

Original Research Article

“Field efficacy of selected 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, UP during *Rabi*, 2021-2022. The experiment was laid out in RBD (Randomized Block Design). Seven treatments were replicated thrice which involves Neem oil, NSKE 2%, Flubendiamide 480 SG, Novaluron 10% EC, Indoxacarb 14.5% SC, Emamectin benzoate 5%SG, Spinosad 45% SC and untreated Control were tested to compare the efficacy against *Helicoverpa armigera* and their influences on yield of Tomato. 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.

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 for around 34.75 per cent 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 insect of the tomato is the fruit borer (*Helicoverpa armigera*). It causes damage to the developing fruit, which in turn results. The worldwide annual yield loss due to *H. armigera* alone is approximately 5billion US dollars (Sharma, 2001)⁵. The bollworm, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae), 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 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 worm also caused 35% yield loss in tomatoes and 37.79% specifically in Karnataka, India.

In many cases, alternate or eco-friendly method of insect management offer adequate level of pest control with less hazards and safe to non-target organisms. Keeping in view the following objectives were taken:

- To evaluate the efficacy of selected treatments on percentage incidence of tomato fruit borer, *Helicoverpa armigera* (Hubner) on tomato
- To estimate the cost benefit ratio.

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 at an altitude of 98 meter 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 sub-divided 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. Transplantation of seedlings was done on the 2nd november, 2021. One month old seedlings were transplanted @ two seedlings per hill at a spacing of 60 x 40 cm.

The observations of fruit borer was recorded by observing the damaged (infested) fruits and healthy fruits on five randomly selected plants. Observations on percent infestation was recorded one day before spray 3rd, 7th, 14th, days after spraying. Insecticidal spray solution of desired concentration for each treatment was freshly prepared each time at the site of experiment, just before spraying. The quantity of spray materials required for crop was gradually increased as the crop advanced in age.

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

Percent fruit infestation:

$$\text{Percent fruit damage} = \frac{\text{number of damaged fruits}}{\text{total number of fruits}} \times 10$$

Benefit Cost Ratio:

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment was worked out by deducting total cost of the treatment from gross returns. Total cost of production included both cultivation 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 first spray revealed that all treatments were significantly superior over control. Among all the treatments, the lowest percent infestation of fruit borer was recorded Indoxacarb (11.70 %), followed by Spinosad (12.52 %), followed by Flubendiamide (13.33 %), followed by Novaluron (13.69 %) followed by Emamectin benzoate (14.44 %) followed by Neem oil (15.20 %) followed by NSKE (15.51 %) is at least effective among all the treatments and is significantly superior over control.

The data on the percent infestation of fruit borer on mean after second spray revealed that all treatments were significantly superior over control. Among all the treatments, The lowest percent infestation of fruit borer was recorded in in Indoxacarb (8.78 %), followed by Spinosad (10.11 %), followed by Flubendiamide (11.09 %), followed by Novaluron (11.61 %) followed by Emamectin benzoate (12.10 %) followed by Neem oil (12.80 %) followed by NSKE (13.73 %) was found to be least effective than all the treatments and is significantly superior over the control.

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 over control. Among all the treatments lowest percent infestation of fruit borer was recorded in Indoxacarb (10.24 %), followed by Spinosad (11.31 %), followed by Flubendiamide (12.21 %), followed by Novaluron (13.21 %) followed by Emamectin benzoate (12.44 %) followed by Neem oil (13.79 %) followed by NSKE (14.42 %) was found to be least effective than all the treatments and is significantly superior over the control.

All the treatments were superior over control. Among all the treatments minimum percent infestation of fruit borer was recorded as 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 lowest number of fruit borer 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).

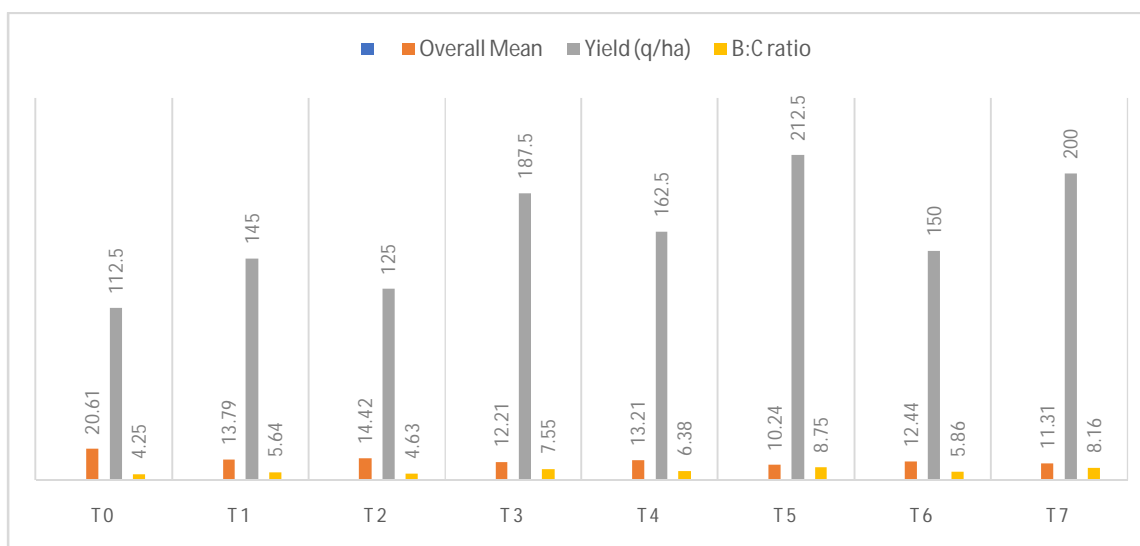
When cost benefit ratio was worked out, interesting result was achieved. Among the treatment studied, the best and most economical treatment was Indoxacarb (1 :8.75), followed by Spinosad (1:8.16), Flubendiamide (1:7.55), Novaluron (1:6.38), Emamectin benzoate (1:5.86), Neem oil (1:5.64), NSKE (1:4.63), as compared to control 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 lowest (112.5 q/ha) in untreated control plot. Similar findings 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 ^{bc} | 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 ^{bcd} | 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 ^{de} | 14.91 ^{cd} | 12.45 ^c | 11.00 ^d | 11.37 ^c | 13.21 | 162.5 | 1:6.38 |
| T5 | Indoxacarb @14.5% SC | 17.18 | 10.19 ^d | 7.61 ^f | 11.85 ^f | 8.18 ^e | 8.58 ^f | 9.59 ^c | 10.24 | 212.5 | 1:8.75 |
| T6 | Emamectin benzoate @5 %SG | 17.15 | 13.46 ^{bc} | 11.70 ^{cd} | 15.46 ^{bc} | 12.77 ^c | 11.39 ^c | 12.13 ^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 ^e | 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 | 0.43 | 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 | ----- | ----- |

Graph 1 : Graphical representation of overall mean, yield and benefit cost ration of *Helicoverpa armigera* in tomato



CONCLUSION:

It was concluded that among all the treatments lowest percent infestation of fruit borer was recorded in Indoxacarb 14.5%SC (10.24 %) proved to be the best treatment which is 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* reduction. Recommended dose of chemicals may be useful in devising proper integrated pest management strategy against fruit borer of Tomato.

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