

Original Research Article

Field efficacy of some insecticides and neem products against tomato fruit borer [*Helicoverpa armigera* (Hubner)] in tomato

ABSTRACT

The field trial was conducted at Central Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttarpradesh during *Rabi*, 2021-2022. The experiment was laid out in RBD (Randomized Block Design). Seven treatments were replicated thrice: Neem oil, NSKE (Neem Seed Kernel Extract) 2%, Flubendiamide 480 SG, Novaluron 10% EC, Indoxacarb 14.5% SC, Emamectin benzoate 5%SG, Spinosad 45% SC and untreated Control. The treatments were tested to compare their efficacy against *Helicoverpa armigera* and their influences on the yield of tomatoes. Out of all treatments Indoxacarb 14.5% SC, Spinosad 45% SC, Flubendiamide 480SG and Novaluron10% EC recorded the minimum fruit infestation by 10.24, 11.31, 12.21 and 13.21 percent respectively. The highest yield was noticed in Indoxacarb14.5% SC (212.5 q/ha), followed by Spinosad 45% SC (200 q/ha) and Flubendiamide 480 SC (187.5 q/h). The best and most economical treatment is Indoxacarb (1:8.75), followed by Spinosad (1:8.16), Flubendiamide (1:7.55), Novaluron (1:6.38), Emamectin benzoate (1:5.86), Neem oil (1:5.64), NSKE (1:4.63), as compared to control T₀-control (1:4.25) having the lowest B: C

ratio.

Keywords: *Helicoverpa armigera*, Tomato, Indoxacarb, Neem products, Insecticides and Cost-benefit ratio.

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INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is the largest vegetable crop in the world after potato and sweet potato and it is a warm-season crop. It is the most significant vegetable, belongs to the Solanaceae family, and is widely produced for both fresh market and processing. Tomatoes are high in vitamin C, manganese, and vitamin E. Furthermore, tomato lycopene is a potent antioxidant that lowers the incidence of prostate cancer (Das and Khatun,2021)¹.

Tomatoes are grown on an area of 23,886.63 hectares with a total production of 190,000 tons, an average yield of 32.20 tons/acre. China is the largest producer of tomatoes in the world. It contributes to around 34.75 percent of total tomato production worldwide. India contributes 10% of the total world tomato production with a production of 19.01 million tons. Every year, the rate of growth is increased by 1.45%. Turkey and the United States are the third and fourth-largest tomato producers.

India is the world's second-largest producer of tomatoes. Andhra Pradesh is responsible for 20% of all tomato production in India. Madhya Pradesh is the second-largest producer of tomatoes in India, and it contributes 12% of the country's total production. Karnataka is the third-largest producer of tomatoes in India, contributing 10% of the total. Gujarat, Maharashtra, Chhattisgarh, Telangana, and Tamil Nadu are the next four largest producers.

Whitefly (*Bemisia tabaci*), leaf hopper (*Amrasca devastans*), leaf miner (*Liriomyza trifolii*), potato aphid (*Myzus persicae*), and hadda beetle (*Epilachana dodecastigma*) are the most common insect pests of tomatoes (Sharma *et al.*, 2013)⁶. The most common and serious pest of the tomato is the fruit borer (*Helicoverpa armigera*) due to its direct attack on fruits, high mobility, voracious feeder and overlapping generations. The worldwide annual yield loss due to *H. armigera* alone is approximately 5 billion US dollars (Sharma, 2001)⁵. The tomatofruit borer, *Helicoverpa armigera*) is a highly polyphagous species and a pest of great economic importance for a wide variety of crops, especially cotton, soybean, tobacco, chickpea and pigeon pea.

Helicoverpa armigera is one of the most important and destructive pests in tomato farms in India, causing production losses of up to 50-80%. Fruit losses in Tamil Nadu range between 40 to 50%. Similarly, the tomato fruit worm has caused a 30 percent loss of produce in Northern India. In India's tomato-growing regions, this insect pest has caused 5–55% losses. Tomato fruit borer also caused a 35% yield loss in tomatoes and 37.79% specifically in Karnataka, India.

MATERIALS AND METHODS

The experiment was conducted at the Central Research Farm of the Department of Entomology, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj during the *Rabi* season of 2021-2022. Research field situated at 25°27' North latitude 80°50'

East longitudes and an altitude of 98 meters above sea level. The climate is typically semi-arid and sub-tropical. The maximum temperature reaches up to 47°C in summer and drops down to 2.5°C in winter. The average rainfall in this area is around 1013.4 mm annually.

It was carried out in a Randomized block design (RBD) with three replications. A good tilth area was divided into three main blocks. Each main block was subdivided into 8 sub-plots of 2m×2m size. The experiment has 8 treatments comprising of Neem oil (3 ml/lit), NSKE 2% (5 ml/lit), Flubendiamide 480 SC (0.5 g/lit), Novaluron 10% EC (1.5 ml/lit), Indoxacarb 14.5% SC (1 ml/lit), Emamectin benzoate 5%SG (0.5 g/lit), Spinosad 45% SC (0.2 ml/lit) and untreated Control. One-month-old seedlings were transplanted @ two seedlings per hill at a spacing of 60 x 40 cm.

The observations of fruit borers were recorded by observing the damaged (infested) fruits and healthy fruits on five randomly selected plants. Observations on percent infestation were recorded one day before spray 3rd, 7th, and 14th, days after spraying. Insecticidal spray solution of desired concentration for each treatment was freshly prepared each time at the site of an experiment, just before spraying.

The extent of the damage was computed by using the formula;

Percent fruit infestation:

$$\text{Percent fruit damage} = \frac{\text{number of damaged fruits}}{\text{total number of fruits}} \times 100$$

Benefit Cost Ratio:

Cost-effectiveness of each treatment was assessed based on net returns. The net return of each treatment was worked out by deducting the total cost of the treatment from gross return. The total cost of production included both cultivations as well as plant protection charges.

$$\text{Benefit-cost ratio} = \frac{\text{Net returns}}{\text{Total cost}}$$

RESULTS AND DISCUSSION

The present study entitled, “Field efficacy of some insecticides and neem products against tomato fruit borer, *Helicoverpa armigera* (Hubner) in Tomato” The data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the compiled mean data are tabulated in the following pages.

The data on the percent infestation of fruit borer on mean after the first spray revealed that all treatments were significantly superior to control. With regard to all of the treatments, Indoxacarb had the lowest percentage of fruit borer infestation (11.70%), followed by Spinosad (12.52%), Flubendiamide (13.33%), Novaluron (13.69%),

Emamectin benzoate (14.44%), Neem oil (15.20%), and NSKE (15.51%).

All of the treatments outperformed the control by a significant margin. The data on the percent infestation of fruit borer on mean after the second spray revealed that all treatments were significantly superior to control. With regard to all of the treatments, Indoxacarb had the lowest percentage of fruit borer infestation (8.78 %), followed by Spinosad (10.11 %), Flubendiamide (11.09 %), Novaluron (11.61 %), Emamectin benzoate (12.10 %), Neem oil (12.80 %) and NSKE (13.73 %)

The overall data on the percent infestation of fruit borer on overall mean of first and second spray revealed that all treatments were significantly superior to control. With regard to all of the treatments, Indoxacarb had the lowest percentage of fruit borer infestation (10.24 %), Spinosad (11.31 %), Flubendiamide (12.21 %), Novaluron (13.21 %), Emamectin benzoate (12.44 %), Neem oil (13.79 %) and NSKE (14.42 %)

All the treatments were superior over control. Among all the treatments minimum percent infestation of fruit borer was recorded in Indoxacarb (10.24 %) as compared to untreated control (20.61 %). These results were similar to the findings reported by **Reddy *et al.*, (2020)⁴**, **Kumar *et al.*, (2016)³** **Yogeeswarudu *et al.*, (2014)⁸**, **Gautam *et al.*, (2018)²**, **Singh *et al.*, (2017)⁷** reported that among all the treatments a lowest

percentage of fruit borer infestation was recorded in Indoxacarb 14.5SC.

The yields among the treatment were significant. The highest yield was recorded in Indoxacarb (212.5 q/ha), followed by Spinosad (200 q/ha), Flubendiamide (187.5 q/ha), Novaluron (162.5 q/ha), Emamectin benzoate (150 q/ha), Neem oil (145 q/ha), NSKE (125 q/ha), as compared to control T₀-control (112.5 q/ha).

When cost-benefit ratio was worked out, an interesting result was achieved. Among the treatment studied, the best and most economical treatment was Indoxacarb (1:8.75), followed by Spinosad (1:8.16), Flubendiamide (1:7.55), Novaluron (1:6.38), Emamectin benzoate (1:5.86), Neem oil (1:5.64), NSKE (1:4.63), as compared to control (1:4.25).

Higher yield (212.5 q/ha) and Higher Cost: Benefit Ratio (1:8.75) was obtained from the Indoxacarb treated plots and the lowest (112.5 q/ha) in the untreated control plot. Similar findings were made by **Singh *et al.*, (2017)⁷** who reported that the Indoxacarb 14.5 SC is the best and most economical treatment.

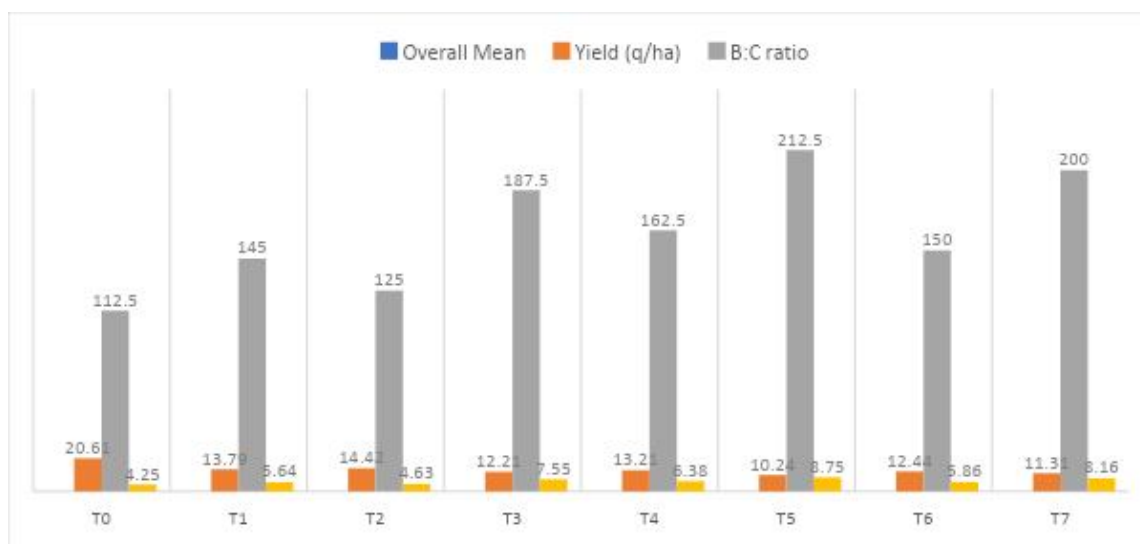
Table 1: Efficacy of some insecticides and neem products on tomato fruit borer [*Helicoverpa armigera* (Hubner)] in tomato.

S.No.	Treatments	Percent fruit infestation of tomato fruit borer							Overall mean	Yield (q/ha)	B:C ratio
		First spray				Second spray					
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS			
T0	Control	18.99	20.80 ^a	23.26 ^a	24.80 ^a	18.77 ^a	19.21 ^a	19.74 ^a	20.61	112.5	1:4.25
T1	Neem oil	18.81	13.86 ^{bc}	12.09 ^b	16.04 ^b	13.90 ^{bc}	11.60 ^b	12.91 ^b	13.79	145	1:5.64
T2	NSKE @2%	18.19	14.43 ^b	12.69 ^b	16.75 ^b	15.17 ^b	12.33 ^b	13.68 ^b	14.42	125	1:4.63
T3	Flubendiamide @480SG	16.86	12.00 ^c	10.91 ^e	13.58 ^{de}	12.07 ^d	10.37 ^d	10.83 ^c	12.21	187.5	1:7.55
T4	Novaluron @10% EC	15.62	12.73 ^c	11.50 ^d	14.91 ^{cd}	12.45 ^c	11.00 ^d	11.37 ^c	13.21	162.5	1:6.38
T5	Indoxacarb	17.18	10.19 ^d	7.61 ^f	11.85	8.18 ^e	8.58 ^f	9.59 ^c	10.24	212.	1:8.

	@14.5% SC				f					5	75
T6	Emamectin benzoate @5%SG	17.15	13.46 ^b _c	11.70 ^c _d	15.46 ^{bc}	12.77 ^c	11.39 ^c	12.15 ^b	12.44	150	1:5.86
T7	Spinosad @45% SC	17.80	10.68 ^d	8.75 ^e	12.88 ^{ef}	10.54 ^{de}	9.31 ^c	12.59 ^c	11.31	200	1:8.16
	F- test	NS	S	S	S	S	S	S	S	-----	-----
	S. Ed. (±)	1.95	0.42	0.59	1.19	0.45	0.52	0.74	0.58	-----	-----
	C. D. (P = 0.05)	-	0.91	1.28	2.55	0.93	1.12	1.59	1.39	-----	-----

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Fig 1 : Graphical representation of overall mean, yield and benefit-cost ratio of *Helicoverpa armigera* in tomato



CONCLUSION:

It can be concluded that among all the treatments, the lowest percent infestation of fruit borer was recorded in Indoxacarb 14.5%SC (10.24 %) and proved to be the best treatment followed by Spinosad 45%SC (11.31 %), Flubendiamide 480 SG (12.21 %), Novaluron 10% EC (13.21 %), Emamectin benzoate 5%SG (12.44 %), Neem oil (13.79 %), NSKE 2% (14.42%) and Untreated control in managing *Helicoverpa armigera* infestation.

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