

## Original Research Article

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

#### **Abstract**

Bio-efficacy of insecticides and bioagent against *Plutella xylostella* on cabbage var Soccer 546 conducted during rabiseason 2021-2022 at Central Research Farm (CRF), SHUATS with eight treatments and three replications was variety Green Soccer (546) was conducted during rabiseason 2021-2022 at Central Research Farm (CRF), SHUATS. The experiment was laid out in Randomised Block Design with eight treatments each replicated thrice using variety Green Soccer (546). The treatments were Chlorantraniliprole 18.5 %SC -T<sub>1</sub>, Indoxacarb 14.5%SC-T<sub>2</sub>, Emamectin benzoate 5%SG-T<sub>3</sub>, Spinosad 45% SC-T<sub>4</sub>, *Beauveria bassiana* (1x10<sup>8</sup>CFU/ml)-T<sub>5</sub>, *Metarhiziumanisopilae* (1x10<sup>8</sup>CFU/ml)-T<sub>6</sub>, *Bacillus thuringiensis* (1x10<sup>8</sup>CFU/ml)-T<sub>7</sub> and untreated control-T<sub>8</sub>. Mean reduction in the larval population per plant revealed that all the treatments were significantly superior over the control (6.51). Chlorantraniliprole 18.5% SC recorded lowest mean larval population of *P. xylostella* (1.52), followed by Spinosad 45% SC (1.75), Indoxacarb 14.5% SC (2.00), Emamectin Benzoate 5%SG (2.28), *B. thuringiensis* (2.68), *B. bassiana* (2.87), *M. anisopilae* (3.02). Highest yield (280q/ha) as well as B:C ratio (1:6.37) was obtained from the treatment Chlorantraniliprole 18.5% SC followed by Indoxacarb 14.5% SC (1:6.33), Emamectin Benzoate 5%SG (1:6.25), *B. thuringiensis* (1:5.97), Spinosad 45% SC (1:5.75), *B. bassiana* (1:5.72), *M. anisopilae* (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* is also 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 as 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. (Kangetal., 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 persons suffering from diabetes. It may be used to prepare soup, stew, as stuffing for cake (Norton *et al.*, 1997).

In India, West Bengal account 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) (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 nigricornis* Walker), Tobacco caterpillar (*Spodoptera litura* Fabricius), Cabbage leaf Webber (*Crocodyloma binotalis* Zeller), Cabbage

orer (*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).

The research topic is not properly introduced and why this was conducted in Uttar Pradesh. The Introduction is also not connected with the result/outcome. It needs to be rewritten

## Materials and methods

The experiment was conducted at Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj Uttar Pradesh (U.P.) during the rabi season of 2021-2022 with a recommended package of practices excluding plant protection. The Cabbage seedlings of (var '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 three and three replications with each plot size of 2m x 2m plot with 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* ( $1 \times 10^8$  CFU/ml), *Beauveria bassiana* ( $1 \times 10^8$  CFU/ml), *Metarhiziumanisopliae* ( $1 \times 10^8$  CFU/ml) were the treatments with, and were applied in two sprayings at 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 the randomly tagged five observational cabbage plants per replication from each treatment replication wise were recorded at 1 Day before spraying, 3<sup>rd</sup>, 7<sup>th</sup> and 14<sup>th</sup> 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 head harvested were recorded from each individual plots produce were calculated to work out the yield of the treatments. Yield of healthy heads was and converted into quintal per hectare.

The cost of insecticides and biopesticides used in this experiment was obtained from the local 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* revealed that all the treatments were significantly superior over the control in reducing the infestation of *P. xylostella* Diamondback moth and harvest of higher resulting in increasing the yield, significantly as compared to control. The first spray was given after 30 days of transplanting. There was a significant reduction in the mean larval population of Diamondback moth on cabbage *P. xylostella* after first spray of treatments at 30 DAT revealed that all the chemical treatments were significantly superior over control. Among all the treatments the mean lowest larval population lowest (2.17), 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* ( $1 \times 10^8$  CFU/ml) (3.44) and *Beauveria bassiana* ( $1 \times 10^8$  CFU/ml) (3.55). The treatment *Metarhizium anisopliae* ( $1 \times 10^8$  CFU/ml) (3.66) was least effective (3.66) among all the treatments, and but maximum damage highest larval population per plant (5.77) 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 lowest mean larval population (0.86) was recorded 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), *B. thuringiensis* (1.93) and *B. bassiana* (2.2). In the second spray also

*Manisopliae* was least effective (2.37) among all the treatments. The highest mean larval population (7.24) 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), *B. thuringiensis* (2.68) and *B. bassiana* (2.87). The treatment *M. anisopliae* (3.02) was least effective among all the treatments and but control treatment had higher mean larval population of 6.51 (Table 1).

Highest yield and benefit cost ratio (1:6.37) was recorded in Chlorantraniliprole 18.5% SC (325 q/ha) (1:6.37) is similar to the findings of Sharma *et al.*, (2016) reported benefit cost ratio (1:5.75) with Spinosad 45% SC (310 q/ha) (1:5.75) is similar to the findings of Gillet *et al.*, (2008) and Gaddam *et al.*, (2021), Indoxacarb 14.5% also reported high benefit cost ratio ((1:6.33) and yield (300 q/ha) with Indoxacarb 14.5% SC also reported (300 q/ha) (1:6.33) reported findings of similar findings (1:6.25 ; 295 q/ha) were reported by Harika *et al.*, (2019) and Gaddam *et al.*, (2021) with Emamectin benzoate 5% SG (295 q/ha) (1:6.25) is similar to the findings of Akbar *et al.*, (2014) with *B. thuringiensis* ( $1 \times 10^8$  CFU/ml) reported 1:5.97 BC ratio and yield of 280 q/ha (280 q/ha) (1:5.97) is similar to the findings of Choyonet *et al.*, (2022) and *Beauveria bassiana* ( $1 \times 10^8$  CFU/ml) (270 q/ha) (1:5.72) is similar to the findings of Debbarma *et al.*, (2017). The treatments *Metarhizium anisopliae* ( $1 \times 10^8$  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). Rewrite this part as suggested

**Table1:Effectofcertaininsecticides and biopesticides onlarval populationofdiamondback moth (*Plutellaxylostella*).**

S.No.	Treatments	Larval population of diamondback moth							Overall mean population	Yield(q /ha)	C:Bratio
		1 <sup>st</sup> spray				2 <sup>nd</sup> spray					
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS			
T1	Chlorantraniliprole18.5 %SC (0.3ml/lit)	04.06	02.6 <sup>d</sup>	01.8 <sup>e</sup>	02.13 <sup>e</sup>	01.13 <sup>e</sup>	00.93 <sup>f</sup>	00.53 <sup>f</sup>	01.52	325	1:6.37
T2	Indoxacarb 14.5% SC(1ml/lit)	04.26	03.13 <sup>c</sup>	02.33 <sup>de</sup>	02.5 <sup>cd</sup>	01.6 <sup>cd</sup>	01.26 <sup>ef</sup>	01.2 <sup>de</sup>	02.00	300	1:6.33
T3	Emamectinbenzoate5%SG(0.6 gm/lit)	04.6	03.26 <sup>c</sup>	02.66 <sup>cd</sup>	02.93 <sup>b</sup>	01.73 <sup>c</sup>	01.53 <sup>de</sup>	01.6 <sup>cd</sup>	02.28	295	1:6.25
T4	Spinosad 45% SC (2ml/lit)	04.4	02.73 <sup>d</sup>	02.06 <sup>e</sup>	02.33 <sup>de</sup>	01.26 <sup>de</sup>	01.2 <sup>ef</sup>	00.93 <sup>ef</sup>	01.75	310	1:5.75
T5	<i>Beauveria bassiana</i> (1x10 <sup>8</sup> CFU/ml)(2ml/lit)	04.46	04.73 <sup>b</sup>	03.2 <sup>bc</sup>	02.73 <sup>bc</sup>	02.46 <sup>b</sup>	02.2 <sup>bc</sup>	01.93 <sup>bc</sup>	02.87	270	1:5.72
T6	<i>Metarhiziumanisopliae</i> (1x10 <sup>8</sup> CFU/ml)(2ml/lit)	04.8	04.86 <sup>ab</sup>	03.26 <sup>b</sup>	02.86 <sup>b</sup>	02.66 <sup>b</sup>	02.4 <sup>b</sup>	02.06 <sup>b</sup>	03.02	260	1:5.50
T7	<i>Bacillus thuringiensis</i> (1x10 <sup>8</sup> CFU/ml)(2ml/lit)	04.46	04.6 <sup>b</sup>	03.06 <sup>bc</sup>	02.66 <sup>bc</sup>	02.33 <sup>b</sup>	01.86 <sup>cd</sup>	01.6 <sup>cd</sup>	02.68	280	1:5.97
T0	Control	04.33	05.2 <sup>a</sup>	05.73 <sup>a</sup>	06.4 <sup>a</sup>	06.73 <sup>a</sup>	07.2 <sup>a</sup>	07.8 <sup>a</sup>	06.51	150	1:3.34
	F-test	NS	S	S	S	S	S	S	-	-	-
	C.D.at0.5%	---	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	-	-	-

Angular transformation of insect count should have been done

Litre is abbreviated as l not lit

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