Field efficacy of selected insecticides against tomato fruit borer [*Helicoverpa armigera* (Hubner)] on tomato

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Abstract

The present investigation entitled “Field Efficacy of Selected Insecticides Against Tomato Fruit Borer [*Helicoverpa armigera* (Hubner)]” in Gooty mandal, Anantapur Dist. (A.P.)" cultivar i.e., SWEAKHAR-448 was conducted during August to November 2020. Two applications of seven insecticides viz.; T1 Profenophos 40% EC, T2 Fipronyl 15%, T3 Profenophos 40% + cypermethrin 4% E.C, T4 Novaluron 10EC, T5 Emamectin benzoate 5% SG, T6 Chlorpyrifos 20EC, T7 Indoxacarb 14.5SL, were evaluated against fruit borer, *Helicoverpa armigera*. Lowest percent infestation of fruit borer was recorded in Indoxacarb 14.5SL (11.36%) followed by Fipronyl 5%w/w (10.27 %) which was at par Profenophos 40% EC (10.27%), Novaluron 10 EC (10.47%) and followed by Emamectin benzoate 5%SG (11.76%) which was at par Chlorpyrifos 20EC (12.19%) and at last Profenophos 40% + Cypermethrin 4% EC (14.2%)

Introduction

Vegetables are the novel and edible portion of the herbaceous plants and play an important role in the daily intake of our food. They contribute an important status in the agricultural economy of India. The area under vegetable cultivation in the country is about 9,542 in thousand ha and the production is about 169478 in thousand million tons (Anonymous, 2015). Tomato is being cultivated in 808.54 thousand ha producing 19696.92 thousand MT (Horticultural Statistics at a Glance, 2017) [7]. Tomato is a good source of all nutrients especially vitamin C, B and K. (Anonymous, 2014) [15]. The important insect pest of tomato is 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, *Epilachna vigintioctopunctata* (Widmann). But in India fruit borer is one of the most important pests of tomato, limiting production and market value of crop produce. The fruit borer, *Helicoverpa armigera* (Hubner) is the most destructive pest of tomato in India, which is commonly known as gram pod borer, American bollworm and fruit borer (Meena *et al.*, 2014). Early instar larvae feed on flower buds and foliage while matured instars bore into fruit resulting in yield reduction (Rath *et al.*, 1997) Considerable economical losses due to *Helicoverpa armigera* reported by many workers to the extent of about 50-60% fruits (Singh *et al.*, 1977) and 25.99 to 41.34% fruits in Chhattisgarh. It is cosmopolitan in distribution and attained a status of national pest because of its economical damage caused to several cultivated crop. The early instar larvae feed on foliage, buds and flowers, while later instar larvae bore into the fruits by feeding the content, followed by rotting of fruits due to secondary infection of pathogens causing considerable losses in and even to the extent of 55 per cent damage reported by (Selvanarayanan, 2000).

Objectives

1. To study the field efficacy of chemicals against fruit borer in tomato.
2. To calculate the cost-benefit ratio of the treated insecticides.
Materials and Methods
Due to Covid-19 situation, studies on “to study the efficacy of selected insecticides against tomato fruit borer” In Gooty Mandal, (Anantapur Dist.), under field condition was carried out in Area plot, Andhra Pradesh, India. These are replicated thrice in randomized block design.

Table 1: Details of treatments

| Sr. No. | Treatments names | Chemical Names and Formulations | Group | Dosage | References |
|---------|------------------|---------------------------------|-------|--------|------------|
| 1       | T0               | Control                         |       | -      | -          |
| 2       | T1               | Profenophos 40% EC              | Organophosphate insecticides | 1000g/ha | Katoju et al. (2014) |
| 3       | T2               | Fipronyl 5% w/w                 | Phenylpyrazole                 | 10g/ml/lit | Pati et al. (2018) |
| 4       | T3               | Profenophos 40% + cypermethrin 4% E.C | Organophosphate, sythentic pyrethroid | 400g and 40g a.i/ha | Ghosal A ML et al. (2017) |
| 5       | T4               | Novaluron 10 EC                 | Insect growth regulators       | 7.5ml/lit | Narendra S et al. (2017) |
| 6       | T5               | Emamectin benzoate 5% SG        | Semisynthetic avermectin        | 200g/ha   | Mohanty KM et al. (2020) |
| 7       | T6               | Chlorpyrifos 20EC               | Carboxyl acid amide group      | 500 g a.i/ha | Solange et al. (2015) |
| 8       | T7               | Indoxacarb 14.5SL               | Oxadiazines                    | 7.5g a.i/ha | Pati et al. (2018) |

Statistical analysis
Statistical analysis was done to test the level of significance and to compare the treatments using the following formula (Kumar, 2009): Formula (Kumar, 2009):

\[
\tau = \frac{\sum XY - n \bar{x} \bar{y}}{\sqrt{\sum x^2 - n \bar{x}^2 \sqrt{\sum y^2 - n \bar{y}^2}}}
\]

Where,
\[x = \text{Mean of 1st factor}\]
\[y = \text{Mean of 2nd factor}\]
\[n = \text{Total no. of observations}\]
\[r = \text{correlation coefficient ranges between +1 to -1}\]

After correlating significant and non-significant is seen through t-test value of n- 2 degrees of freedom.

\[+=\frac{\sqrt{n-2}}{\sqrt{1-r^2}} \sim t (n-2)
\]

Test of significance
If the variance ratio (MST/EMS) is greater than the tabulated value of F value at 5% and 1% level of significance, the variance between treatments is considered to be significant and if it is lower than the tabulated value, the difference is considered to be non-significant.

Results and Discussion
Among all the treatments lowest percent infestation of fruit borer was recorded in (T7) Indoxacarb 14.5SL (11.36%) followed by (T2) Fipronil 5% w/w (10.27%) which was at par (T1) Profenophos 40% EC (10.27%), (T4) Novaluron 10 EC (10.47%) and followed by (T5) Emamectin benzoate 5% SG (11.76%) which was at par (T6) Chlorpyrifos 20EC (12.19%) and at last (T3) (Profenophos 40%) + Cypermethrin 4% EC (14.24%) among all treatments (T3) (Profenophos + Cypermethrin 40% EC (14.2) is found to be least effective than all the treatments and (T7) Indoxacarb is significantly superior over the control (28.91%).

The yields among the treatment were significant. The highest yield was recorded in (T7) Indoxacarb 14.5SL (192 q/ha) which was at par with (T2) Fipronil 5% w/w (186 q/ha), (T1) Profenophos 40% EC (170 q/ha) which was at par with (T4) Novaluron 10 EC (156 q/ha). Followed (T5) Emamectin benzoate 5% SG (152 q/ha) are statistically at par with (T6) Chlorpyrifos 20EC (145 q/ha) are statistically at par with (T3) Profenophos 40% + Cypermethrin 4% E.C (142 q/ha) is found to be least effective than all the treatments and is significantly superior over the control (89 q/ha). When cost benefit ratio was worked out, interesting result was achieved. Among the treatment studied, the best and most economical treatment was in (T7) Indoxacarb 14.5SL (1:8.5) which was at par with (T2) Fipronil 5% w/w (1:8.28), (T1) Profenophos 40% EC (1:7.5) which was at par with (T4) Novaluron 10 EC (1:6.9). Followed (T5) Emamectin benzoate 5% SG (1:6.7) are statistically at par with (T6) Chlorpyrifos 20EC (1:6.4) are statistically at par with (T3) Profenophos 40% + Cypermethrin 4% E.C (1:6.3) is found to be least effective than all the treatments and is significantly superior over the control (1:3.9).

Table 2: To evaluate the effect of insecticides to fruit borer (Helicoverpa armigera) in Tomato (First Spray): percent fruit infestation

| Sr. No. | Treatments       | % Fruit infestation |
|---------|------------------|---------------------|
|         |                  | 1 DBS | 3 DAS | 7 DAS | 14 DAS | Mean  |
| T1      | Profenophos 40% EC | 16.80 | 16.74 | 7.54  | 13.96  | 12.75 |
| T2      | Fipronyl 5% w/w   | 18.47 | 16.66 | 7.44  | 13.92  | 12.67 |
| T3      | Profenophos 40% + cypermethrin 4% E.C | 16.97 | 19.25 | 14.07 | 16.61 | 16.64 |
| T4      | Novaluron 10 EC   | 17.05 | 16.89 | 7.86  | 15.02  | 13.26 |
| T5      | Emamectin benzoate 5% SG | 19.15 | 18.09 | 11.62 | 15.58 | 15.10 |
| T6      | Chlorpyrifos 20EC | 16.37 | 19.02 | 12.34 | 15.86 | 15.74 |
| T7      | Indoxacarb 14.5 SL | 17.28 | 14.09 | 6.90  | 7.22   | 9.40  |
| T0      | Untreated        | 20.71 | 25.24 | 28.32 | 28.87  | 27.48 |

DBS: Day before spray, DAS: Day after spray
was in (T7) Indoxacarb (1:8.5). Effective and it shown highest yield(192 q/ha) among all and (T7) Indoxacarb (11.36%) is found to be most significant control over untreated or control plot among all (T7) Indoxacarb (1:8.5). The population dynamics of crop pests. Advances in Ecological Research 1992;22:117-162.

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From the above discussion it was found that all treatments shown significant control over untreated or control plot among all (T7) Indoxacarb (11.36%) is found to be most effective and it shown highest yield(192 q/ha) among all and be ratio is also found that best and most economical treatment was in (T7) Indoxacarb (1:8.5).

Table 3: To evaluate the efficacy of certain insecticides to fruit borer (Helicoverpa armigera) in Tomato (Second Spray): percent fruit infestation

| Sr. No | Treatments                  | 1 DBS  | 3 DAS  | 7 DAS  | 14 DAS | Mean |
|--------|-----------------------------|--------|--------|--------|--------|------|
| T1     | Profenophos 40%EC           | 13.96  | 11.01  | 8.16   | 11.65  | 10.27|
| T2     | Fipronyl 5%w/w              | 13.92  | 10.81  | 8.07   | 11.25  | 10.04|
| T3     | profenophos + cypermethrin 4%EC | 16.61  | 13.80  | 14.06  | 13.94  | 14.2 |
| T4     | Profenophos 10 EC           | 15.02  | 11.13  | 8.58   | 11.71  | 10.47|
| T5     | Emamectin benzoate 5%SG     | 15.58  | 11.26  | 12.09  | 11.94  | 11.76|
| T6     | Chlorpyriphos 20EC          | 15.86  | 11.26  | 13.18  | 12.13  | 12.19|
| T7     | Indoxacarb 14.5SL           | 12.91  | 10.00  | 7.42   | 9.39   | 8.93 |
| T0     | Untreated                   | 28.87  | 27.90  | 29.65  | 29.19  | 28.91|

| F-Test | S   | S   | S   | S   | S   |
|--------|-----|-----|-----|-----|-----|
| S. Ed. (+) | 1.3 | 0.81 | 0.82 | 1.01 | 1.01|
| C.D. (P = 0.05) | 2.68 | 1.67 | 1.69 | 2.09 | 2.08|

Table 4: Overall mean of 1st and 2nd spray

| Sr. No | Treatments                  | Mean of 1st spray | Mean of 2nd spray | Overall mean |
|--------|-----------------------------|-------------------|-------------------|--------------|
| T1     | Profenophos 40% EC          | 12.75             | 10.27             | 11.51        |
| T2     | Fipronyl 5%w/w              | 12.67             | 10.04             | 11.36        |
| T3     | Profenophos 40% + cypermethrin 4% EC | 16.64 | 14.2 | 15.42 |
| T4     | Profenophos 10 EC           | 13.26             | 10.47             | 11.87        |
| T5     | Emamectin benzoate 5%SG     | 15.10             | 11.76             | 13.43        |
| T6     | Chlorpyriphos 20EC          | 15.74             | 12.19             | 13.97        |
| T7     | Indoxacarb 14.5SL           | 9.40              | 8.93              | 9.17         |
| T0     | Untreated                   | 27.48             | 28.91             | 28.20        |

| F-Test | S   | S   | S   | S   | S   |
|--------|-----|-----|-----|-----|-----|
| S. Ed. (+) | 1.88 | 1.01 | 1.01 | 1.19 | 1.19|
| C.D. (P = 0.05) | 3.88 | 2.08 | 2.08 | 2.53 | 2.53|