Determining the Efficacy of selected insecticides against diamond back moth (Plutella xylostella L.) on cabbage (Brassica oleracea L.)

Abstract

The research trial was undertaken at Central Research Field, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Experiment was laid in RBD with three replication consists of eight treatments viz, Emamectin benzoate 5% SG (0.4 gm/lit), Chlorantraniliprole 18.5% SC (0.5 ml/lit), Novaluron 10% EC (2 ml/lit), Spinosad 45% SC (0.5 ml/lit), *Beauveria bassiana* 1.15% WP (1 gm/lit), Neem oil 1% (10 ml/lit), Karanj oil 2% (20 ml/lit) and untreated control in Randomized block design with three replications against diamondback moth (*Plutella xylostella*) on Cabbage. The mean larval population of diamondback moth (*Plutella xylostella*) on cabbage at 3^{rd}, 7^{th}, and 14^{th} days after two sprays revealed that the treatment Chlorantraniliprole 18.5% SC (2.63) observed the lowest population of diamond back moth followed by Spinosad 45%SC (2.96), Emamectin benzoate 5% SG (3.02), Novaluron 10% EC (3.32), *Beauveria bassiana* 1.15% WP (3.54), Neem oil 1% (3.70) and Karanj oil2% (3.85) as compared to control (5.45). Among the treatments studied, the best and most economical treatment was Chlorantraniliprole 18.5 %SC with 245.52 q/ha yield and cost benefit ratio (1:6.53), followed by Spinosad 45% SC 230.15 q/ha with (1:6.04) C:B ratio, Emamectin benzoate 5% SG 190.30 q/ha with (1:5.54) C:B ratio, Novaluron 10% EC 170.20 q/ha with (1:4.67) C:B ratio, *Beauveria bassiana* 1.15%WP 150.35 q/ha with (1:4.40) C:B ratio, Neem oil 1% 142 q/ha with (1:3.85) C:B ratio and Karanj oil 2% 135.45 q/ha with (1:3.68) C:B ratio and Control 65.20 q/ha (1: 1.97) C:B ratio.

Keywords: Biopesticides, *Brassica oleracea*, insecticides, efficacy, *Plutella xylostella*, Economical

Introduction

Cabbage is one of the most popular cole vegetables grown in India. It is commonly used fresh as boiled vegetables, cooked in curries and process, salad, etc. It is known to possess medicinal properties and its enlarged terminal buds is a rich source of Ca, P, Na, K, S, Vitamin A, Vitamin C and dietary fibre.**(Nikam *et al*., 2015)** 100 gm of cabbage contains 25g of calories, 18mg of sodium, 170 gm of potassium, 6g of carbohydrate, 1.3 gm of protein , vitamin A 1%, vitamin C 60%, calcium 4%, iron 2%, vitamin B_6 5%, mg 3%.**(Kadam and Kumar 2022)**

India is the second largest producer of cabbage after China. India is producing about 8,755,000 million tonnes in an area of 388 ha with a productivity of 22.5 MT/ha. In Uttar Pradesh cabbage is grown in an area of about 0.72 million ha producing 5.7 million tonnes. China accounts for 33,881,51 tons of cabbage produced in the world. Other Asian countries in the list are Japan (1,446,000 tons), South Korea (2,501,953 tons), and Indonesia (1,513,326 tons). **(Devi and Tayde 2017)**

The brassica crop has a multiple insect pest complex. The important insect pest species are Diamondback moth (*Plutella xylostella* L), Cabbage caterpillar (*Pieris brassicae* L), Cabbage semi-looper (*Thysanoplusia orichalcea* Fabricius) and (*Autographa nigrisigna* Walker), Tobacco caterpillar (*Spodoptera litura* Fabricius), Cabbage leaf Webber (*Crocodolomia binotalis* Zeller), Cabbage borer (*Hellula undalis* Fabricius) **(Gaddam *et al.*, 2021)**

The most important insect pest of cabbage crop is Diamondback moth (DBM*) Plutella xylostella* (Plutellidae: Lepidoptera), recorded from more than 128 countries of the world. **(Alexander *et al*., 2018)** In India, diamondback moth has national importance on cabbage as it causes 50-80% annual loss in the marketable yield also reported that there is 52% loss in yield due to the attack of diamondback moth. **(Bhagat *et al*., 2019)** lot of damage is due to the construction of tunnels in the head as in cabbage and brussel sprouts. Further more, crop damage is usually first evident on plants growing on ridges in the crucifier field. The most devastating pest that causes severe damage in cabbage production is the diamondback moth (DBM). **(Gautam *et al.*, 2018)**

In recent years, various types of insecticides belonging to different chemical groups have been used to manage the pests and excessive reliance on these chemicals has led to the problem of resistance, environmental pollution and health threat to the consumers thus it has become essential to use the insecticides in optimal dosage so as to reduce and control the damage to environment and human health as well as to reduce the pest incidence. Hence an investigation was undertaken to evaluate the performance of certain chemical insecticides and biopesticides at their recommended dosages against diamondback moth in cabbage.

Materials and methods

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Field experiment was carried out at the Central Research Farm of Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, U.P. during *rabi* season 2023. Trail was laid out in randomised block design consisting of eight treatments including control. Each treatment was replicated three times using variety Pride of india in a plot size of (2 m × 1 m) maintaining 30 cm borders as a bund with total gross area 176 m^2 along with a recommended package of practices excluding plant protection. The treatments used in experiment were, Emamectin benzoate 5% SG (0.4 gm/lit), Chlorantraniliprole 18.5% SC (0.5 ml/lit), Novaluron 10% EC (2 ml/lit), Spinosad 45% SC (0.5 ml/lit), *Beauveria bassiana* 1.15% WP (1 gm/lit), Neem oil 1% (10 ml/lit), Karanj oil 2% (20 ml/lit) and Control. As the ETL 2-3 larvae per plant were crossed (Gaddam *et al*., 2021) and application of the two rounds of insecticidal treatments were applied at 15 days interval.

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. 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 **(Devi and Tayde, 2017)**

Gross return was calculated by multiplying total yield with the market price of the produce. Cost of cultivation and cost of treatment imposition deducted from the gross returns, to find out net returns and cost benefit ratio by following formula.

$$\text{B:C Ratio} = \frac{\text{Gross Returns}}{\text{Total Cost}}$$ **(Gadhe and Tayde 2022)**

Result and discussion

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The results (Table-1) after 1^{st} and 2^{nd} spray revealed that all the treatments were significantly superior over the control. The data on the mean larval population of *P. xylostella* in cabbage at 3^{rd}, 7^{th} and 14^{th} day after first spray revealed that the chemical treatments were significantly superior over control. Among all the treatments lowest larval population was recorded in Chlorantraniliprole 18.5% SC (3.08) followed by Spinosad 45% SC (3.28), Emamectin benzoate 5% SG (3.41), Novaluron 10% EC (3.62), *Beauveria bassiana* 1.15% WP (3.93), Neem oil 1% (4.04), Karanj Oil 2% (4.15) and control (5.17)

The data on the mean larval of diamond back moth *P. xylostella* in cabbage after second spray revealed that the chemical treatments were significantly superior over control. Among all the treatments lowest larval population was recorded in Chlorantraniliprole 18.5% SC (2.19) followed by Spinosad 45% SC (2.64), Emamectin benzoate 5%SG (2.62), Novaluron 10% EC (3.02), *Beauveria bassiana* (3.15), Neem oil 1% (3.73), Karanj Oil 2% (3.55) and control (5.73)

The highest yield and cost-benefit ratio was recorded in Chlorantraniliprole 18.5 SC (245.51 q/ha), (1:6.53) followed by Spinosad 45% SC (230.15 q/ha), (1:6.04), Emamectin benzoate 5% SG (190.30 q/ha) (1:5.54), Novaluron 10% EC (170.20 q/ha) (1:4.67), *Beauveria bassiana* (150.35 q/ha) (1:4.40), Neem oil 1% (142 q/ha) (1:3.85), Karanj oil 2% (122.45 q/ha) (1:3.68) Untreated (65.20 q/ha) (1:1.97).

The data on the mean larval population in Chlorantraniliprole 18.5% SC (3.08) and (2.19) these results were supported by **Gadhe and Tayde (2022).** Spinosad 45% SC (3.28), (2.64) and Emamectin benzoate 5% SG (3.41) and (2.62) similar finding were observed by **Kadam and Kumar (2022).**

The cost-benefit ratio ranged between 1:6.53 and 1:1.97. Maximum cost benefit ratio (1:6.53) and yield (245.51 q/ha) was obtained in Chlorantraniliprole treated plants, which is supported by the findings of **Sawant and Patil (2018)**. Followed by spinosad with cost benefit ratio (1:6.04) and yield (230.15 q/ha), the result were similar to the findings **Kumar and Kumar (2020)**. Emamectin benzoate also had a profitable yield of (190.30 q/ha) and cost benefit ratio (1:5.54) and this results are in support of **Sawant and Patil (2018)**.

Table 1. Evaluation of insecticides against diamond back moth (*Plutella xylostella* L.) on cabbage during *rabi* 2023- 2024

S.NO	Treatment name	Mean larval population										Yield	B:C ratio
		First spray					**Second spray**						
		1DBS	3DAS	7DAS	14DAS	MEAN	1DBS	3DAS	7DAS	14DAS	MEAN	(q/ ha)	
T_0	**Control**	04.53	04.93^{a}	05.20^{a}	05.40^{a}	05.17^{a}	05.40^{a}	05.53^{a}	05.73^{a}	05.93^{a}	05.73^{a}	65.20	1:1.97
T_1	**Emamectin benzoate 5% SG @0.4 gm/lit**	04.06	03.86^{bc}	03.06^{de}	03.33^{d}	03.41^{de}	03.33^{d}	03.13^{e}	02.66^{e}	02.13^{d}	02.64^{d}	190.30	1:5.54
T_2	**Chlorantraniliprole 18. 5 SC @0.5 ml/lit**	03.86	03.66^{c}	02.66^{f}	02.93^{e}	03.08^{e}	02.93^{e}	02.66^{f}	02.33^{f}	01.60^{e}	02.19^{e}	245.51	1:6.53
T_3	**Novaluron 10 EC @2ml/lit**	04.20	04.00^{bc}	03.20^{d}	03.66^{c}	03.62^{cd}	03.66^{c}	03.46^{d}	02.93^{de}	02.67^{c}	03.02^{cd}	170.20	1:4.67
T_4	**Spinosad 45 SC @0.5 ml /lit**	03.93	03.73^{c}	02.86^{ef}	03.26^{d}	03.28^{de}	03.26^{d}	03.06^{e}	02.66^{e}	02.20^{d}	02.64^{d}	230.15	1:6.04
T_5	***Beauveria bassiana* 1.15 % WP @1gm/lit**	04.40	04.53^{ab}	03.46^{c}	03.80^{bc}	03.93^{bc}	03.80^{bc}	03.60^{cd}	03.06^{cd}	02.80^{c}	03.15^{bc}	150.35	1:4.40
T_6	**Neem Oil 1% @10 ml/lit**	04.53	04.33^{abc}	03.73^{b}	04.06^{b}	04.04^{bc}	04.06^{b}	03.86^{b}	03.26^{c}	03.00^{bc}	03.37^{bc}	142.00	1:3.85
T_7	**Karanj oil 2% @20 ml/lit**	04.46	04.73^{a}	03.73^{b}	04.00^{b}	04.15^{b}	04.00^{b}	03.80^{bc}	03.60^{b}	03.26^{b}	03.55^{b}	135.45	1:3.68
	F-TEST	**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	-	-
	CD (5%)	-	**0.703**	**0.263**	**0.285**	**0.426**	**0.265**	**0.263**	**0.290**	**0.423**	**0.428**	-	-

DBS- Day Before Spraying, DAS- Day After Spraying, NS- Non- Significant, S- Significant

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