

COMPARATIVE EFFICACY OF NOVEL INSECTICIDES AND BIOPESTICIDES AGAINST DIAMONDBACK MOTH (*PLUTELLA XYLOSTELLA* (L.) ON CAULIFLOWER UNDER REPEATED FIELD APPLICATIONS

Manjunatha M N

Research Scholar, P.G. & Research Department of Zoology, J.K.K. Nataraja College of Arts
& Science, Komarapalayam, Namakkal (Dt),

Affiliated to Periyar University, Salem, Tamil Nadu and Assistant Professor, Department of
Zoology, Maharani's Science College for Women, Mysore, Karnataka

P Madhiyazagan

Assistant Professor of Zoology, P.G. & Research Department of Zoology, J.K.K. Nataraja
College of Arts & Science, Komarapalayam, Namakkal District,

Affiliated to Periyar University, Salem, Tamil Nadu

ABSTRACT

The diamondback moth (*Plutella xylostella* L.) is one of the most destructive insect pests of cruciferous vegetables and has developed resistance to several conventional insecticides worldwide. A field experiment was conducted during May–June 2025 at Kolar, Karnataka, to evaluate the efficacy and resistance development of the Diamondback Moth (DBM), *Plutella xylostella* (L.), against various novel insecticides and biopesticides on cauliflower (var. Dhawal). The experiment was laid out in a Randomized Complete Block Design (RCBD) with ten treatments comprising six novel insecticides, three biopesticides and an untreated control. Four sprays were imposed at 10-day intervals beginning when the pest population reached an economic threshold level of two larvae per plant. The results revealed that Broflanilide 20 SC recorded the lowest larval population throughout the experiment, followed by Fluxametamide 10 EC. Among the biopesticides, *Beauveria bassiana* performed better than *Bacillus thuringiensis* var. *kurstaki* and Azadirachtin. Progressive increase in larval population after repeated sprays indicated varying levels of resistance development, with Broflanilide and Fluxametamide maintaining superior efficacy throughout the cropping period. The untreated control recorded continuous population buildup. The study suggests that Broflanilide and Fluxametamide remain effective options for resistance management of diamondback moth in cauliflower under field conditions.

Keywords: *Plutella xylostella*, cauliflower, insecticide resistance, Broflanilide, Fluxametamide, biopesticides, integrated pest management.

INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis*) is one of the major cole crops cultivated throughout India. Among the insect pests attacking cauliflower, the diamondback moth (*Plutella xylostella* L.) is considered the most destructive, causing severe yield losses by feeding on leaves and curds. Continuous and indiscriminate use of synthetic insecticides has resulted in rapid development of resistance in *P. xylostella*, making its management increasingly difficult.

Novel insecticides possessing unique modes of action and environmentally safer biopesticides have emerged as important alternatives for resistance management. However, repeated field exposure may also lead to gradual reduction in their effectiveness. Therefore, periodic evaluation of these molecules under field conditions is essential to formulate

effective resistance management strategies. The present investigation was undertaken to evaluate the resistance developed by *P. xylostella* against selected novel insecticides and biopesticides under cauliflower cultivation in Kolar, Karnataka.

MATERIALS AND METHODS

The field experiment was conducted during May–June 2025 at Kolar district, Karnataka. Thirty-day-old seedlings of cauliflower variety Dhawal were transplanted in the field following a Randomized Complete Block Design (RCBD).

Plants were maintained at a spacing of 45 × 45 cm, while the experimental plots were separated by 1 m × 1 m spacing to avoid spray drift. The first insecticidal spray was applied 10 days after transplanting, when the average diamondback moth population reached two larvae per plant, corresponding to the economic threshold level. Subsequently, four sprays were applied during the crop season. Separate knapsack sprayers were used for each insecticide treatment to avoid cross contamination.

The treatments consisted of: Emamectin benzoate 5 SG (0.4 g L⁻¹), Fipronil 5 SC (2 ml L⁻¹), Fluxametamide 10 EC (1 ml L⁻¹), Broflanilide 20 SC (0.25 ml L⁻¹), Chlorfenapyr 10 SC (2 ml L⁻¹), Tolfenpyrad 15 EC (2 ml L⁻¹), *Bacillus thuringiensis* var. *kurstaki* (2 g L⁻¹), *Beauveria bassiana* 1.15 WP (10 g L⁻¹), Azadirachtin 5 EC (0.5 ml L⁻¹) and Untreated control (water spray). 5 plants were selected randomly from each block and the larval population was recorded one day before spraying and at 3, 5, 7 and 10 days after each spray. Average larval populations after each spray were calculated and used for assessing changes in efficacy following repeated insecticide applications.

RESULTS AND DISCUSSION

Effect of initial efficacy and repeated sprays on diamondback moth population was studied which shows that considerable differences among treatments were observed after successive applications. Broflanilide 20 SC consistently maintained the lowest average larval population, recording 0.65, 0.55, 0.90 and 1.15 larvae plant⁻¹ after the first, second, third and fourth sprays, respectively. Fluxametamide 10 EC was the next most effective treatment with corresponding larval populations of 0.90, 0.70, 1.05 and 1.55 larvae plant⁻¹.

Emamectin benzoate and Fipronil initially provided satisfactory suppression of the pest; however, gradual increases in larval population were observed after repeated applications, indicating reduced effectiveness over time. Chlorfenapyr and Tolfenpyrad also showed progressive increases in larval population following successive sprays.

Among the biological treatments, *Beauveria bassiana* maintained comparatively lower larval populations than *Bacillus thuringiensis* var. *kurstaki* and Azadirachtin during later sprays. The untreated control exhibited a continuous increase in larval population from 2.45 larvae after the first spray period to 7.10 larvae per plant after the fourth observation, confirming severe pest multiplication in the absence of control measures.

Table:1. Efficacy of novel insecticides and biopesticides against diamondback moth (<i>Plutella xylostella</i> L.) on cauliflower under repeated field applications																			
			Av. No. of Diamondback moth larvae per plant																
	Insecticides	R e c o n c e n t r a t i o n	B e f o r e s p r a y	1st spray				2nd spray				3rd Spray				4th spray			
				3 D A S	5 D A S	7 D A S	1 0 D A S	3 D A S	5 D A S	7 D A S	1 0 D A S	3 D A S	5 D A S	7 D A S	1 0 D A S	3 D A S	5 D A S	7 D A S	1 0 D A S
T 1	Emamectin benzoate 5 SG	0.4g /lt	1.8	1	0.8	1.2	1.6	1	0.6	1	1.6	1.4	1.6	2	2.4	2	2	2.4	3
T 2	Fipronil 5% SC	2 ml/l	1.8	1.2	1	1.4	1.8	1	0.8	1.2	1.8	1.6	1.8	2.2	2.8	2.8	2.2	2.6	3
T 3	Fluxametamide 10%EC	1 ml/l	2	1	0.6	0.8	1.2	0.6	0.4	0.6	1.2	1	0.8	1	1.4	1.4	1.2	1.6	2
T 4	Broflanilide 20%SC	0.25 ml/l	2	0.8	0.4	0.6	0.8	0.4	0.2	0.6	1	0.8	0.6	1	1.2	1	0.8	1.2	1.6
T 5	Chlorfenapyr 10%SC	2 ml/l	1.6	1	0.8	1.2	1.8	1	0.8	1.2	1.6	1.2	1.8	2.2	2.4	2.2	2.4	2.8	3.2
T 6	Tolfenpyrad 15% EC	2 ml/l	1.8	1.2	1	1.2	1.8	1	1.4	1.8	2	1.8	2.2	2.4	2.8	2.6	2.8	3.2	3.6
T 7	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	2g /lt	2	1.4	1.2	1.6	2	1.2	1	1.6	2	1.4	1.2	1.8	2	1.8	1.8	2	2.2
T 8	<i>Beauveria bassiana</i> 1.15% WP. 1x10 ⁸ CFU/gm. min	10 gm /lt	2	1.8	1.4	1.6	2.2	1.4	1.2	1.4	1.8	1.4	1.2	1.6	1.8	1.6	1.4	1.6	2
T 9	Azardirectin 5% EC	0.5 ml/l	1.8	1.6	1.4	1.8	2.2	1.6	1.4	1.8	2	1.6	1.4	1.8	2.2	2	2	2.2	2.4

		t																	
T 1 0	Control		1.8	2	2. 2	2. 6	3	3. 4	3. 6	3. 8	4	4. 2	4. 8	5. 4	5. 8	6	6. 8	7. 6	8

Table 2. Efficacy of novel insecticides and biopesticides against diamondback moth (*Plutella xylostella* (L.) on cauliflower under repeated field applications after each spray

Treatments	Insecticides	Av. No. of Diamondback moth larvae per plant				
		Before spray	1st Spray	2nd Spray	3rd Spray	4th Spray
T1	Emamectin benzoate 5 SG	1.8	1.15	1.05	1.85	2.35
T2	Fipronil 5% SC	1.8	1.35	1.2	2.1	2.65
T3	Fluxametamide 10%EC	2	0.9	0.7	1.05	1.55
T4	Broflanilide 20%SC	2	0.65	0.55	0.9	1.15
T5	Chlorfenapyr 10%SC	1.6	1.2	1.15	1.9	2.65
T6	Tolfenpyrad 15% EC	1.8	1.3	1.55	2.3	3.05
T7	<i>Bacillus thuringiensis</i> va. <i>kurstaki</i>	2	1.55	1.45	1.6	1.95
T8	<i>Beauveria bassiana</i> 1.15% WP. 1x10 ⁸ CFU/gm. min	2	1.75	1.45	1.5	1.65
T9	Azardirectin 5% EC	1.8	1.75	1.7	1.75	2.15
T10	Control	1.8	2.45	3.7	5.05	7.1

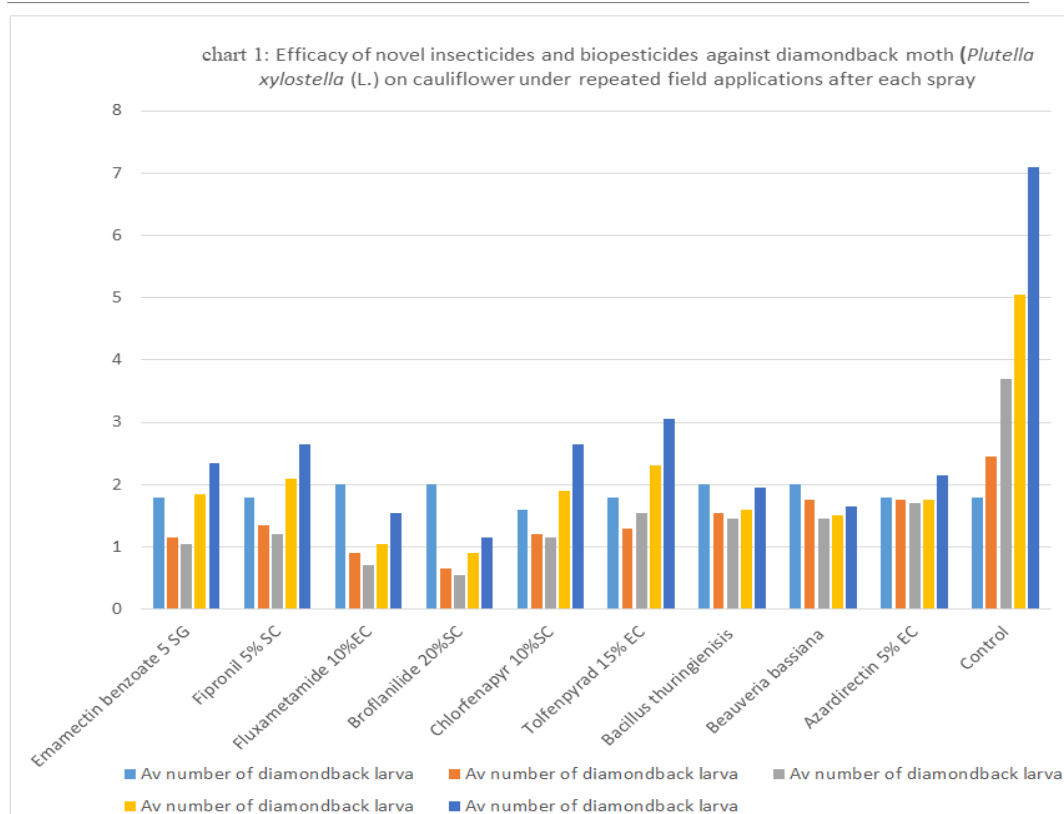
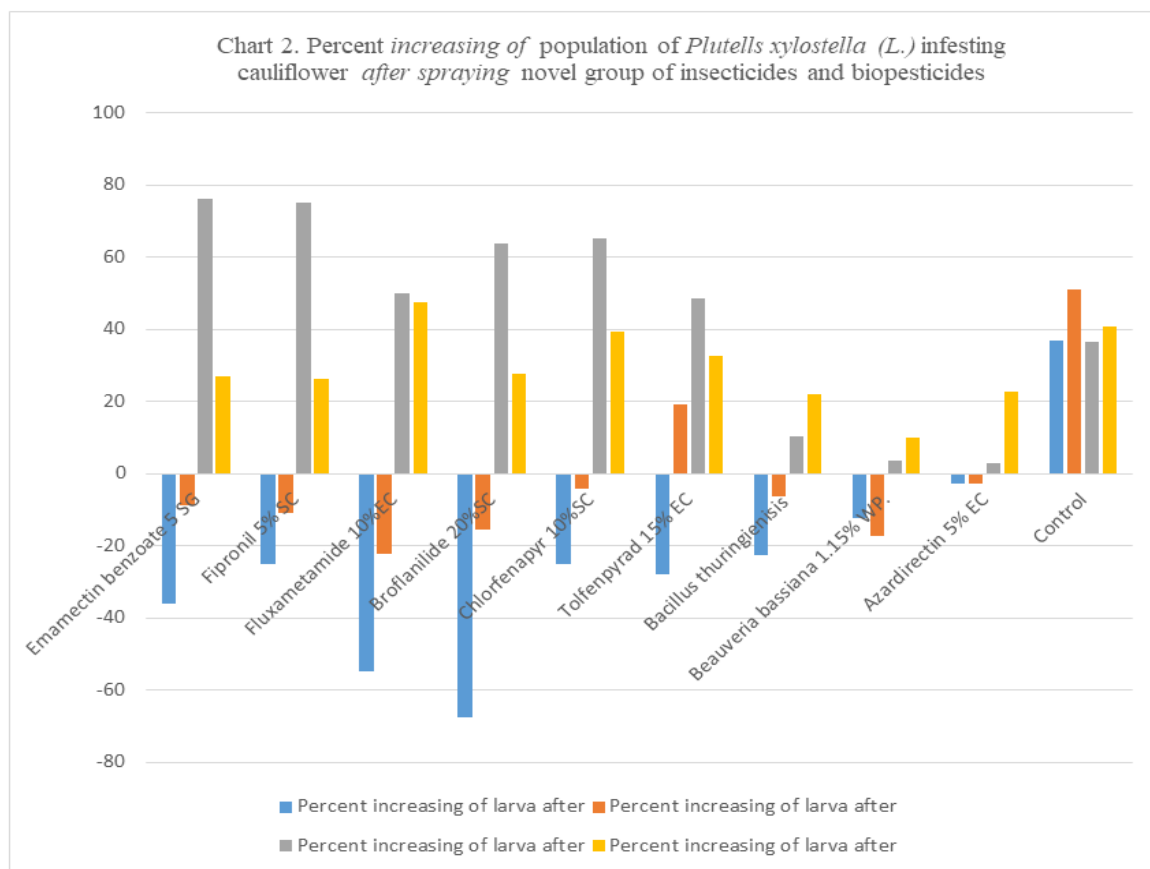


Table: 3. Percent increasing of population of *Plutells xylostella* (L.) infesting cauliflower after spraying novel group of insecticides and biopesticides

Treatments	Insecticides	Percent increasing in each successive spary			
		1st Spray	2nd Spray	3rd Spray	4th Spray
T1	Emamectin benzoate 5 SG	-36.11	-8.69	76.19	27.02
T2	Fipronil 5% SC	-25	-11.11	75	26.19
T3	Fluxametamide 10%EC	-55	-22.22	50	47.61
T4	Broflanilide 20%SC	-67.5	-15.38	63.63	27.77
T5	Chlorfenapyr 10%SC	-25	-4.16	65.21	39.47
T6	Tolfenpyrad 15% EC	-27.77	19.23	48.38	32.6
T7	<i>Bacillus thuringienisis</i> va. <i>kurstaki</i>	-22.5	-6.45	10.34	21.87
T8	<i>Beauveria bassiana</i> 1.15% WP. 1x10 ⁸ CFU/gm. min	-12.5	-17.14	3.44	10
T9	Azardirectin 5% EC	-2.77	-2.86	2.94	22.85
T10	Control	36.8	51.02	36.48	40.59



RESISTANCE DEVELOPMENT FOLLOWING REPEATED INSECTICIDE EXPOSURE

Analysis of percentage change in larval population after successive sprays indicated differential resistance development among treatments. Broflanilide showed the greatest initial suppression (−67.50%), while Fluxametamide recorded a reduction of −55.00% after the first spray. Emamectin benzoate and Fipronil also reduced larval populations initially but showed higher increases during subsequent sprays.

The biopesticides exhibited comparatively smaller fluctuations in larval population. *Beauveria bassiana* recorded only a 3.44% increase after the third spray and 10.00% after the fourth spray, suggesting relatively stable field performance. *Bacillus thuringiensis* var. *kurstaki* showed moderate increases, whereas Azadirachtin exhibited gradual loss in efficacy with repeated applications.

The increasing larval populations observed after repeated applications indicate gradual development of field tolerance or resistance in *P. xylostella*. Nevertheless, Broflanilide and Fluxametamide maintained comparatively superior efficacy throughout the experiment, suggesting that their novel modes of action remain effective against field populations in Kolar.

CONCLUSION

The present field investigation demonstrated that repeated applications of different insecticides influenced the effectiveness of pest suppression against diamondback moth. Broflanilide 20 SC proved to be the most effective treatment throughout the experiment, followed by Fluxametamide 10 EC. Among the biological treatments, *Beauveria bassiana* showed comparatively better performance than *Bacillus thuringiensis* and Azadirachtin. Although gradual increases in larval population were observed after repeated applications in all treatments, Broflanilide and Fluxametamide maintained comparatively lower levels of resistance development. These insecticides may therefore be incorporated into resistance management programmes for sustainable management of *Plutella xylostella* in cauliflower under integrated pest management strategies.

REFERENCES

1. Abbott WS. 1925. A method of computing the effectiveness of an insecticide. *Journal of Economic Entomology* 18: 265–267.
2. Finney DJ. 1971. *Probit Analysis*. Cambridge University Press, London.
3. Talekar NS and Shelton AM. 1993. Biology, ecology and management of the diamondback moth. *Annual Review of Entomology* 38: 275–301.
4. IRAC. 2024. IRAC Mode of Action Classification Scheme. Insecticide Resistance Action Committee.
5. Kodandaram MH, Rai AB and Halder J. 2010. Novel insecticides for management of diamondback moth in cruciferous vegetables. *Indian Journal of Plant Protection*.
6. Anagu Anil Reddy, Shashi Vemuri, CH, S Rao and M. aruna. 2017 Bio- Efficacy of Insecticides against Diamond Back Moth *Plutella xylostella* (L.) in Cabbage (Brassica oleracea var. Capitata). *int.j.curr.Microbial.App.Sci* (2007) 6 (6):1121-1125.
7. Anitha V and Ravi kalasariya. Efficacy of Insecticides against Diamond Back Moth *Plutella xylostella* infecting cauliflower. *Indian Journal of Entomology* 87(2). 428-431 (2025).