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Efficacy of Some New Insecticides against Diamond Back Moth (*Plutella xylostella* L.) on Cauliflower

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A B S T R A C T

The efficacy of different insecticides against the diamondback moth (DBM) on cauliflower was studied at CSAUA&T, Kanpur. Among the various insecticides evaluated against the DBM, spinosad (45 SC @ 0.5ml/ litre) treated cauliflower plot showed highest per cent reduction over control (89.97%) with less number of larvae (0.58 larvae/ plant). The larval count and per cent reduction over control in the different treated plots ranged from 0.58 to 3.94 and 89.97 to 41.37 respectively as against 8.79 numbers of larvae in untreated control. Flubendiamide 48 SC @ 0.3 ml/ litre and chlorantriniliprole 18.5 SC @ 0.3 g/ litre were next effective pesticides to reduce the pest incidence significantly. All the treatments were also observed to be significantly superior over control.

Introduction

Diamond back moth, *Plutella xylostella* L. (Plutellidae: Lepidoptera) is the most important pest causing severe yield loss to cauliflower every year. The damage caused by diamond back moth, *P. xylostella* L. has been estimated globally to cost US$ 1 billion in direct losses and control costs (Grzywacz *et al.*, 2010). The use of synthetic insecticides is the main control strategy (Kibata, 1996). This pest has developed resistance against all major groups of pesticides, including *Bacillus thuringiensis* bacterial based bio-pesticides (Tabashnik *et al.*, 1990; Zhou *et al.*, 2011). In India, Krishnamoorthy (2004) reported that 52% yield loss on cauliflower due to diamond back moth.

Farmers are compelled to use chemical insecticides in order to cultivate lucratively, as traditional and cultural practices alone cannot give satisfactory control over the pest menace. Frequent use of chemical insecticides at higher doses results in development of insecticide resistance in *P. xylostella* against a range of insecticides in different parts of India (Talekar *et al*., 1990 and Vastrad *et al*., 2003). This has necessitated the use of alternative eco-friendly insecticides to sustain the management of diamondback moth and the development of resistance against these traditional insecticides can be easily breakdown by using the newer group of molecules.

In this context, the efficacy of few newer insecticides viz., flubediamide, chlorantriniliprole, emamectin benzoate, fipronil, imidacloprid, spinosad and neem oil etc., were evaluated under field condition for their comparative efficacy against diamondback moth on cauliflower.

Materials and Methods

A field experiment on cauliflower *var*. Pusa Snowball-16 was laid out during *Rabi season* 2014-15 at Student Instructional Farm in Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) India, in Randomised Block Design (RBD) with eight treatments including untreated control each replicated thrice. Each treatment schedule comprised two sprays, except treatment No. 8 which was taken as untreated control. The present study was carried out to evaluate the efficacy of newer insecticides against diamond back moth, (*P. xylostella* Linn.) of cauliflower.

Required numbers of plots having a size of 3m X 3m were prepared to accommodate all the 8 treatments, each having 3 replications. Along with two main irrigation channels of 1m width at the two length sides of the experimental field, two sub-irrigation channels 1.0m were provided in between 3 replications and each plot was separated by a trench of 0.5m so that drifting of different insecticides during spraying was minimized.

First spraying was applied after 75 days of transplanting followed by second spraying at 15 days interval. The percentage of reduction in insect pest population was calculated on the basis of pre and post treatment count after 7 and 15 days of each spraying. To estimate the larval population of diamondback moth, direct visual counting method was used (Lal, 1998). The mean number of DBM larval population were recorded from randomly 5 selected plants in each plot and same expressed as numbers of larval population /plant during morning hours between 6:30 a.m. to 8.00 a.m. when most of the insect species are less active. The observations on DBM population were recorded at weekly intervals to monitor the ETL of the pest and to decide the time of application of insecticides. Pre-treatment counts of DBM larvae were taken one day prior in all the plots at each time just before the application of insecticides. Post-treatment counts of DBM larvae were taken after 7^{th} and 15^{th} days of application of treatments. Similar observations were also taken after 2^{nd} applications of treatments.

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

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

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 DBM population were transformed into angular values (Bliss, 1937) and natural enemies in to $\sqrt{x + 0.5}$ (Gomez and Gomez, 1976) and subjected to analysis of variance.

Results and Discussion

The perusal of Table 1 reveals that larval population of DBM was statistically uniform varying from 6.26 to 7.56 larvae per plant in all plots before application of insecticides.

Table.1 Efficacy of newer insecticides against *Plutella xylostella* Linn., infesting on cauliflower during Rabi, 2014-15

No. of DBM larvae / Plant													
		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**	**Average larval count**	**Average % Reduction over control**
1	Fipronil 5 SC	1.0 ml/l	6.67 (2.68)*	4.17 (2.16)	45.76	4.83 (2.31)	41.26	3.07 (1.89)	44.46	2.50 (1.73)	52.76	3.64 (2.02)	46.06
2	Chlorantriniliprole 18.5 SC	0.3 g/l	6.26 (2.60)	0.93 (1.20)	87.07	1.37 (1.37)	82.32	0.23 (0.86)	85.05	0.18 (0.83)	87.75	0.68 (1.06)	85.55
3	Flubendiamide 48 SC	0.3 ml/l	7.15 (2.77)	0.97 (1.21)	88.26	1.47 (1.40)	83.37	0.20 (0.84)	88.06	0.15 (0.81)	90.66	0.70 (1.06)	87.59
4	Emamectin benzoate 5 SG	0.2 g/l	7.56 (2.84)	1.50 (1.41)	82.77	2.23 (1.65)	76.05	0.43 (0.97)	83.01	0.37 (0.93)	85.01	1.13 (1.24)	81.71
5	Neem oil 2%	2.0 ml/l	6.77 (2.70)	2.23 (1.65)	71.36	3.07 (1.89)	63.28	0.87 (1.17)	75.26	0.77 (1.13)	77.17	1.74 (1.46)	71.77
6	Imidacloprid 17.8 SL	0.2 g/l	6.53 (2.65)	4.53 (2.24)	39.78	4.97 (2.34)	38.41	3.30 (1.95)	41.84	2.97 (1.86)	45.45	3.94 (2.10)	41.37
7	Spinosad 45 SC	0.5 ml/l	7.33 (2.80)	0.73 (1.11)	91.32	1.33 (1.35)	85.27	0.15 (0.81)	90.15	0.10 (0.77)	93.15	0.58 (1.01)	89.97
8	Untreated control	-	6.83 (2.71)	7.87 (2.89)		8.43 (2.99)		9.63 (3.18)		9.23 (3.12)		8.79 (3.04)	
	SE (m) ±	-	0.017	0.026		0.055		0.050		0.041			
	CD (P=0.05)	-	0.053	0.079		0.169		0.154		0.126			

DBS - Days before spray, DAS -Days after spray, figures in parentheses $\sqrt{x+0.5}$ transformed values

The larval population was significantly decreased in all treated plots after application in comparison to untreated control. Spinosad 45 SC @ 0.5ml/ litre had its superiority and it recorded 0.58 larvae per plant and provided 89.97 per cent reduction in larval population over untreated control. Flubendiamide 48 SC @ 0.3 ml/ litre was statistically at par with chlorantriniliprole 18.5 SC @ 0.3 g/litre with 0.70 and 0.68 larvae per plant and they provided 87.59 and 85.55 per cent reduction in population over untreated control, respectively. Effectiveness of emamectin benzoate 5 SG @ 0.2 g/ litre and neem oil 2% @ 2.0 ml/ litre was 81.71 and 71.77 per cent reduction over untreated control with 1.13 and 1.74 larvae of DBM. The efficacy of fipronil 5 SC @ 1.0 ml/ litre and imidacloprid 17.8 SL @ 0.2 g/ litre highly toxic followed by was significantly poor but they were superior over untreated control against DBM (Table-1).

After 15 days of the first spray of treatments, the data revealed that all the treatments were superior over untreated control. Spinosad 45 SC @ 0.5ml/ litre had its superiority and provided 85.27 per cent reduction in larval population over untreated control. Flubendiamide 48 SC @ 0.3 ml/ litre was statistically at par with chlorantriniliprole 18.5 SC @ 0.3 g/ litre recording 83.37 and 82.32 per cent reduction in larval population over untreated control, while emamectin benzoate 5 SG @ 0.2 g/ litre was also effective with 76.05 per cent reduction in larval population over untreated control. The performance of fipronil 5 SC @ 1.0 ml/ litre and imidacloprid 17.8 SL @ 0.2 g/ litre was significantly poor but better than untreated control.

The results (Table-1) revealed that reduction in DBM population in all the treatments was noticed; spinosad 45 SC @ 0.5 ml/ litre highly toxic followed by flubendiamide 48 SC @ 0.3 ml/ litre. The remaining new chemicals, chlorantriniliprole 18.5 SC @ 0.3 g/ litre, emamectin benzoate 5 SG @ 0.2 g/ litre, neem oil 2% @ 2.0 ml/litre, fipronil 5 SC @ 1.0 ml/ litre and imidacloprid 17.8 SL @ 0.2 g/ litre were moderately toxic. Imidacloprid 17.8 SL @ 0.2 g/ litre was found least in controlling DBM.

The present studies revealed that spinosad, flubendiamide, chlorantriniliprole and emamectin benzoate were effective in managing diamond back moth in cauliflower. Our results, suggest that spinosad was most effective insecticide in both sprays. Our findings are supported by Mandal *et al.*, (2009) who reported the superiority of spinosad (Spinotor 45SC; 0.4 ml/L) against diamond back moth, *P. xylostella.* Dhawan *et al.*, (2009) evaluated chlorantraniliprole @ 30 g a.i./ ha which was the most effective treatment for the control of bollworm complex on cotton. Deshmukh *et al.*, (2010) also revealed that flubendiamide 0.007%, spinosad 0.009% and emamectin benzoate 0.0015% were most effective in reducing the *Helicoverpa armigera* population and pod damage in chickpea. Venkateswarlu *et al.*, (2011) also showed that Chlorantraniliprole (18.5% SC @ 10 g a.i./ ha) had highest PROC of diamond back moth, *Plutella xylostella* (83.65% and 82.08%). Shankara Murthy and Sannaveerappanavar (2013) also reported that the new molecules, flubendiamide, spinosad and emamectin benzoate were highly toxic to the susceptible DBM strain. Nikam *et al.*, (2014) also reported effectiveness of spinosad against this pest, who observed the better efficacy of spinosad against DBM. Lal and Meena (2001) also reported similar result which shows that besides imidacloprid other insecticides were found less effective against diamond back moth.

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