



Research Article

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Evaluation of Some Insecticides against Tomato Leaf Miner, *Tuta absoluta* (Meyrick) (Gelechiidae: Lepidoptera) Under Laboratory and Glasshouse Conditions



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Abstract

The tomato leafminer *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), is a native devastating pest, particularly to the tomato *Lycopersicon esculentum*. The present study was carried out to determine the efficacy of different insecticides at different concentrations against the larvae of *Tuta absoluta* on tomato in laboratory and glasshouse. Percent mortalities were recorded after 24, 48 and 72 hours of application in the laboratory and after 3 and 5 days in the glasshouse. The results showed that the tested insecticides were significantly ($P < 0.01$) different in relation to pest mortality than untreated check, while after 72 hours of treatment application percent mortalities were obtained by Coragen 200SCTM proved most effective and gave (95.55%) followed by the mixture of Prove 1.9E.CTM and Levo 2.4SLTM (80.0%) while Levo 2.4SLTM alone gave lowest percent mortality 37.78%. Similarly, in glasshouse also Coragen 200STMC proved most effective and gave (89.68%) after 3 days of treatments application. Therefore, the mixture of Prove 1.9 E.CTM and Levo 2.4 SLTM was used for the management of *T. absoluta* in addition to Coragen 200SCTM under glasshouse conditions.

Keywords: Efficacy; Mortality; *Tuta absoluta*; Concentration; Insecticides; Coragen 200SCTM; Levo 2.4SLTM; Prove 1.9E.CTM

Introduction

Tomato leafminer, *Tuta absoluta* (Meyrick) (Gelechiidae: Lepidoptera) originating from South America, was considered in its origin distribution area as a significant tomato insect pest [1,2], it is not only to the intensity of its attack but also to its occurrence during all crop cycle [3]. Frequently the tomato leaf miner, *T. absoluta* attack it in sufficient numbers to cause damage each year that feed on the leaves and fruits of this plant. It is an invasive pest causing severe loss for tomato production in many countries either in open field or green houses [4]. If no control measures are taken, then the pest can cause up to 80-100% yield losses by attacking leaves, flowers, stems and especially fruits [5].

T. absoluta introduction in Ethiopia is rather recent. Its first report is recorded in the Eastern Shawa of Rift valley, Ethiopia in 2012 [6] and then distributed to most parts of the country. Chemical insecticide control has been the first strategy adopted

in the newly invaded areas, alternative control measures are being investigated [7]. In the case of *T. absoluta*, the need for alternative control methods is strengthened by the development of resistance to insecticides by the pest [8,9] as well as the side effects of pesticides on beneficial arthropods [10,11]. Insecticide control against *T. absoluta* has been developed and widely applied in different countries such as several South American, Asia and Africa including Ethiopia, using the new active ingredient which is likely to be the core of the integrated pest management (IPM) programme is Chlorantraniliprole (Coragen 200SCTM). At present there are no other alternative insecticides to control *T. absoluta* in Ethiopia.

Therefore, two new other insecticides from the new chemistries, which were relatively safer to human and environment, i.e. Emamectin benzoate (Prove 1.9E.CTM), Prosuler Oxymatrin (Levo 2.4SLTM), the mixture of Prosuler Oxymatrin

and Emamectin benzoate (Levo 2.4SL™+Prove 1.9E.C™), and Chlorantraniliprole (Coragen 200SC™), were tested on tomato crop infested by *T. absoluta* in the laboratory and glasshouse in years of 2015/16-2016/17. Hence, the objective of this study was to determine the appropriate concentration and screening new insecticides against *T. absoluta*.

Materials and Methods

Experiments under laboratory and glasshouse conditions

Laboratory and glasshouse studies were under taken to evaluate the newly introduced Prosuler Oxymatrin (Levo 2.4SL™) and Emamectin Benzoate (Prove 1.9E.C™) insecticides in three different concentrations (1ml, 2ml and 3ml/liter). The experiments were conducted at a temperature of 24±2 °C and 50±5% RH for a period of 72 hrs in the laboratory. Larvae were inserted in a Petri dish within the leaves and provided with coated cotton moist that was kept as fresh leaves of tomato that had collected from the glasshouse. Seventy two hours latter larval percent mortalities were counted. The best performing, insecticides of each concentration were selected for subsequent glasshouse experiments.

In glasshouse 24 pots were prepared and filled with compost, loam soil and sand soil in the ratio of 1:1:2, respectively. A Pot having a height of 25cm and a diameter of 20cm was used. The experiment was arranged in a randomized completely block design (RCBD) in three replications. Purposefully the door and

Result and Discussion

Effect of insecticides against *T. absoluta* under laboratory

Table 2: Mean percent mortality of *T. absoluta* caused by tested insecticide under laboratory Conditions.

| S.N | Treatments | Conc. | Mean Percent Mortality | | |
|-----|--------------------------------------|-------|------------------------|---------------------|---------------------|
| | | | After 24hrs | After 48hrs | After 72hrs |
| 1 | Emamectin benzoate (Prove 1.9E.C™) | 1% | 31.11 ^{cd} | 42.22 ^{de} | 51.11 ^{cd} |
| | | 2% | 37.78 ^c | 44.45 ^{cd} | 57.78 ^c |
| | | 3% | 37.78 ^c | 46.67 ^c | 60.00 ^c |
| 2 | Prosuler oxymatrin (Levo 2.4SL™) | 1% | 22.22 ^d | 33.33 ^e | 37.78 ^e |
| | | 2% | 35.55 ^c | 35.55 ^{de} | 42.22 ^{de} |
| | | 3% | 35.55 ^c | 37.78 ^{de} | 42.22 ^{de} |
| 3 | Prove 1.9 E.C™ + Levo 2.4SL™ | 2:2% | 62.22 ^b | 77.78 ^b | 80.00 ^b |
| 4 | Chlorantraniliprole (Coragen 200SC™) | 1% | 93.33 ^a | 95.55 ^a | 95.55 ^a |
| 5 | Control | 1% | 0.00 ^e | 0.00 ^f | 0.00 ^f |
| | LSD at 0.01 | | 12.79 | 12.68 | 12.27 |
| | CV (%) | | 13.96 | 12.26 | 11.07 |
| | SE ± | | 5.36 | 5.31 | 5.15 |

Note: Means with the same letter(s) are not significantly different for each other. All treatment effects were highly significant at p<0.01 (DMRT).

windows of the glasshouse was kept open for 24 hours for the entrance of moths. Hence, plants were infested under natural conditions. After treatment application of 24 hours the counted larvae in the leaves were collected and put under laboratory till five days to observe the mortality rate. Mortality data were recorded after application at 1st, 3rd and 5th days (Table 1).

Table 1: List of experimental treatments at different Concentration.

| S. N. | Common Name | Trade Name | Concentration (%) |
|-------|---------------------------------------|----------------------------|----------------------|
| 1 | Prosuler Oxymatrin | Levo 2.4SL™ | 1, 2 and 3ml/ liter. |
| 2 | Emamectin Benzoate | Prove 1.9 E.C™ | 1, 2 and 3ml/liter. |
| 3 | Prosuler Oxymatrin+Emamectin Benzoate | Levo 2.4SL™+Prove 1.9 E.C™ | 2:2ml/liter |
| 4 | Chlorantraniliprole | Coragen 200 SC™ | 1ml/ liter |
| 5 | Control | | |

Statistical Analysis

Efficacy analysis was done based on data transformation to Arcsine when necessary according to Gomez and Gomez 1984 and mortalities were corrected using Abbot 1925 formula. The data was subjected to analysis of variance (ANOVA) and the means were compared by Least Significant Different (LSD) test at 0.05 levels, using SAS program version 9.1 [12].

The data on the effectiveness of insecticides against *T. absoluta* revealed that highly significant ($P < 0.01$) difference among treatments in laboratory after treatment exposure of 72 hours (Table 2). The results showed that the insecticide Coragen 200SCTM, Prove 1.9E.CTM) and the mixture of Prove 1.9E.CTM+Levo 2.4 SLTM were found to be highly significant ($P < 0.01$) superior over the control 95.55% mortality followed by the mixture of Prove 1.9E.CTM and Levo 2.4STML 2% concentration 80.0% mortality. The lowest mortality percent recorded at 1% concentration of Levo 2.4SLTM, 22.22% followed by Prove 1.9E.CTM, 31.11% were observed after 24 hours treatment application while they were found to be highly significant ($p < 0.01$) and superior over the control (Table 2).

The mortality of *T. absoluta* was higher after 48 and 72 hours of insecticidal application as compared with 24 hours because of the lethal influence gradually the insect physiology which culminated in the highest control. The best performance by Chlorantraniliprole (Coragen 200SCTM) among the insecticides could be due to their desirable mode of action that effectively blocked a physiological mechanism in the target insect right 48 hours of application and after 72 hours mortality reached the highest percent mortality followed by the mixture of Emamectin benzoate (Prove 1.9E.CTM) and Prosuler oxymatrin (Levo 2.4SLTM). Our findings indicated that increase in mortality rate in all the treatments in concentration and time dependent manner.

Limited information is available regarding the efficacy of new chemistry on tomato leaf miner, *T. absoluta*, anyway the results of

this study are in conformity with Emmanouil [13] who reported that the toxicity of the insecticides was determined on second instar larvae using commercial formulations of the insecticides clorantraniliprole, Prosuler Oxymatrin and emamectin benzoate. He also reported that mortality was estimated after 72 hours of exposure and results were subjected to prohibit analysis. The insecticides clorantraniliprole and the mixture of emamectin benzoate and Prosuler Oxymatrin exhibited high larvicide activity. Emmanouil [13] also reported that experiments under laboratory indicated that emamectin benzoate insecticide exhibited high larvicidal activity over LC95, while our results showed low larvicidal effects (60%) in the laboratory.

Effect of insecticides against *T. absoluta* under glasshouse

The data on the effectiveness of insecticides sprayed to overcome the *T. absoluta* revealed a highly significant ($P < 0.01$) difference among treatments in glasshouse (Table 3). The presented data are pertaining to mean percent reduction of *T. absoluta* revealed that, among all the treatments the Coragen 200SCTM gave the highest mortality 89.68(74.56%) percent mortality followed by the mixture of Prove 1.9E.CTM+Levo 2.4SLTM insecticides 78.94(62.73%) percent mortality. Prove 1.9E.CTM and Levo 2.4SLTM were recorded to be 39.81(39.09%) and 25.28(30.12%) significantly inferior in efficacy against *T. absoluta* within five days of application, respectively. All insecticides gave the mean percent reduction of *T. absoluta* and significantly higher than control treatments.

Table 3: Mean percent mortality of tested insecticides against tomato leafminer, *T. absoluta* Under glasshouse conditions.

| S.No. | Treatments | Conc (%) | Mean Percent Mortality | | |
|-------------|---|----------|-----------------------------|-----------------------------|----------------------------|
| | | | 1 day | 3 day | 5 day |
| 1 | Emamectin benzoate (Prove 1.9 E.C TM) | 2% | 30.55 (33.51) ^b | 34.26 (35.69) ^c | 39.81 (39.09) ^b |
| 2 | Prosuler oxymatrin (Levo 2.4SL TM) | 2% | 17.49 (24.67) ^c | 22.25 (28.04) ^d | 25.28 (30.12) ^c |
| 3 | Prove 1.9E.C+Levo 2.4SL TM | 2:2% | 51.52 (45.87) ^{bc} | 74.77 (60.14) ^{ab} | 78.94 (62.73) ^a |
| 4 | Chlorantraniliprole (Coragen 200 SC TM) | 1% | 76.59 (61.21) ^a | 89.68 (74.56) ^a | 89.68 (74.56) ^a |
| 5 | Control | | 3.33 (6.14) ^d | 7.50 (13.04) ^c | 7.50 (13.04) ^c |
| LSD at 0.01 | | | 12.42 | 24.7 | 17.83 |
| CV (%) | | | 12.63 | 19.73 | 13.49 |
| SE± | | | 4.53 | 9.02 | 6.51 |

Note: Means with the same letter(s) are not significantly different for each other. All treatment effects were highly significant at $p < 0.01$ (DMRT).

Throughout the experiments, the mixture of Emamectin Benzoate and Prosuler Oxymatrin products proved more efficacy suppressed *T. absoluta* larval populations followed by Emamectin Benzoate alone. Indeed, several authors reported the performance of Emamectin Benzoate product against several insects, for example, Seal [14], reported the efficacy of emamectin benzoate at various rates in reducing the densities of the melon thrips, *Thrips palmi* adults and larvae. Stanley et al.

[15] reported the high acute toxicity of emamectin benzoate to *Helicoverpa armigera* under laboratory conditions.

It was reported by several authors the active ingredient of Emamectin benzoate has a high potency against a broad spectrum of lepidopterous pests with an efficacy potent against certain armyworm species [16]. Cook et al. [17] conducted field and laboratory trials on cotton and soybean for the control of the beet armyworm *Spodoptera exigua* (Hübner) and the fall

armyworm *Spodoptera frugiperda* using emamectin benzoate demonstrated the good efficacy of tested products compared with the control. But we obtained low percent mortality of *T. absoluta* larvae under laboratory and glasshouse conditions.

The efficacies of spraying using mixtures of natural products and synthetic chemicals for the control of the pests are crucial. Indeed, insecticides that work in synergy when mixed together are an avenue to explore in *T. absoluta* control. We agreed that the work of Bielza et al. [18], they have been proposed that pesticides mixtures with different modes of action may delay the onset of resistance developing in pest populations. However, some problems need to be considered when two or more insecticides are mixed together especially Phytotoxicity [19].

Management of resistance to prevent or delay the development of resistance to an insecticide and cross resistance to additional insecticides is necessary for increasing the chance of insecticide control of *T. absoluta*. Our glasshouse and laboratory studies suggest the good performance of the tested compounds Chlorantraniliprole (Coragen 200SC™) followed by (a mixture of Emamectin Benzonate and Prosuler Oxymatrin were important for the management of tomato leafminer, *T. Absoluta* [20-23].

Conclusion and Recommendation

T. absoluta has been a serious pest of tomatoes in Ethiopia since 2012. These studies clearly indicated the efficacious of chemicals such as Chlorantraniliprole (Coragen 200 SC™) and a mixture of Emamectin benzoate and Prosuler oxymatrin (Prove 1.9 E.C™ and Levo 2.4 SL™) showed good efficacy in controlling *T. absoluta* larvae, they can be used in conjunction with chemical products and integrated pest management. Therefore, it was recommended that Coragen 200 SC™ and a mixture of Prove 1.9 E.C™ + Levo 2.4 SL™ are used as a management option of *T. absoluta* as components of integrated pest management.

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