*International Journal of Plant & Soil Science*

***34(21): 642-649, 2022; Article no.IJPSS.89641***
***ISSN: 2320-7035***

# Efficacy and Economics of Certain Insecticides and Neem oil against Tomato Fruit Borer, *Helicoverpa armigera* (Hubner) on Tomato

**Chinnakotla Nagaveni [a*¥] and Ashwani Kumar [a#]**

[a] *Department of Entomology, SHUATS, Prayagraj, U.P., India.*

***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/IJPSS/2022/v34i2131312

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/89641

***Original Research Article***

***Received 12 May 2022***
***Accepted 16 July 2022***
***Published 22 July 2022***

## ABSTRACT

A field trail was carried out at P. Kothapalli village in Ananthpur District, Andhra Pradesh, India, in Randomised Block Design, each replicated thrice during the kharif season of 2021. Two applications were used against Helicoverpa armigera (Hubner) and the results revealed that the highest incremental per cent reduction of larvae was recorded in the plot treated with T6 Indoxacarb 14.5% SC (48.47) which was at par with T4 Spinosad 45%SC (42.24), T2 Emamectin benzoate 5%SG (33.7), T3 Chlorantranilprole 18.5%SC (33.17), T1 Flubendamide 480 %SC (30.89), T7 Fipronil 5%SC (29.42) and T5 Neem oil 4% (25.06) is found to be least affective than all other treatments. Cost benefit ratio were found highest in Indoxacarb 14.5% SC (1:12.6), followed by Spinosad (1:11.7), Emamectin benzoate 5% SG (1:9.85), Chlorantranilprole 18.5%SC (1:9.82) Flubendiamide 480 SC (1:8.7), Fipronil 5% SC (1:6.7), Neem oil 4% EC (1:7.9) as compared to control T0 (1:5.06).

*Keywords: Benefit cost ratio; Helicoverpa armigera; tomato fruit borer.*

---

[¥] *M.Sc. Scholar;*
[#] *Associate Professor;*
**Corresponding author: E-mail: chinnakotlanagaveni@gmail.com;*

## 1. INTRODUCTION

"Tomato (Lycopersicon esculentum Mill) is one of the most important vegetables in the world, ranking second in importance to potato in many countries. It is a warm season crop and native to Peru and Mexico. It is grown as an off-season vegetable in the hills of India and farmers fetch a good income after sending their produce to the plains from June to September. It is popularly known as Wolf apple, Love of apple or Vilaayati baingan" [1]. "It ranks the third largest vegetable crop after potato and sweet potato, but it tops the list of canned vegetables. It can be used freshly in salads, curries or in bi-products like chutney, pickle, soups, ketchup, sauce, powder, purees and as a whole etc" [2]**.** "In terms of nutrition, the tomato contains double the amount of nutritive elements compared to the apple. It is the cheapest source of vitamins (A, B and C), minerals like calcium and proteins which the majority of people can buy easily" [3] (Pedro and Ferreira, 2007). "Lycopene in ripe tomatoes is a potential antioxidant which reduces the risk of prostate cancer in humans. Regular consumption of tomatoes can prevent short sightedness, night blindness, and other eye diseases. It is also helpful in preventing joint pain problems and respiratory disorders as well" [4].

Globally, India ranks second in tomato production after China. The area under cultivation of vegetables was 10383 thousand hectares with production of 179692 thousand metric tons during 2020 - 21. In India, tomatoes were grown in an area of 865.29 million hectares with production of 21055.85 million tonnes during 2020 - 21. Around 11% of the total world produce of tomatoes is cultivated in India. Madhya Pradesh ranks first followed by Tamil Nadu and Andhra Pradesh. (Department of Agriculture and Farmers welfare).

"The major insect pests are the fruit borer, Helicoverpa armigera (Hubner); whitefly, Bemisia tabaci (Gen); jassids, Amrasca devastans (Ishida); leaf miner, Liriomyza trifolii (Blanchard); potato aphid, Myzus persicae (Thomas) and hadda beetle, Epilachana dedecastigma (Widemann). In India, the fruit borer is one of the major pests of tomatoes, limiting production and the market value of crop produce. The fruit borer, Helicoverpa armigera (Hubner) is the most destructive pest of tomato, which is commonly known as the gram pod borer, American bollworm and fruit borer" [5].

"Young larvae feed voraciously on foliage, flower buds and flowers, while the later instars of these insects bore into fruit and render them unmerchandable. Due to wider host range, multiple generations, migratory behavior, high fecundity and existing insecticide resistance, the insect has become a difficult pest to handle" [6].

"The problem of pests is magnified due to its direct attack on fruiting structure, voracious feeding habits, high mobility, fecundity and multivoltine overlapping generations. Losses solely due to this pest up to Rs. 10,000 million have been reported in various crops like chickpea, cotton, pigeonpea, groundnut, tomato and other crops of economic importance. Tomatoes being a commercial vegetable crop, farmers have a tendency to overuse and even abuse insecticide in an over-ambitious approach to knocking down this destructive pest" [6]. "As a result, it has caused turbulence in the Agri-ecosystem. It has led to many problems like buildup of insecticide resistance, pest resurgence, reduction or killing of natural enemies and insecticide residue in the tomato fruit. In such situations, newer groups of insecticides and biological insecticides offer great scope as they maintain higher toxicity to insects at lower doses and are not persistent like conventional groups of insecticides" [6]. "Several new groups of insecticides like Indoxacarb, Fipronil, Spinosad belonging to a novel class of insecticides have been introduced which have a unique chemical structure and have been reported to be effective against insect pests of many crops. These are also reported to be safe from natural enemies and the environment. In order to avoid the adverse consequences of traditional insecticides on non-target organisms, environmental pollution, health hazard and development of resistance, it has become necessary to evaluate the new insecticides which are not only safe to natural enemies and the environment but also effective at very low doses" [6].

## 2. MATERIALS AND METHODS

The Field experiment was conducted during the kharif season of 2021 at Kothapalli village in Ananthpur District, Andhra Pradesh, India, in Randomised Block Design, each replicated thrice. The experiment was laid out in RBD with 8 treatments comprising of Flubendamide 480% SC (100 ml/lit), Emamectin benzoate 5% SG (0.4 g/lit), Chlorantraniliprole 18.5%SC (0.4 ml/lit), Spinosad 45%SC (0.3 ml/lit), Neem oil 4%

EC (40ml/lit), Indoxacarb 14.5%SC (0.65 ml/lit), Fipronil 5%SC (1.5 ml/lit) and untreated control. All the treatments were randomly distributed among the plots and replicated three times. Observations were recorded on healthy and infected fruits on 5 randomly selected plants in each plot. The incidence of pests was recorded one day before the spray as pre-treatment observations taken on the first observation were recorded before the spray of each plot and 3,7 and 14 after each spray. After last picking, the total of all pickings of individual plots produced was calculated to work out the yield of the treatments. Yields of healthy fruit were converted into quintals per hectre. As the experiment was conducted in fruit terms, the economics of the treatments were calculated in terms of cost benefit ratio.

## 2.1 Percent Reduction by Fruit Borer

The total number of infested and healthy plants at fruiting stage were counted from selected five plants of each plot. Thus the larva was calculated using the formula:

$$\text{Per centage reduction} = \frac{\text{Control- Treatment}}{\text{Control}} \times 100$$

## 2.2 Benefit Cost Ratio

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

$$\text{Benefit cost ratio} = \frac{\text{Gross return}}{\text{Total cost}}$$

## 3. RESULTS AND DISCUSSION

The present study entitled, **"**Efficacy and economics of certain insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner)". 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 per cent population reduction of fruit borer on mean after first spray revealed that all treatments were significantly superior over control. Among all the treatments, The highest per cent population reduction of fruit borer was recorded in Indoxacarb 14.5% SC (67.85) followed by, Spinosad 45% SC (65.71), Chlorantraniliprole 18.5% SC (58.52), Emamectin benzoate 5% SG (51.85) Fipronil 5% SC (50.07) Flubendiamide 480% SC (44.5) and Neem oil 4% EC (40.48) was found to be least effective than all the treatments and is significantly superior over the control.

The data on the per cent population reduction of fruit borer on mean after second spray revealed that all treatments were significantly superior over control. Among all the treatments, The highest per cent population reduction of fruit borer was recorded in Indoxacarb 14.5% SC (48.58) followed by Spinosad 45% SC (42.4), Emamectin benzoate 5% SG (33.72), Chlorantraniliprole 18.5% SC (32.77) Flubendamide 480% SC (31.04), Fipronil 5% SC (29.95), and Neem oil 4% (25.22) was found to be least effective than all the treatments and is significantly superior over the control.

The overall data on the per cent population reduction of fruit borer on overall mean of first and second spray revealed that all treatments were significantly superior over control. Among all the treatments highest per cent population reduction of fruit borer was recorded in Indoxacarb 14.5% SC (58.21) followed by Spinosad 45% SC (54.05), Chlorantraniliprole 18.5%SC (45.64), Emamectin benzoate 5% SG (42.78), Fipronil 5% SC (40.01), Flubendamide 480 %SC (37.77), and Neem oil 4% (32.85) was found to be least effective than all the treatments and is significantly superior over the control.

All the treatments were found to be significantly superior to control in reducing fruit infestation. The maximum larval population reduction were recorded in Indoxacarb. The results were similar to be findings reported by Reddy et al., [7], Singh et al., [8], Wajid et al., [9] spinosad found to be next best. The results of spinosad were supported by Islam et al., [10], Meena et al., [5], Sushma et al., [11], Sharma and Kumar et al., [12].

Emamectin benzoate found to be next best effective treatment. These results were similar finding of Khademul et al., [13], Kumar et al., [14]. Chlorantraniliprole found to be next best effective treatment. These results were similar finding of Reddy et al., [15], Patil et al., [2], Sapkal et al., [16]. Flubendiamide found to be next effective treatment and its results are supported by Jat et al., [17], Kubendran et al., [18] and Deshmukh et al., [19]. Fipronil are found to be effective treatments and the results were similar to findings reported by Ghosal et al., [20], Satish et al., [21] and Meena et al., [5]. Neem oil found to be effective in reducing the larval population and the results were supported by Bhati et al., [22].

Higher yield (226 q/ha) and higher cost benefit ratio (1:11.6) was obtained from Spinosad and lowest in control plot (100 q/ha). Similar findings made by Nitharwal et al., [23], recorded the highest cost benefit ratio. Pal et al., [24] who reported that the Indoxacarb is the best and most economical treatment recorded (220 q/ha) and cost benefit ratio (1:10.6). Khademul et al., [13] reported cost highest grain yield was recorded in Emamectin benzoate and cost effectiveness of Emamectin benzoate was also very high and very favorable with incremental benefit ratio. Sapkal et al., [16] reported that cost effectiveness of clorantranpriole was high with cost benefit ratio. Recorded yield (200q/ha) and cost benefit ratio (1:9.03).

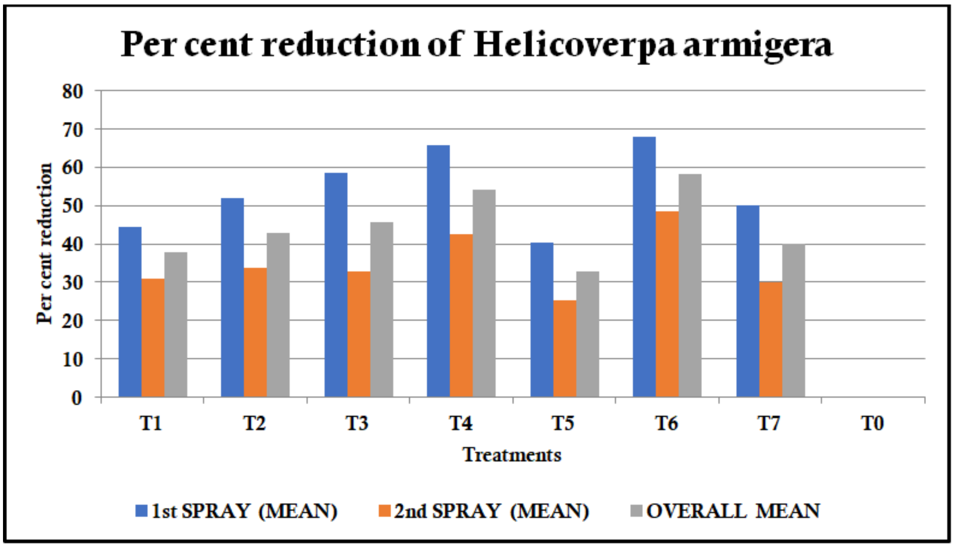


**Fig. 1. Effect of certain insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner) (Over all mean)**

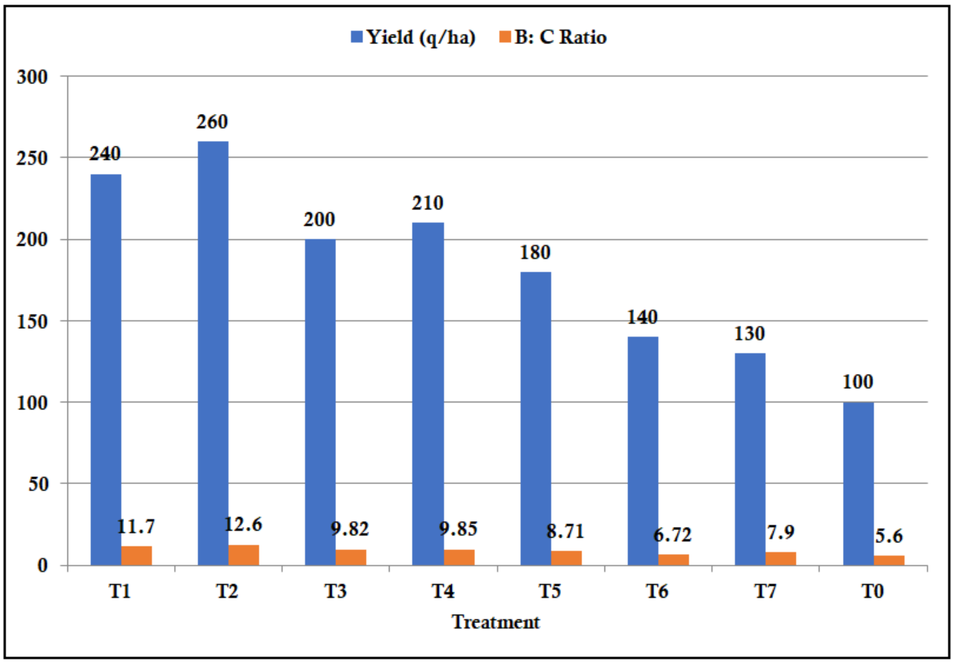


**Fig. 2. Yield and benefit cost ratio**

**Table 1. Effect of certain insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner)**

| Treatment | | Before spray (Average mean of larva/5 plants) | Per cent reduction of larvae of *H. armigera* / 5 Plants | | | | Per cent reduction of larvae of *H. armigera* / 5 Plants | | | | Overall Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | First Spray | | | | Second Spray | | | | |
| | | | 3rd DAS | 7th DAS | 14th DAS | Mean | 3rd DAS | 7th DAS | 14th DAS | Mean | |
| $T_1$ | Flubendamide 480 %SC | 3.33 | 53.59 | 41.04 | 38.87 | 44.5 | 36.56 | 28.83 | 27.75 | 31.04 | 37.77 |
| $T_2$ | Emamectin benzoate 5%SG | 3.06 | 59.28 | 46.29 | 49.98 | 51.85 | 39.45 | 31.54 | 30.19 | 33.72 | 42.78 |
| $T_3$ | Chlorantranilprole 18.5%SC | 3.46 | 67.22 | 58.22 | 50.14 | 58.52 | 36.41 | 31.67 | 30.24 | 30.24 | 45.64 |
| $T_4$ | Spinosad 45%SC | 3 | 77.29 | 61.44 | 58.42 | 65.71 | 47.18 | 38.92 | 41.10 | 42.40 | 54.05 |
| $T_5$ | Neem oil 4% | 3.33 | 45.72 | 37.21 | 38.53 | 40.48 | 30.48 | 22.96 | 22.23 | 25.22 | 32.85 |
| $T_6$ | Indoxacarb 14.5%C | 3 | 75.2 | 65.05 | 63.31 | 67.85 | 53.24 | 44.66 | 47.84 | 48.58 | 58.21 |
| $T_7$ | Fipronil 5%SC | 3.26 | 55.45 | 48.14 | 46.64 | 50.07 | 34.97 | 25.86 | 29.03 | 29.95 | 40.01 |
| $T_0$ | Control | 3.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **F-test** | **NS** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| | **C.D. at 5%** | **NS** | **7.632** | **8.373** | **8.526** | **6.033** | **0.237** | **0.254** | **0.332** | **0.232** | **16.008** |
| | **S.Ed. (+)** | **0.243** | **34.56** | **29.07** | **27.51** | **30.27** | **22.36** | **18.80** | **19.93** | **20.30** | **19.95** |

**Table 2. Economics and benefit cost ratio**

| Treatments | Yield (q/ha) | Selling price (Rs/q) | Gross return (Rs) | Total cost of cultivation (Rs) | Net return (Rs) | B: C Ratio |
|---|---|---|---|---|---|---|
| Spinosad 45%SC | 240 q/ha | 2000 | 480000 | 40689 | 439311 | 1:11.7 |
| Indoxacarb 14.5% SC | 260 q/ha | 2000 | 520000 | 41051 | 478949 | 1:12.6 |
| Chlorantranilprole 18.5% SC | 200q/ha | 2000 | 400000 | 40701 | 359299 | 1:9.82 |
| Emamectin benzoate 5%SG | 210q/ha | 2000 | 420000 | 42636 | 377364 | 1:9.85 |
| Flubendamide 480% SC | 180 q/ha | 2000 | 360000 | 41301 | 318699 | 1:8.71 |
| Fipronil 5%SC | 140 q/ha | 2000 | 280000 | 41651 | 238349 | 1:6.72 |
| Neem oil 4% | 130 q/ha | 2500 | 325000 | 40801 | 284199 | 1:7.9 |
| Control | 100 q/ha | 2000 | 200000 | 39451 | 160549 | 1:5.6 |

### 3.1 Economics of Various Treatments

Higher cost benefit ratio (1:12.6) was obtained from Indoxacarb and lowest in control plot (100 q/ha). Similar findings made by Nitharwal et al., [23], recorded the highest cost benefit ratio. Pal et al., [24] who reported that the Spinosad is the best and most economical treatment recorded (210q/ha) and cost benefit ratio (1:9.85). Khademul et al., [13] reported cost highest grain yield was recorded in Emamectin benzoate and cost effectiveness of Emamectin benzoate was also very high and very favorable with incremental benefit ratio. Sapkal et al., [16] reported that cost effectiveness of chlorantraniliprole was high with cost benefit ratio. Recorded yield (200 q/ha) and cost benefit ratio (1:9.82).

## 4. CONCLUSION

Results showed that among all the treatments highest per cent population reduction of fruit borer was recorded in $T_6$ Indoxacarb 14.5% SC (58.21) which was significantly superior over the control followed by $T_4$ Spinosad 45% SC (54.05) and $T_3$ Chlorantraniliprole 18.5%SC (45.64) was least effective treatment against gram pod borer with highest mean larval population 2.25 of *Helicoverpa armigera* due to their mode of action compare to other selected Insecticides and Neem product.

## ACKNOWLEDGEMENT

The authors are grateful to Prof. (Dr.) Rajendra B. Lal Hon'ble Vice Chancellor SHUATS, Prof. (Dr.) Shailesh Marker, Director of research, Dr. Deepak Lal, Dean of Pg studies, Prof. (Dr.) Gautam Gosh, Dean, Naini Agricultural Institute and Dr. Mrs Sobita Simon it's Dr. Ashwani kumar, Head and Associate Professor, Department of Entomology Sam Higginbottom University of Agriculture, Technology and Sciences., Sam Higginbottom University of Agriculture Technology and Sciences, for taking their keen interest and encouragement to carry out this research work.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Choudhary R, Kumar A, Jat GC, Vikram, Deshwal HL. Comparative Efficacy of Certain Bio-Pesticides against Tomato Fruit Borer, *Helicoverpa armigera* (Hub.). International Journal of Current Microbial Applied Sciences. 2017;6(8): 1068-1081.
2. Patil PV, Pawar SA, Kadu RV, Pawar DB. Bio-efficacy of newer insecticides, botanicals and microbial against tomato fruit borer *Helicoverpa armigera* (Hubner) infesting tomato. Journal of Entomology and Zoology Studies. 2018;6(5):2006-2011.
3. Bose TK, Som MG. Vegetable crops in India, Naya Prokash, 206, Bidhan Sarani, Calcutta, India. 1990;249.
4. Friedman M. Anticarcinogenic, Cardioprotective, and Other Health Benefits of Tomato Compounds Lycopene, α-Tomatine, and Tomatidine in Pure Form and in Fresh and Processed Tomatoes.

Journal Agriculture Food Chem. 2013;61: 9534-9550.

5. Meena LK, Raju SVS. Bio efficacy of newer insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner) on tomato, *Lycopersicon esculentum* mill under field conditions. International Quarter Journal of Life Science. 2014;347-350.
6. Kumar S, Umrao RS, Kumar A, Patel VK, Debnath R, Kumar A. Evaluation of the efficacy of insecticides and bio-pesticides against *Helicoverpa armigera* (Hubner) on tomato. Journal of Entomology and Zoology Studies 2020;8(3):555-558.
7. Reddy RD, Kumar A, Sai KP. Field efficacy of some insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner). Journal of Entomology and Zoology Studies. 2021;9(1):1434-1436.
8. Singh N, Dotasara SK, Kherwa B, Singh S. Management of tomato fruit borer by incorporating newer and biorational insecticides. Journal of Entomology and Zoology Studies. 2017;5(2):1403-1408.
9. Wajid H, Chhibber RC, Singh CP. Effect of indoxacarb against tomato fruit borer (*Helicoverpa armigera* Hub.) and phytotoxicity to tomato plants. Advances in Plants and Agriculture Research. 2016; 3(2):51-54.
10. Islam MM, Nasrin S, Mannan MA, Khan SAKU. Evaluation of Tomato Varieties Against Resistance to Fruit Borer (*Helicoverpa armigera* Hub.)January 2021SAARC Journal of Agriculture. 2020; 18(2):87-99.
11. Sushma D, Bharpoda. Field evaluation of biopesticides against *Helicoverpa armigera* (Hubner) in tomato, *Lycopersicon esculentum* Mill. Under middle Gujarat condition. International Journal of Applied Agriculture and Horticulture Sciences. 2016;8(1):1266-1518.
12. Sharma VG, Kumar S. Bio-efficacy of different insecticides against fruit borer (*Helicoverpa armigera* hubner) and its impact on yield of tomato (*Lycopersicon esculentum* mill.), ijrar - International Journal of Research and Analytical Reviews. 2020;7(2):380-386.
13. Khademul MDI, Howlader MTH, Ahmed KS. Management of *Helicoverpa armigera* (Hubner) infesting tomato using bio-pesticides under field condition and its effect on tomato yield. Journal of Bangladesh Agriculture University. 2020; 18(1):1-5.
14. Kumar GVS, Sarada O. Field efficacy and economics of some new insecticide molecules against lepidopteran caterpillars in chickpea. Journal of Current Biotica. 2015;9(2):153-158.
15. Reddy KVN, Lekha AV, Chhangani G. Bio-efficacy of insecticides against fruit borer, *Helicoverpa armigera* (Hub.) infesting tomato (*Solanum lycopeRsicum* L.). Indian Journal of Applied Entomology. 2019; 33(1):24-28.
16. Sapkal SD, Sonkamble MM, Gaikwad BB. Bio efficacy of newer insecticides against tomato fruit borer, *Helicoverpa armigera* (Hubner) on tomato, *Lycopersicon esculentum* (mill) under protected cultivation. International Journal of Chemical Studies. 2018;6(4):3326-3330.
17. Jat SK, Ameta OP. Relative efficacy of biopesticides and newer insecticides against *Helicoverpa armigera* (hub.) in tomato. The Bioscan. 2013;8(2):579-582.
18. Kubendran D, Bojan V, Kuttalam S. Evaluation of flubendiamide 480 SC against tomoto fruit borer *Helicoverpa armigera* (Hubner). Pestology. 2008; 32(10):54-57.
19. Deshmukh SG, Sureja BV, Jethva DM, Chatar VP. Field efficacy of different insecticides against *Helicoverpa armigera* (Hubner) infesting chickpea. Legume Research. 2010;33(4):269–273.
20. Ghosal A, Dolai AK, Chatterjee M. Plethora (Novaluron + Indoxacarb) insecticide for the management of tomato fruit borer complex. Journal of Applied and Natural Science. 2016;8(2):919-922.
21. Sathish BN, Singh VV, Kumar S, Kumar S. Efficacy of different chemical insecticides and bio-pesticides against tomato fruit borer *Helicoverpa armigera* (Hubner) on tomato crop. Bulletin of Environmental Pharmacol and Life Sciences. 2018; 7(12):107-110.
22. Bhati R, Singh R, Singh G. Efficacy of Bio-pesticide and Novel Insecticides against Tomato Fruit Borer (*H. armigera*). International Journal of Current Microbiology and Applied Sciences. 2020; 11:2889-2896.
23. Nitharwal RS, Kumar A, Jat SL, Chula MP. Efficacy of newer molecules against gram pod borer, *Helicoverpa armigera* (Hub.) on chickpea (*Cicer arietinum* L.). Journal of

Pharmacognosy and Phytochemistry. 2017;6(4):1224-1227.

24. Pal S, Singh DK, Umrao RS, Sharma O. Eco-Friendly Management of Tomato Fruit Borer, Helicoverpa armigera under Hill Condition, Uttarakhand, India. International Journal of Current Microbiology and Applied Sciences. 2018;7(10):3008-3013.

---

*© 2022 Nagaveni and Kumar; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*https://www.sdiarticle5.com/review-history/89641*