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Efficiency of sex pheromone traps and some bio and chemical insecticides against tomato borer larvae, *Tuta absoluta* (Meyrick) and estimate the damages of leaves and fruit tomato plant

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Abstract This study was carried out at Berket El-Sabaa province, Menoufia Governorate, Egypt, during the period from March to June 2014. The present study aimed to study, the efficiency of pheromone traps on population fluctuation of *Tuta absoluta*, to determine the most suitable insecticide and rate of some selected bio and chemical insecticides against *T. absoluta* larvae, and to estimate the damage area of tomato leaves and fruits infested with *T. absoluta* after the second spray of the tested insecticides. Data showed that the population fluctuation of *T. absoluta* male captured has three stages, the first stage extended from 1st week of April to 1st week of May with a peak of 477.7 male/trap/week. The second stage extended from the 1st week to the 4th week of May with a peak of 210.7 *male*/trap/week. The third stage began from the 4th week of May to the 4th week of July (95.7 male/trap/week). Data showed that, 200 g/100 l water for each bio-pesticides such as Biovar, Bioranza, Dipel-2x and Bitoxybacillin and the rate of 75 ml/100 l water for Tracer and Challenger were the most efficient against *T. absoluta* larvae. In this respect, the evaluation of damage of tomato leaves by *T. absoluta* larvae was done under the application of some selected insecticides at the high rate. The descending arrangement of these insecticides according to their efficiency is as follows Tracer < Bitox < Challenger < Bioranza < Dipel-2x < Biovar (17.18% < 17.8% < 21.03% < 26.44% < 64.18% < 69.4% damage). The obtained data showed that Tracer gave a promising result where it recorded 16.0% damage fruit, compared with the unsprayed plots (54.3%). In general, the values obtained after the second application recorded low infested leaf area %. This explains the importance of sustainable control of *T. absoluta* larvae, to suppress its population.

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Introduction

Tomato considered one of the best fresh market and processing vegetable crop belongs to family Solanaceae (Salunkhe et al., 1987). *Tuta absoluta* is the major pest of tomato crop newly detected in the Mediterranean basin (Guenaoui, 2008). Pests such as *T. absoluta*, which have a short generation time and high biotic potential are at increased risk of developing resistance to insecticides use (Siqueira et al., 2000). This pest has been responsible for losses of 80–100% in tomato plantations in both the protected cultivation and open fields (CFIA, 2010). *T. absoluta* attacks the upper ground parts of tomato plants and several species of Solanaceae plants. Larvae preferentially feed on new growth, thus affecting the overall growth and yield of the plant. Up to 100% losses have been reported in tomato crops (Korycinska and Moran, 2009).

The use of sex pheromone traps is one of the most recognized tactics against the most of tomato pests that becoming increasingly used at worldwide. The pheromone lures have the same active component which is a synthetic pheromone of *T. absoluta* (3E, 8Z, 11Z -3,8,11-tetradecatrien-1-yl acetate). They differ between products in the composition of the rubber capsules, the rate of diffusion, its lifetime consequently, and its effectiveness (Fernando et al., 2001).

The use of a limited number of insecticides proved to be an unsustainable management option, where insecticide resistance has been recorded for several products in Brazil (Siqueira et al., 2001). Three bio-insecticides and four chemical insecticides were evaluated for their efficacy in the control of *T. absoluta* (Meyrick), (Lepidoptera: Gelechiidae) on tomato plant. Hanafy and El-sayed (2013) used some bio-insecticides and chemical insecticides against *T. absoluta* larvae on tomato plants. The present study aimed to study, the efficiency of pheromone traps on population fluctuation of *Tuta absoluta*, to determine the most suitable insecticide and rate of some selected bio and chemical insecticides against *T. absoluta* larvae, and to estimate the damage area of tomato leaves and fruits with *T. absoluta* after the second spray of the tested insecticides.

Materials and methods

This study was carried out at Berket El-Sabaa Province, Menoufia Governorate, Egypt. The study period was extended from the beginning of March 2014 to June 2014.

The experimental area was about one and half feddan. The area was divided into parts. The first part was about half feddan prepared to evaluate the impact of pheromone trap on *T. absoluta* population and tomato yield quality. Three water plastic dish trap baited with sex pheromone compound (E3, Z8, Z11)-tetradecatrien-1-yl acetate (0.6 mg). The tested pheromone capsules were synthesized by Trifolio Company (MDMBH) Germany. Also, three unbaited pheromone traps (as control) were distributed. The pheromone trap and without were randomly distributed in the tomato plants. The male moth was weekly counted and the water in traps was renewed.

The second tomato part was about one feddan (4200 $m^{2)}$. The area was divided into seven strips (600 m^2 for each strip). Each strip was divided into three parts to represent the three replicates. Hence the total plots were 21 strips (200 m^2/plot).

Table 1 shows the common name, trade name, formulation, concentration and rate of application of tested insecticides. Each insecticide was used at three rates, and the tested insecticides were sprayed two times. The first spray was after 60 days of transplantation of tomato plants *Lycopersicon esculentum* (Var. Alesa), seven days between each spray. The samples were collected before spray and after 3rd, 5th and 7th days. Ten leaves/replicate (see Table 2).

Five plants were randomly selected from each plot to estimate the damage of leave area on the foliage through image analysis with the scion image program (scion corp., Frederick MD) (Fladung and Ritter, 1991). The healthy and damaged fruits by tomato borer were counted in the field to calculate damage % of *T. absoluta* after 3rd, 5th and 7th days of pesticides application.

Statistical analysis: The obtained data were submitted to analysis of variance (ANOVA) using *F* test and means were compared at 0.05 probability level (SPSS, 2010).

Results and discussion

Efficiency of pheromone traps on population fluctuation of ***T. absoluta*** *male moths*

Fig. 1 shows that the population fluctuation of *T. absoluta* male has three stages. The first stage extended from 1st week of April to 1st week of May. The first stage was characterized by jumping increases in the captured male moth till the peak of population (477.7 *T. absoluta* male/trap/week).

The second stage recorded sharp decline in the population of *T. absoluta*. It extended from 1st week of May (477.7 *T. absoluta* male/trap/week) to 4th week of May with 210.7 *T. absoluta male*/trap/week.

The third stage extend from 4th week of May (210.7 *T. absoluta* male/trap/week) to 4th week of July (95.7 male/trap/week). This stage had a gradual decrease in the population of *T. absoluta*. The distance between the curves A and B due to the influence of sex pheromone trap in males capture.

These results are in harmony with those obtained by Miguel et al. (2000a,b) and Taha et al. (2012).

Determine the most suitable rate of five selected bio insecticides comparing with chemical insecticides against T. absoluta larvae

Figs. 2 and 3 illustrate the 1st and 2nd sprays for the three used rates of tested bio and chemical insecticides. In general, the results indicated that, reduction % increased directly with the increases in the rate of application. Hence 200 g/100 l water for each bio-insecticides such as Biovar, Bioranza, Dipel-2x and Bitoxybacillin and the rate of 75 ml/100 l water for Tracer and Challenger were the most efficient against *T. absoluta* larvae. In respect to the first spray, data in Fig. 2, clearly indicated that the differences in the reduction % differences between the recommended rate (150 g., 50 ml and 50 ml/100 l water) and the highly tested rate (200 g, 75 ml and 75 ml/100 l water) of Bitoxybacillin, Tracer and Challenger lead to a high reduction in *T. absoluta* larvae (37.66%, 30.57% and 37.71%, respectively). The obtained results are confirmed with those reported by Cely et al. (2010), Nannini et al. (2011) and Magali et al. (2011).

Table 1 Common name, trade name, formulations, concentrations and the rate of application of tested insecticides.

Common name	Trade name	Formulations	Concentration of A.I.	Rate of appl./100 L water
Beauveria Bassiana	Biovar	WP	10% (32×10^6) conidia/g	200 150[a] 100 g
Meterhizium anisoplae	Bioranza	WP	10% (32×10^6) conidia/g	200 150[a] 100 g.
Bacillus Thuringiensis	Dipel 2X	WP	6.4% (32,000) Iu/mg	200 150[a] 100 g
Bacillus Thuringiensis	Bitoxybacillin	WP	6.4% (32,000) Iu/mg	200 150[a] 100 g
Spinosad	Tracer	SC	24%	75 50[a] 25 ml
Chlorfenapyr	Challenger	SC	36%	75 50[a] 25 ml

A.I. = Active Ingredient, WP = Wettable powder, SC = Suspension Concentrate, g = gram, ml = milliliter.
[a] Recommended rate.

Table 2 Estimation of damage percentage of tomato leaves and fruits with *Tuta absoluta* after the second application of tested pesticides.

Treatments	Vegetative characters		Fruits		
	Plant height (cm)	Infested leaf area %	Total numbers	Healthy numbers	Infestation %
Biovar	37.2[c]	29.8[b]	32.6[d]	21.3[d]	34.7[c]
Bioranza	34.9[d]	26.8[b]	39.9[c]	22.6[d]	43.4[b]
Dipel x	38.7[c]	23.0[c]	42.3[c]	32.3[c]	23.6[d]
Bitox.	45.9[a]	17.2[c]	52.6[b]	41.3[b]	21.5[d]
Tracer	47.5[a]	16.4[d]	56.3[a]	47.3[a]	16.0[e]
Challenger	41.6[b]	19.8[c]	59.6[a]	46.6[a]	21.8[d]
Control	31.2[e]	72.3[a]	26.9[e]	12.3[e]	54.3[a]

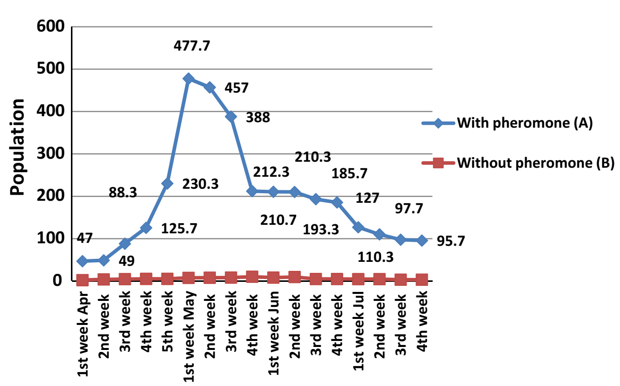

Fig. 1 Population fluctuation of *T. absoluta* male during the early summer plantation of tomato at Berket El-Sabaa Province, Menoufia Governorate 2014.

Data of the second spray had the same trend of the first spray, where the differences between the highest and recommended rates recorded 48.57, 38.81 and 47.8 for the previous insecticides, respectively (Fig. 3).

On the other hand, the differences between the recommended and high rates in case of Biovar, Dipel-2x and

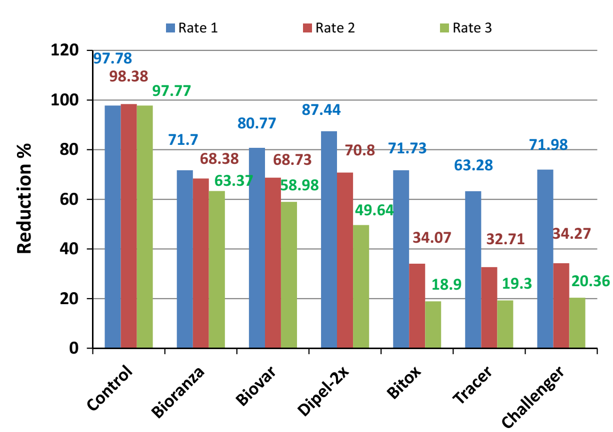

Fig. 2 Reduction % of *T. absoluta* larvae of some selected insecticides at three rates during the first application.

Bioranza recorded increase in reduction percentage of *T. absoluta* larvae about 12.04, 16.64 and 3.32 in the first spray and 13.65, 25.73 and 5.44 in the second spray.

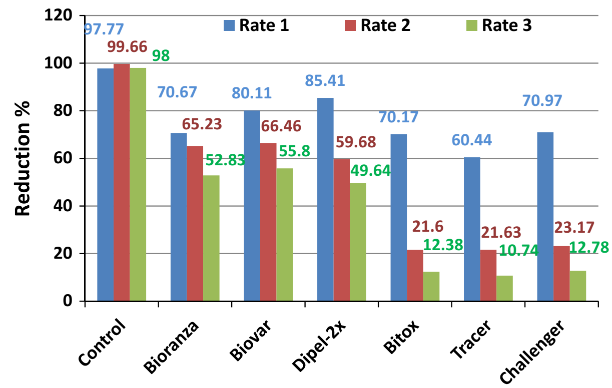

Fig. 3 Reduction % of *T. absoluta* larvae of some selected insecticides at three rates during the second application.

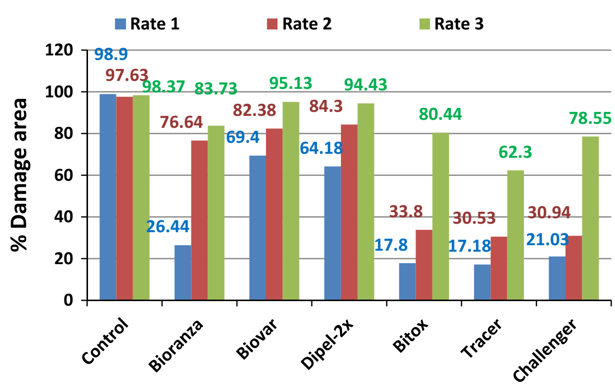

Fig. 4 The damage area of tomato leaves by *Tuta absoluta* larvae at three rates after the second spray.

Estimation of the damage area of tomato leaves and fruits infested with T. absoluta after the second spray of tested insecticides

Tomato leaves from the marked plants were randomly picked and subjected to image analysis with the section image program (scion corp.) Frederick MD to measure the damage area from foliage area.

Fig. 4 represents % damage area relative to the tomato leaf area of the high rate. The descending arrangement of the tested insecticides activities in decreasing tomato damage area is as follows: Tracer < Bitox < Challenger < Bioranza < Dipel-2x < Bivar (17.18% < 17.8% < 21.03% < 26.44% < 64.18% < 69.4% damage.

Estimation of the damage area of tomato leaves by T. absoluta larvae after the second application of some selected insecticides

In case of vegetative characters, the results illustrated significantly that Tracer came in the first category recording the highest height of plant (47.5 cm) and causing decrease of leaf area with about 16.4%. Again Tracer insecticide proved to be the most efficient one on the fruits. It recorded only 16.0% fruit damage, compared with unsprayed plots (54.3%).

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Further reading

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