Rabi season of the year 2014-15. The estimation of aphid population was based on the numerical count method [6]. For recording the aphid population marked leaves were grasped at the petiole by thumb and fore finger and twisted until entire underside of the leaves were

clearly visible. The observations on aphid population were recorded at weekly intervals with the help of magnifying lens. The mean number of aphids was recorded by taking the aphid population (both nymph and adult) per leaf present on three leafs (upper, middle and lower) from each of randomly 5 selected plants per plot and same expressed as numbers of aphids per three leaves/plant. Pre-treatment counts of aphid population were taken one day prior in all the plots just before the application of insecticides. Post-treatment counts of aphid population were taken after 7th and 15th days of application of treatments. Similar observations were also taken after 2nd applications of treatments.

The experiment on insecticides evaluation was laid out in Randomized Block Design with three replications. The efficacy of treatments was recorded in respect of percent reduction of population of pests.

The formula used for the calculation of percentage reduction of pest population over control using following formula giving by Henderson and Tilton (1955) [7] referring it to be modification of Abbott (1925) [8].

$$\text{Per cent efficacy} = \left(1 - \frac{Ta}{Ca} \times \frac{Cb}{Tb}\right) \times 100$$

Where,

Ta = Number of insects on treated plots after insecticidal application

Tb = Number of insects in treated plots before insecticidal application

Ca = Number of insects in untreated plots after insecticidal application

Cb = Number of insects in untreated plots before insecticidal application

The data on percentage reduction of aphid population were transformed into angular values (Bliss, 1937) [9] subjected to analysis of variance.

3. Result and Discussion

To suppress the mustard aphid, *L. erysimi* two sprays of newer insecticidal molecules *viz.*, spinosad 45 SC @ 0.5ml/ litre, fipronil 5 SC @ 1.0 ml/ litre, Chlorantraniliprole 18.5 SC @ 0.3 g/litre, flubendiamide 48 SC @ 0.3 ml/ litre, emamectin benzoate 5 SG @ 0.2 g/litre, neem oil 2 % @ 2.0 ml/litre and imidacloprid 17.8 SL @ 0.2 g/litre were conducted at weekly intervals.

3.1 First spray

The aphid population in each treatment before spraying was approximately uniform in each plot and varied non-significantly ranging from 35.30 to 39.67 aphids per 3 terminal leaves (Table 1). All the treatments except spinosad 45 SC @0.5ml/litre was significantly effective in reducing the aphid population after 7 days of spraying in comparison to untreated control. Imidacloprid 17.8 SL @ 0.2 g/ litre had its superiority and it recorded 4.97 aphids per 3 terminal leaves and provided 87.53 % reduction in population over untreated control. Fipronil 5 SC @ 1.0 ml/ litre and neem oil 2 % @ 2.0 ml/ litre recorded 6.40 and 11.57 aphids per 3 terminal leaves and they provided 83.56 and 70.92 % reduction in population over untreated control, respectively. Chlorantraniliprole 18.5 SC @ 0.3 g/ litre was statistically at par with flubendiamide 48 SC @ 0.3 ml/ litre with 13.43 and 14.33 aphids per 3 terminal leaves and they provided 64.34 and 63.00 % reduction in population over untreated control, respectively. Emamectin benzoate 5 SG @ 0.2 g/ litre gave 54.16 % reduction in aphid population, while spinosad 45 SC @ 0.5ml/ litre was significantly poor but superior over untreated control in reducing aphid population. The efficacy of all the insecticides decreased after 15 days of application, though they were significantly superior over untreated control. Imidacloprid 17.8 SL @ 0.2 g/ litre was most effective treatment having only 14.80 aphids per 3 terminal leaves with 83.86 % reduction over untreated control. Fipronil 5 SC @ 1.0 ml/ litre and neem oil 2 % @ 2.0 ml/ litre were proved effective in reducing aphid population by 78.90 and 67.73 % over untreated control, showing their statistical parity with each other. The efficacy of Chlorantraniliprole 18.5 SC @ 0.3 g/litre and flubendiamide 48 SC @ 0.3 ml/litre was 58.93 and 57.71 % in reducing aphid population over untreated control and were moderately effective at par among them. Emamectin benzoate 5 SG @ 0.2 g/litre and spinosad 45 SC @ 0.5ml/litre application were significantly inferior but superior over untreated control against aphid.

3.2 Second spray

The treatments, imidacloprid 17.8 SL @ 0.2 g/litre, fipronil 5 SC @ 1.0 ml/ litre and neem oil 2 % @ 2.0 ml/ litre were very promising after 7 days of spraying, which gave lesser aphid population i.e. 1.67, 2.73 and 6.37 aphids per 3 leaves with 85.45, 81.31 and 72.15 % reduction in comparison to untreated control, respectively. Meanwhile Chlorantraniliprole 18.5 SC @ 0.3 g/ litre and flubendiamide 48 SC @ 0.3 ml/ litre showed 62.50 and 60.70 % reduction of aphid population over untreated control, respectively. The performance of emamectin benzoate 5 SG @ 0.2 g/litre and spinosad 45 SC @ 0.5ml/litre was significantly poor but superior over untreated control in reducing aphid population. As regards the efficacy of treatments, imidacloprid 17.8 SL @ 0.2 g/ litre, fipronil 5 SC @ 1.0 ml/ litre and neem oil 2 % @ 2.0 ml/ litre had recorded 88.09, 84.54 and 73.92 % reduction of aphid population, respectively. The efficacy of Chlorantraniliprole 18.5 SC @ 0.3 g/ litre and flubendiamide 48 SC @ 0.3 ml/ litre were statistically at par and proved moderately effective with 62.86 and 58.41 % reduction in aphid population over untreated control. Emamectin benzoate 5 SG @ 0.2 g/ litre and spinosad 45 SC @ 0.5ml/ litre were significantly poor but superior over untreated control. Thus almost all the treatments were found effective to minimize the aphid population after 7 days and significantly superior over untreated control. The most effective treatment was imidacloprid 17.8 SL @ 0.2 g/ litre followed by fipronil 5 SC @ 1.0 ml/ litre, and neem oil 2 % @ 2.0 ml/litre to reduce the aphid population. Spraying with Chlorantraniliprole 18.5 SC @ 0.3 g/ litre and flubendiamide 48 SC @ 0.3 ml/ litre provided moderate control of aphid. Emamectin benzoate 5 SG @ 0.2 g/litre and spinosad 45 SC @ 0.5ml/ litre application were significantly poor but superior over untreated control in reducing aphids. After 15 days of spraying, Imidacloprid 17.8 SL @ 0.2 g/litre was most effective treatment, fipronil 5 SC @ 1.0 ml/litre and neem oil 2 % @ 2.0 ml/litre were proved highly effective to reducing aphid population. Chlorantraniliprole 18.5 SC @ 0.3 g/litre and flubendiamide 48 SC @ 0.3 ml/litre were moderately effective and emamectin benzoate 5 SG @ 0.2 g/litre and spinosad 45 SC @ 0.5ml/litre were significantly poor but superior over untreated control. Seven days after second spraying, the insecticides, imidacloprid 17.8 SL @ 0.2 g/litre, fipronil 5 SC @ 1.0 ml/litre and neem oil 2 % @ 2.0 ml/litre

were most effective treatments with 85.45, 81.31 and 72.15 % reduction in aphid population, respectively.

The above results are in agreement with the findings of, [10] who noticed that imidacloprid had highest reduction in aphid population (90.5 %) with its superiority. [11] also reported similar results which show that besides imidacloprid 17.8 SL and fipronil 5 SL showed better results than spinosad 45 SC. Hence, these may also be applicable for mustard aphid management. [12] who also reported the efficacy of imidacloprid 17.8 SL @ 20 g followed by fipronil 5 SC @ 50 g against mustard aphid, *L. erysimi.* [13] also found imidacloprid 17.8 SL @ 20 g a.i./ha and fipronil 5 SC @ 50 g a.i./ha were effective in reducing the aphid density.

Table 1: Efficacy of newer insecticides against *L. erysimi*, infesting of cauliflower during Rabi in the year 2014-15.

No. of aphids/3 terminal leaves											
			First spray					Second spray			
S.N.	Treatment	Dose	DBS	7 DAS	% Reduction over control	15 DAS	% Reduction over control	7 DAS	% Reduction over control	15 DAS	% Reduction over control
1	Fipronil 5 SC	1.0 ml/l	36.50 (6.08)*	6.40 (2.63)	83.56	18.90 (4.40)	78.90	2.73 (1.80)	81.31	2.10 (1.61)	84.54
2	Chlorantraniliprole 18.5 SC	0.3 g/l	35.33 (5.99)	13.43 (3.73)	64.34	35.60 (6.01)	58.93	10.33 (3.29)	62.50	9.50 (3.16)	62.86
3	Flubendiamide 48 SC	0.3 ml/l	36.33 (6.07)	14.33 (3.85)	63.00	37.70 (6.18)	57.71	11.47 (3.46)	60.70	11.27 (3.43)	58.41
4	Emamectin benzoate 5 SG	0.2 g/l	37.17 (6.14)	18.17 (4.32)	54.16	45.77 (6.80)	49.81	17.20 (4.21)	51.44	16.47 (4.12)	49.92
5	Neem oil 2%	2.0 ml/l	37.30 (6.15)	11.57 (3.47)	70.92	29.53 (5.48)	67.73	6.37 (2.62)	72.15	5.53 (2.46)	73.92
6	Imidacloprid 17.8 SL	0.2 g/l	37.37 (6.15)	4.97 (2.34)	87.53	14.80 (3.91)	83.86	1.67 (1.47)	85.45	1.27 (1.33)	88.09
7	Spinosad 45 SC	0.5 ml/l	35.30 (5.98)	20.97 (4.63)	44.30	52.10 (7.25)	39.84	22.80 (4.83)	43.46	20.27 (4.56)	45.86
8	Untreated control	-	39.67 (6.34)	42.30 (6.54)		97.33 (9.89)		75.33 (8.71)		69.93 (8.39)	
	SE (m) ±	-	0.091	0.030		0.027		0.060		0.045	
	CD (P=0.05)		N/S	0.091		0.084		0.185		0.137	

DBS - Days before spray, DAS -Days after spray * figures in parentheses $\sqrt{x+0.5}$ transformed values
N/S- Non significant

4. Conclusion

In present study, it was concluded that novel insecticides reduced the risk to human being and environment. The efficacy of tested newer insecticides like, Imidacloprid, fipronil and neem oil were found promising against mustard aphid (*L. erysimi* Kalt.) on cauliflower and they provided safety to coccinellid population/predators, which can be utilized in IPM programme. To reduce risk, newer insecticides have been found more appropriate as compared to conventional broad spectrum high dose insecticides as they enables to conserve natural enemy fauna and minimize residual effect in vegetables and environment.

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