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Comparative Efficacy and Economics of Biopesticides with Emamectin Benzoate against Diamondback Moth, *Plutella xylostella* (L.) in Cabbage, *Brassica oleracea* var. *Capitata* (L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A field trial was conducted during *rabi* season 2023-2024 at Central Research Farm (CRF), Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh. The experiment was laid out in Randomised Block Design (RBD) with eight treatments each replicated thrice using a variety Green Soccer (546). The treatments *viz.,* Emamectin benzoate 5% SG, *Bacillus thuringiensis* 5.0% WP, Spinosad 02.50 % SC, *Verticillium lecanii* 5.0% SC, Neem seed kernel extract 5%, *Beauveria basssiana* 1x 10^8CFU/ml, Azadirechtin 00.03 % WSP and along with an untreated control against *plutella xylostella* in cabbage.The data on larval population of Diamond back moth over control on first and second spray overall mean revealed that all treatments

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were significantly superior over control.Amomg all the treatments minimum larval population was recorded in in T_3 Spinosad 02.50 %SC (1.045) followed by T_1 Emamectin benzoate5%SG (1.212), T_2*Bacillus thuringiensis* 5.0% WP (1.345),T_6 *Beauveria bassiana* 1x 10^8 CFU/ml (1.512),T_4 *Verticillium lecanii* 5.0 % SC (1.667),T_5 Neem seed kernel extract 5 % (1.934),T_7 Azadirechtin 00.03 % WSP (2.133).While, the highest yield (298q/ha) was obtained from the treatment T_3 spinosad 02.50%SC as well as B:C ratio (1:5.76) was obtained high from this treatment. It followed by T_1 Emamectin benzoate 5%SG (276q/ha) (1:5.53),*T_2 Bacillus thuringiensis* 5.0% WP (269q/ha)(1:5.42),T_6 *Beauveria bassiana* 1x 10^8CFU/ml (259q/ha) (1:5.24), T_4 *Verticillium lecanii* 5.0% SC(249q/ha)(1:5.04), T_5 Neem seed kernel extract 5% (233q/ha) (1:4.65), T_7 Azadirechtin 00.03% WSP(215q/ha)(1:4.42) and the lowest yield and B:C ratio is recorded in T_0 Control (186q/ha) (1:4.05).

Keywords: Biopesticides; emamectin benzoate 5% SG; Plutella xylostella; spinosad 2.5%SC.

1. INTRODUCTION

"Cabbage, (*Brassica oleracea* var *capitata* L.) an herbaceous plant of Family *Brassicaceae*, is a widely cultivated vegetable throughout the world as a longstanding dietary supplement. It has numerous health benefits that have increased its popularity all over the world" [1].

"Brassica oleracea used like food and in herbal medicine. Cabbage juice can reduce constipation and has also been used as a laxative, as an antidote to mushroom poisoning, or a treatment for hangovers and headaches. In fact, cabbage has historically been used to stop sunstroke, or to relieve fevers. The leaves were also used to soothe swollen feet and to treat childhood croup. *Brassica* vegetables have also anti-inflammatory activity and have been used to different irritations of the human body" [2].

Regular consumption of dark green leafy vegetables is highly recommended because of their potential in reducing chronic diseases [3] and glucosinolates in cabbage reduced risk of cancer induction and development [4].

"Cabbage cultivation is good at mainly on sandy to heavy soils rich in organic matter. Early crops desire light soil while late crops flourish better on heavier soils because of holding the moisture. On heavy soils, plants grow more slowly and the keeping quality is improved. A P^H range of 6.0-6.5 is considered as optimum for growing cabbage. Plants growing in saline soils are prone to diseases. In India, cabbage is grown in large areas having a cool and moist climate. The temperature range of 15^o-21^o C is considered as optimum for growth and head formation of the crop. The intensity of flowering depends upon the age of the plants and the period for which they are exposed to low temperatures" [5].

"In 2020, world production of cabbages was 71 million tones, led by China with 48% of the world total (table). Other substantial producers were India, Russia, and South Korea" UN food and Agriculture Organization, Corporate Statistical Database (FAOSTAT) [6]. "India is the largest producer of cabbage after China. India accounts for 8755000 tons of productivity in an area of 388000/ha. In India, Uttar Pradesh accounts for production of 5.7 million tones in an area of 0.72 million ha" [7].

"The major insect pests, which cause maximum yield losses in cabbage are diamond back moth (*Plutella xylostella* L), cabbage butterfly, (*Pieris brassicae* L), cabbage aphid (*Brevicoryne brassicae* L.), cabbage semilooper (*Trichoplusiani*), leaf webber (*Crocidolomia binotalis*), cabbage head borer, (*Hellulaundalis* Fab.). Diamondback moth is the most destructive pest in cabbage growing areas and the yield loss were reported up to 52% in India" [8].

"However, the set back to optimum cabbage production is the attack of insect pests, the most important of which is the diamond back moth (DBM), *Plutella xylostella* which has become a single limiting factor in the production of quality heads. It is one of the most destructive insect pests of cruciferous vegetables, currently accounting for US$2.7 billion worth of annual worldwide crop losses. Management of this pest depends largely on imposing heavy quantities of synthetic chemical pesticides all over the world**.**The DBM has developed resistance to all major classes of insecticides" [1].

1. To evaluate the efficacy of biopesticides with Emamectin benzoate on the larval population of diamondback moth *Plutella xylostella* (L.) in cabbage.

2. To calculate the cost benefit ratio (C:B) of the treatments.

2. MATERIALS AND METHODS

The experiment was conducted during *rabi* season in 2023-2024 at Central Research Farm (CRF), at Sam Higginbottom University of Agriculture, Technology and Sciences(SHUATS), Prayagraj, Uttar Pradesh (U.P) in a Randomized Block Design with eight treatments replicated three times using variety Green soccer-546 in a plot size of (2m x 1m) maintaining 0.3m borders as a bund with total gross area 105.6m^2 along with a recommended package of practices excluding plant protection. The site was uniform, cultivable with typical sandy loam soil having good drainage.

The treatments used in this experiment were Emamectin benzoate 5%SC, *Bacillus thuringiensis* 5.0% WP*,* Spinosad 02.50% SC, *Verticillum lecanii* 5.0%SC, *Beauveria bassiana* 1x10^{8}CFU/ml, Neem seed kernel extract 5%, Azadirechtin 00.03% WSP (300 ppm) along with untreated control. against diamond back moth.

As the ETL 2-3 larvae per plant were crossed and application of the two rounds of insecticidal treatments were applied at 15 days interval [9].

"The insect population was counted from randomly selected plants in every plot and population per 5 plants was noted.After that mean of three replications was calculated for each treatment and the same was done with the untreated plot . The population of Plutella xylostella was recorded before 1 day spraying and on 3rd day ,7th day and 14th day after insecticidal application" [7]. Healthy cabbage heads were harvested and their weight from each treatment was expressed as marketable yield in quintal per hectare. Ultimately, the cost benefit ratio was calculated on the basis of prevailing market price of yield, insecticides and spraying cost.

$$\text{Larval population} = \frac{\text{Number of Larvae}}{\text{Total number of } selected\ plants}$$

Mane et al. [10]

2.1 Economics

Cost Benefit ratio = (Gross Returns (t/ha)/ Total Cost of cultivation(t/ha)

Nikitha et al*.* [11].

3. RESULTS AND DISCUSSION

The data on the larval population of diamondback moth *P. xylostella* in cabbage 3rd,7th and 14th day after first spray revealed that all the chemical treatments, were significantly superior over control. Among all the treatments lowest larval population was recorded in T_3 Spinosad 02.50 %SC (1.445) was recorded in Reddy et al. [12], T_1 Emamectin benzoate 5%SG (1.556), T_2 *Bacillus thuringiensis* 5.0% WP (1.689), T_6 *Beauveria bassiana* 1x 10^8 CFU/ml (1.867), T_4 *Verticillium lecanii* 5.0% SC (2.022), T_5 Neem seed kernel extract 5% (2.289), T_7 Azadirecthin 00.03% WSP (2.444) and T_0 control (3.511).

The data on the larval population of diamondback moth *P. xylostella* in cabbage 3rd,7th and 14th day after second spray revealed that all the chemical treatments, were significantly superior over control. Among all the treatments lowest larval population was recorded in in T_3 Spinosad 02.50 %SC (0.645), T_1 Emamectin benzoate 5%SG (0.867),T_2 *Bacillus thuringiensis* 5.0% WP (1.000), T_6 *Beauveria bassiana* 1x 10^8 CFU/ml(1.156), T_4*Verticillium lecanii* 5.0% SC(1.311), T_5 Neem seed kernel extract 5 % (1.578), T_7 Azadirechtin 00.03 % WSP(1.822) and T_0 control(3.889).

The data revealed on population of *P. xylostella* over control on Overall mean revealed that all the treatments were significantly superior over control (3.700). Among all the treatments minimum larval population was recorded in in T_3 Spinosad 02.50 % SC (1.045) similarly rcorded in Venugopal et al*.* [13] T_1 Emamectin benzoate5%SG (1.212) similarly recorded in Harika et al*.* [14], T_2 *Bacillus thuringiensis* 5.0% WP (1.345), T_6 *Beauveria bassiana* 1x 10^8 CFU/ml (1.512) ,T_4 *Verticillium lecanii* 5.0% SC (1.667), T_5 Neem seed kernel extract 5% (1.934), T_7 Azadirechtin 00.03% WSP (2.133)similarly recorded in Puja et al*.* [15].

All the insecticides were found very effe ctive and significantly superior over control. The minimum larval population and the highest yield was recorded in T_3 Spinosad 02.50%SC (298q/ha) was recorded in Lal et al*.* [16] T_1 Emamectin benzoate5%SG (276q/ha) Patel et al. [17], T_2 *Bacillus thuringiensis* 5.0% WP (269q/ha),T_6 *Beauveria bassiana* 1x 10^{8}CFU/ml (259q/ha) was similarly recorded in Khan and Tayde, [18], T_4 *Verticillium lecanii* 5.0% SC (248q/ha), T_5 Neem seed kernel extract 5% (233q/ha) similarly

recorded in Kumar and Kumar [19], T_7 Azadirecthtin 00.03% WSP (215q/ha) and the lowest yield is recorded in T_0 Control (186q/ha).

When cost benefit ratio worked out, interesting result was achieved, among the treatment studied, the best and most economical treatment is in T_3 Spinosad 02.50%SC (1:5.76) similarly recorded in Yadav et al. [20], followed byT_1 Emamectin benzoate 5%SG (1:5.53) was recorded in Kumar and Devappa, [21],T_2 *Bacillus thuringiensis* 5.0% WP (1:5.42) T_6 *Beauveria bassiana* 1x 10^8CFU/ml (1:5.24), T_4 *Verticillium lecanii* 5.0% SC (1:5.04) recorded in G Laxman et al. [22], T_5 Neem seed kernel extract 5 % (1:4.65), T_7 Azadirechtin 00.03% WSP (1:4.42) and T_0 Control (1:4.05) [23-25].

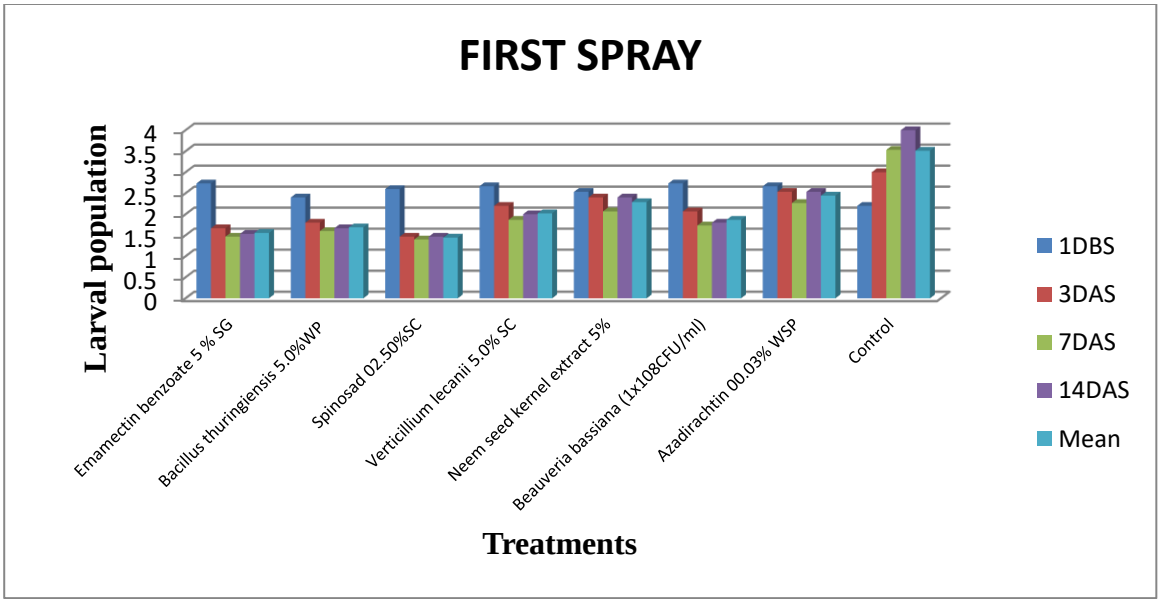

Fig. 1. Assessment of insecticides against diamondback moth, *Plutella xylostella* in cabbage (1st spray)

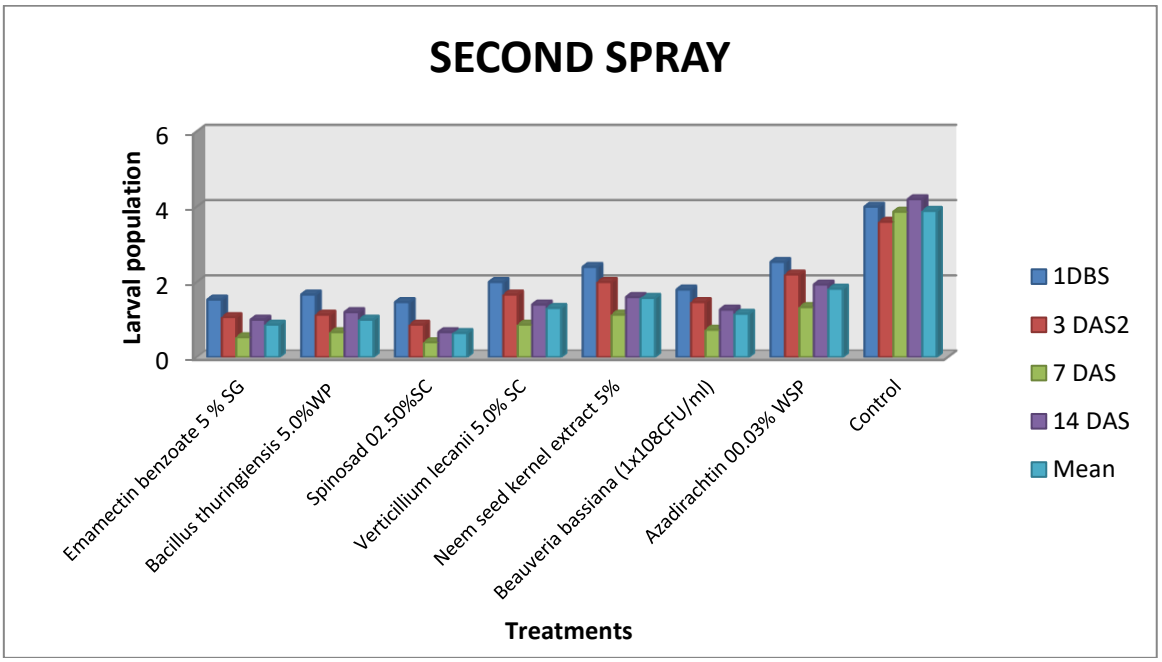

Fig. 2. Assessment of insecticides against diamondback moth, *Plutella xylostella* (L.) in cabbage (2nd Spray)

Table 1. Efficacy of biopesticides with Emamectin benzoate on the larval population of *P. xylostella* in cabbage, Yield and Cost Benefit ratio

	Treatments	Larval population of diamond back moth per five cabbage heads									Overall Mean	Yield (q/ha)	C:B Ratio
		1st Spray					2nd Spray						
		1DBS	3 DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean			
T1	Emamectin benzoate 5%SG	2.733	1.667	1.467	1.533	1.556	1.067	0.533	1.0	0.867	1.212	276	1:5.53
T2	*Bacillus thuringiensis* 5.0% WP	2.4	1.8	1.6	1.667	1.689	1.133	0.667	1.2	1.000	1.345	269	1:5.42
T3	Spinosad 02.50 % SC	2.6	1.467	1.4	1.467	1.445	0.867	0.4	0.667	0.645	1.045	298	1:5.76
T4	*Verticillium lecanii* 5.0% SC	2.667	2.2	1.867	2.0	2.022	1.667	0.867	1.4	1.311	1.667	248	1:5.04
T5	Neem seed kernel extract 5 %	2.533	2.4	2.067	2.4	2.289	2.0	1.133	1.6	1.578	1.934	233	1:4.65
T6	*Beauveria bassiana* 1x10^8CFU/ml	2.733	2.067	1.733	1.8	1.867	1.467	0.733	1.267	1.156	1.512	259	1:5.24
T7	Azadirachtin 00.03% WSP	2.667	2.533	2.267	2.533	2.444	2.2	1.333	1.933	1.822	2.133	215	1:4.42
T8	**Control**	2.2	3.0	3.533	4.0	3.511	3.6	3.867	4.2	3.889	3.700	186	1:4.05
	F-test	**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	S		
	S. Ed. (±)	0.269	0.106	0.054	0.118	0.173	0.102	0.081	0.057	0.167	0.222		
	C.D.(P= 0.05)	-	0.231	0.121	0.185	0.372	0.221	0.177	0.121	0.358	0.645	-	-

4. CONCLUSION

From the analysis of present study finding, it was concluded that among all treatment Spinosad 02.50%SC recorded best and proved best effective for Diamondback moth,(*Plutella xylostella*) and Emamectin benzoate,5% SG proved the 2nd effective followed by *Bacillus thuringiensis* 5.0% WP , *Beauveria bassiana* 1x 10^8CFU/ml , *Verticillium lecanii* 5.0% SC in managing (*Plutella xylostella*) in cabbage (*Brassica oleracea*) on mean larval population. Therefore, the botanicals *i.e* Neem seed kernel extract 5% and Azadirechtin 00.03 % WSP may be useful in devising proper integrated pest management strategy against on Diamond Back Moth *(Plutella xylostella*).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Maity L, Padhi G, Samanta A. Population dynamics and management of diamond back moth *Plutella xylostella* (L.) in cabbage ecosystem of West Bengal. International Journal of Chemical Studies. 2018;6(1):381-385.
2. Alexandra SIM, Andrea Daniela ONA. Cabbage (*Brassica oleracea* L.). Overview of the health benefits andtherapuetical uses. Hop and Medicinal Plants. 2020;1 (2):150-169.
3. Miller-Cebert RL, Sistani NA, Cebert E. Comparative protein and foliate content among canola cultivars and other cruciferous leafy vegetables Journal of Food, Agriculture and Environment, 2009; 7(2):42-49.
4. Kang JY, Ibrahim KE, Juvik JA, Kim DH, Kang WJ. Genetic and environmental variation of glucosinolate content in Chinese cabbage. Horticulture Science. 2006;41(6):1382-1385.
5. National Horticulture Board; 2018.
6. UN food and Agriculture Organization, Corporate Statistical Database (FAOSTAT); 2022.
7. Kommoji T, Tayde AR. Efficacy of newer selected Insecticides, *Beaveria bassiana* and Neem oil against Diamondback moth (*Plutella xylostella*)(L.) in Cabbage *(Brassica oleraceae* var capitata). International Journal of Plant and Soil Science. 2022;34(20):485-491.
8. Krishnamurthy A. Biological control of diamond back moth Plutella xylostella (L.), an Indian scenario with reference to past and future strategies. In Proceedings of the International Symposium. 2004;2 (7):204-11.
9. Devi HD, Tayde AR. Comparative efficacy of bio-agents and botanicals on the management of diamondback moth (*Plutella xylostella* Linn.) on cabbage under Allahabad agroclimatic conditions. International Journal of Current Microbiology and Applied Sciences. 2017; 6(7):711-716.
10. Mane PD, Singh BB, Singh PK. Effect of different insecticides on the management of diamond back moth (*Plutella xylostella* Linn.) on winter cabbage. Journal of Entomology and Zoology Studies. 2021;9 (2):1426-1428.
11. Nikitha RG, Srivastava KV, Tayde AR, Tripathi A. Comparative efficacy of microbials and botanicals against diamondback moth (*Plutella xylostella* Linn) on cabbage. Journal of Entomology and Zoology Studies. 2021;9(1):497-499.
12. Reddy MS, Sathua SK., Sulagitti A, Singh NN. Bio-efficacy of different novel insecticides and their interaction between numbers of sprays against diamondback moth (*Plutella xylostella* L.) infesting cabbage. Journal of Entomological Research. 2018;42(1):51-56.
13. Venugopal U, Kumar A, Kota S, Ramya V. Efficacy of certain insecticides against diamondback moth (*Plutella xylostella* L.) on cabbage (*Brassica oleracea* var.

capitata L.). Agriculture Update. 2017;12 (6):1612-1616.
14. Harika G, Dhurua S, Suresh M, Sreesandhya N. Evaluation of Certain Insecticides against Diamondback Moth (DBM) *Plutella xylostella* on Cauliflower. International Journal of Bio-resource and stress Management. 2019; 10(1):70-76.
15. Rani P, Kumar VJ. Bioefficacy of biological-based insecticides against diamondback moth (*Plutella xylostella*) on cabbage (*Brassica oleracea*). Indian Journal of Agricultural Sciences 2010;80 (4):345–7.
16. Lal J, Swaminathan R, Meena AK, Nagar R. Field efficacy of biorational insecticides against major pestiferous insects of cabbage. International Journal of Pest Management. 2021:1-7.
17. Patel DN, Patel DR. Efficacy of insecticides against diamomd back moth in cauliflower. Indian Journal of Entomology. 2020;82(1):131-133.
18. Khan SAR, Tayde AR. Comparative Efficacy and Economics of Chemicals Insecticides and Bioagents against Diamondback Moth (*Plutella xylostella*) on Cabbage (Brassica oleracea var. *Capitata* L.). International Journal of Plant & Soil Science. 2022;1(4):85-89.
19. Kumar AN, Kumar A. Comparative efficacy of certain chemicals with biopesticides against diamondback moth, *Plutella xylostella* (L.) in cabbage, *Brassica oleracea* (L.). Journal of Entomology and Zoology Studies. 2020;8(6):1350-1353.
20. Yadav S, Raju S, Yadav M, Srivastava A, Dwivedi P. Bio-efficacy of new insecticidal molecules against the Diamondback moth (*Plutella xylostella* L.) on cauliflower. Journal of Experimental Zoology. 2017; 20(1):465-469.
21. Kumar P, Devappa V. Bio-efficacy of Emamectin Benzoate 5% SG (Proclaim) against diamondback moth in cabbage. Pestology. 2006;30(2):23-25.
22. Laxman G, Sharma RK, Sinha S R. Field Efficacy of Biopesticides against Diamondback Moth and Aphids on Cabbage. Pesticide Research Journal. 2019:0970-6763.
23. Mushinamwar DR, Yadav U, Gafar BB, Rajawat S. Efficacy of Selected Biopesticides against Mustard Aphid, Lipaphis erysimi (Kalt.) (Hemiptera: Aphididae). Journal of Advances in Biology & Biotechnology. 2024;27(6):702–707. Available:https://doi.org/10.9734/jabb/2024/v27i6930
24. Dipak, Ashwani Kumar. Comparative Efficacy of Selected Insecticides Against Helicoverpa Armigera (Hubner) on Cowpea, *Vigna Unguiculata* (L.) in Prayagraj, U.P., India. Journal of Experimental Agriculture International 2024;46(6):570-74. Available:https://doi.org/10.9734/jeai/2024/v46i62510
25. 25 Malinga LN, Laing MD. Efficacy of three biopesticides against cotton pests under field conditions in South Africa. Crop Protection. 2021;145:105578.

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