

Original Research Article

“Comparative efficacy and economics of chemicals Insecticides and Bioagents against Diamondback moth (*Plutella xylostella* Linn) on cabbage(*Brassica oleracea* L.var capitata)”

Abstract

Field trial was conducted during *rabi* season 2021-2022 at Central Research Farm (CRF), SHUATS. The experiment was laid out in Randomised Block Design with eight treatments each replicated thrice using a variety Green Soccer (546). The treatments are (T₁) Chlorantraniliprole 18.5 %SC, (T₂) Indoxacarb 14.5%SC, (T₃) Emamectin benzoate 5%SG, (T₄) Spinosad 45% SC (T₅), *Beauveria bassiana* (1x10⁸CFU/ml) (T₆) *Metarhizium anisopilae* (1x10⁸CFU/ml), (T₇) *Bacillus thuringiensis* (1x10⁸CFU/ml) along with an untreated control against *Plutella xylostella* on Cabbage. The data on Larval population of Diamond back moth over control on overall mean revealed that all treatments significantly superior over control (6.51). Among all treatments Chlorantraniliprole 18.5% SC recorded lowest Larval Population of Diamond back moth(1.52), which was significantly superior over control followed by Spinosad 45% SC (1.75), Indoxacarb 14.5%SC (2.00), Emamectin Benzoate 5%SG (2.28), *Bacillus thuringiensis* (1x10⁸CFU/ml) (2.68), *Beauveria bassiana* (1x10⁸CFU/ml) (2.87), *Metarhizium anisopilae* (1x10⁸CFU/ml) (3.02) was least among all treatments. While, the Highest yield 280 q/ha was obtained from the treatment Chlorantraniliprole 18.5% SC as well as B:C ratio (1:6.37) obtained high from this treatment. It was followed by Indoxacarb 14.5 SC (1:6.33), Emamectin Benzoate 5%SG (1:6.25), *Bacillus thuringiensis* (1x10⁸CFU/ml) (1:5.97), Spinosad 45% SC (1:5.75), *Beauveria bassiana* (1x10⁸CFU/ml) (1:5.72), *Metarhizium anisopilae* (1x10⁸CFU/ml) (1:5.50) as compared to control (1:3.34).

Keywords: Chlorantraniliprole, *Bacillus thuringiensis*, *Beauveria bassiana*, Cost benefit ratio, *Plutella xylostella*.

Introduction

Cabbage (*Brassica oleracea* var. *capitata*) is one of the most popular Cole vegetables grown in India. It is originated in Europe and in the Mediterranean region after cauliflower. Cabbage is one of the most popular winter vegetables grown in India. The botanical name of cabbage is *Brassica oleracea* var. *capitata*, Family- Cruciferae and Chromosome number : $2n=18$. Cabbage is the second most important cole crop, which originated in Europe and in the Mediterranean region after cauliflower.

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. (Alexandra *et al.*,2020).

Regular consumption of dark green leafy vegetables is highly recommended because of their potential in reducing chronic diseases. (Miller-Cebert *et al.*,2009) and glucosinolates in cabbage reduced risk of cancer induction and development. (Kang *et al.*,2006). 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. It is said to be good for person suffering from diabetes. It may be used to prepare soup, stew, as stuffing for cake (Norton *et al.*,1997).

In India, West Bengal accounts highest production of cabbage in the world which is 2288.50 tonnes, which has the share of 25.32 percent followed by Orissa 1058.78, tonnes, Madhya Pradesh 686.91 tonnes, Bihar 673.44 tonnes, and Uttar Pradesh 302.97. **source:** National Horticultural board (NHB) (2017-2018).

The brassica crop has a multiple insect pest complex. A total of 37 insect pests have been reported to feed on cabbage in India (Lal *et al.*,1975). The important insect pest species are Diamondback moth (*Plutella xylostella* L), Cabbage caterpillar (*Pieris brassicae* Linnaeus), Cabbage semi-looper (*Thysanoplusia orichalcea* Fabricius) and (*Autographa nigrisigna* Walker), Tobacco caterpillar (*Spodopteralitura* Fabricius), Cabbage leaf Webber (*Crocodolomia binotalis* Zeller), Cabbage borer (*Hellula undalis* Fabricius) and Cabbage aphid (*Brevicoryne brassicae* W). of these Diamondback moth, *Plutella xylostella* (L.) is the most destructive pest (Kumar *et al.*,2007) and is the limiting factor for the successful

cultivation of cruciferous crops. *Plutella xylostella* was first recorded in 1746 and probably from European origin. About 128 countries or regions reported infestation by this insect pest in 1972. The level of infestation varies from place to place for example the infestation is serious in south and southeast Asian countries and moderate in other Asian countries than the Mediterranean region. *Plutella xylostella*. (L.) is a common pest (Harcourt, 1963).

Materials and methods

The experiment was conducted at Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P) during the *rabi* season of 2021-2022 with a recommended package of practices excluding plant protection. The Cabbage seedlings of variety 'Green Soccer-546' were transplanted after 40 days at 60 cm x 45 cm spacing. The experiment was laid down in Randomized Block Design (RBD) with eight treatments replicated thrice with each plot size of 2m X 2m and proper irrigation was provided. The treatments comprising of Chlorantraniliprole 18.5%SC, Spinosad 45% SC, Indoxacarb 14.5% SC, Emamectin benzoate 5% SG, *Bacillus thuringiensis* (1×10^8 CFU/ml), *Beauveria bassiana* (1×10^8 CFU/ml), *Metarhizium anisopliae* (1×10^8 CFU/ml), and were applied in two sprayings in 15 days interval with recommended doses when larval population reaches its ETL level.

As soon as the infestation of pest was initiated, the observations on total number of larvae on cabbage of five observational plants from each treatment replication wise were recorded at 1 Day before spraying, 3rd, 7th and 14th days after imposing treatments. The data recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of RBD experiment. After harvesting of cabbage from each individual plots produce were calculated to work out the yield of the treatments. Yield of healthy heads was converted into quintal per hectare.

The cost of insecticides and biopesticides used in this experiment was obtained from nearby market. The total cost of plant protection consisted of cost of treatment, sprayer, rent and labour charges for the spray. There are two sprays throughout the research period and the overall plant protection expenses was calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from the total income. Benefit over the control for

each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment.

Results and discussion

Effect of different insecticides and biopesticides on the incidence of *Plutella xylostella* showed that all the treatments were significantly superior in reducing the infestation of Diamondback moth resulting in increasing the yield, significantly as compared to control. The first spray was given after 30 days of transplanting. The larval population of Diamondback moth on cabbage after first spray revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest larval population, was recorded in Chlorantraniliprole 18.5% SC (2.17) followed by Spinosad 45% SC (2.37), Indoxacarb 14.5% SC (2.65), Emamectin benzoate 5SG (2.95), *Bacillus thuringiensis* (1×10^8 CFU/ml) (3.44) and *Beauveria bassiana* (1×10^8 CFU/ml) (3.55). The treatment *Metarhizium anisopliae* (1×10^8 CFU/ml) (3.66) was least effective among all the treatments and maximum damage was recorded in control plot (5.77). (Table 1)

The second spray was applied after 15 days of first spray and larval population was recorded. The data for second spray shows minimum larval population in Chlorantraniliprole 18.5% SC (0.86) followed by Spinosad 45%SC (1.13), Indoxacarb 14.5% SC (1.35), Emamectin benzoate 5% SG (1.62), *Bacillus thuringiensis* (1×10^8 CFU/ml) (1.93) and *Beauveria bassiana* (1×10^8 CFU/ml) (2.2) The treatment *Metarhizium anisopliae* (1×10^8 CFU/ml) (2.37) was least effective among all the treatments. The highest damage was recorded in Control plot (7.24) (Table 1).

All the insecticides were found very effective and significantly over control. The data for overall mean larval population was recorded of which least larval population was recorded in Chlorantraniliprole 18.5% SC (1.52), Spinosad 45%SC (1.75), Indoxacarb 14.5% SC (2.00), Emamectin benzoate 5%SG (2.28), *Bacillus thuringiensis* (1×10^8 CFU/ml) (2.68) and *Beauveria bassiana* (1×10^8 CFU/ml) (2.87) The treatment *Metarhizium anisopliae* (1×10^8 CFU/ml) (3.02) was least effective among all the treatments and control (6.51) (Table 1).

The highest yield and Benefit cost ratio was recorded in Chlorantraniliprole 18.5% SC (325 q/ha) (1:6.37) is similar to the findings of **Sharma et al.,(2016)**, Spinosad 45% SC (310 q/ha) (1:5.75) is similar to the findings of **Gill et al.,(2008) and Gaddam et al.,(2021)**, Indoxacarb 14.5% SC (300 q/ha) (1:6.33) is similar to the findings of **Harika et al.,(2019) and Gaddam et al.,(2021)**, Emamectin benzoate 5% SG (295 q/ha) (1:6.25) is similar to the findings of **Akbar et al., (2014)** , *Bacillus thuringiensis* (1×10^8 CFU/ml) (280 q/ha) (1:5.97) is similar to the findings of **Choyon et al.,(2022)** and *Beauveria bassiana* (1×10^8 CFU/ml) (270q/ha) (1:5.72) is similar to the findings of **Debbarma et al.,(2017)** The treatments *Metarhizium anisopliae* (1×10^8 CFU/ml) (260 q/ha) (1:5.50) is similar to the findings of **Singh et al., (2015)**, and the lowest yield was recorded in control (150 q/ha) (1:3.34) (Table 1).

Table 1: Effect of certain insecticides and biopesticides on larval population of diamondback moth (*Plutella xylostella*).

S.No.	Treatments	Larval population of diamondback moth							Overall mean population	Yield (q/ha)	C:B ratio
		1 st spray				2 nd spray					
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS			
T1	Chlorantraniliprole 18.5 % SC (0.3ml/lit)	04.06	02.6 ^d	01.8 ^e	02.13 ^e	01.13 ^e	00.93 ^f	00.53 ^f	01.52	325	1:6.37
T2	Indoxacarb 14.5% SC (1ml/lit)	04.26	03.13 ^c	02.33 ^{de}	02.5 ^{cd}	01.6 ^{cd}	01.26 ^{ef}	01.2 ^{de}	02.00	300	1:6.33
T3	Emamectin benzoate 5 % SG(0.6 gm/lit)	04.6	03.26 ^c	02.66 ^{cd}	02.93 ^b	01.73 ^c	01.53 ^{de}	01.6 ^{cd}	02.28	295	1:6.25
T4	Spinosad 45% SC (2ml/lit)	04.4	02.73 ^d	02.06 ^e	02.33 ^{de}	01.26 ^{de}	01.2 ^{ef}	00.93 ^{ef}	01.75	310	1:5.75
T5	<i>Beauveria bassiana</i> (1x10 ⁸ CFU/ml) (2ml/lit)	04.46	04.73 ^b	03.2 ^{bc}	02.73 ^{bc}	02.46 ^b	02.2 ^{bc}	01.93 ^{bc}	02.87	270	1:5.72
T6	<i>Metarhizium anisopliae</i> (1x10 ⁸ CFU/ml) (2ml/lit)	04.8	04.86 ^{ab}	03.26 ^b	02.86 ^b	02.66 ^b	02.4 ^b	02.06 ^b	03.02	260	1:5.50
T7	<i>Bacillus thuringiensis</i> (1x10 ⁸ CFU/ml) (2ml/lit)	04.46	04.6 ^b	03.06 ^{bc}	02.66 ^{bc}	02.33 ^b	01.86 ^{cd}	01.6 ^{cd}	02.68	280	1:5.97
T0	Control	04.33	05.2 ^a	05.73 ^a	06.4 ^a	06.73 ^a	07.2 ^a	07.8 ^a	06.51	150	1:3.34
	F-test	NS	S	S	S	S	S	S	-	-	-
	C.D. at 0.5%	---	00.35	00.55	00.30	00.41	00.41	00.40	-	-	-
	S.EdA (±)	00.29	00.16	00.82	00.14	00.18	00.19	00.18	-	-	-

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UNDER PEER REVIEW