



Effect of infested tomato plants by tomato leaf miners, *Tuta absoluta* (Meyrick) on the annual production of tomato fruits under greenhouses

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Abstract

This study was carried out to evaluation effect of infested tomato plants *Solanum lycopersicum* (Fam. Solanaceae) by Tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on the annual production of tomato fruits under plastic greenhouses. Experiments were conducted on three varieties of tomato (Floraded, Preged and Mader) at two areas (governorates) Perlash zone (Giza Governorate) and Tokh zone (Qaliobya Governorate) during season 2022 under plastic greenhouses. Results obtained showed that the average of the infestation by the successive insect *T. absoluta* in both of the two successive areas in tomato varieties were arranged ascending as follow; Floraded, Preged and Mader respectively compared to control (tomato plants did not infest with *T. absoluta*) whereas tomato variety (Mader) was higher infested by *T. absoluta* than other varieties, then (Preged) variety then (Floraded) variety respectively at both of the two successive areas. While vice versa in terms of quantity of the annual production of tomato fruits, whereas quantity of the annual production of tomato fruits was arranged descending as follow; Floraded, Preged and Mader respectively compared to control, whereas quantity of the annual production of tomato fruits in Floraded variety was greater than other varieties, then Preged variety then Mader variety respectively in both of the two successive areas.

Keywords: *Tuta absoluta*, tomato plants, three varieties, annual production, greenhouses

Introduction

Tomato fruits *Solanum lycopersicum* one of the most important vegetables fruits all over the world which cultivated in large arias in both of the open fields and under greenhouses, Atherton and Jehoshua (2012) [3] who also indicated that tomato is commercially important throughout the world both for the fresh fruit market and processed food industries and it is grown in a wide range of climates in the field. Birhan (2022) [5] who indicated to that tomato is one of the most economically important vegetables crop grown in the world. Aneta *et al.* 2015 [2] indicated to that tomato (*S. lycopersicum*) is an important and popular vegetable crop plant cultivated all over the world and its production and consumption constantly increasing.

Tomato leafminers, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is one of the most dangerous pests infesting tomato plants and fruits both in open fields and under greenhouses, Peng *et al.* (2019) [11] who indicated that since this insect initial detection in Turkey in 2009 has started its new invasion journey to east and invaded most Asian countries, and referred also that pest currently causes extensive damage to tomato production. Also, Roditakis and Vasakis (2015) [12] indicated to The tomato borer, *T. absoluta* is an invasive pest of tomato crops that is rapidly expanding around the world and causes serious damage to tomato crop. Bekheit (2011) [4] indicated that Tomato borer, *T. absoluta* was found for the first time in Egypt at Nubaria zone during season 2009, Beheira Governorat. And Birhan (2022) [5] who indicated to the Tomato borer, *T. absoluta* is the current impediment to tomato production in the world.

This study was carried out to evaluation effect of infested tomato plants *S. lycopersicum* by Tomato leaf miners, *T.*

absoluta on quantity of the annual production of tomato fruits under plastic greenhouses.

Materials and methods

Experimental design

Experiments were conducted on tomato plants *Solanum lycopersicum* (Solanaceae: Solanales) on three varieties (Floraded, Preged and Mader) to evaluation effect of infested tomato plants by Tomato leaf miners, *T. absoluta* on quantity of the annual production of tomato fruits under plastic greenhouses.

Experiments were carried out during season 2022 at two different areas (governorates), Perlash zone (Giza Governorate) and Tokh zone (Qaliobya Governorate). Tomato seedlings of the three successive varieties were planted at both of the two successive areas on mid of January month season 2022 (same time) which called early summer planting. Experiments were carried out under greenhouse conditions (covered with polyethylene plastic) at both of the two successive zones. Each one divided into equal four separated parts (by polyethylene wire its size 0.5 mm), three parts of them for the three successive varieties of tomato infested with *T. absoluta* and fourth one left free of infestation as control. An artificial infestation by Tomato leafminers, *T. absoluta* was done (at the same time) at both of the two successive different zones. Recommended agricultural operations and non-chemical control were conducted on all tomato plants similarly at both of the two successive areas. Twenty leaves were collected randomly weekly from each tomato plant from different sides. The samples were kept separately in polyethylene bags and transferred to the laboratory for counting individuals. Both surfaces of the leaf were inspected and the immature stages (nymphal instars) were counted. It is proven accurate observations and counting of *T. absoluta* numbers was done

weekly at tomato plants from beginning of February during successive season 2021 at both of the two successive different areas. After harvest tomato fruits in the end of the cultivated season tomato fruits were weighted in each variety of tomato plants and also the control in both of the two successive locations (in unit area). Comparison between average of the infestation by *T. absoluta* and quantity of the annual production of tomato fruits were done at both of the two successive areas to show evaluation effect of infested tomato plants by *T. absoluta* on the production quantity of tomato fruits.

Statistical analysis

Mean numbers (nymphal instars) of Tomato leafminers *T. absoluta* and quantity of the annual production of tomato fruits was analyzed statistically using ANOVA which indicates that significant differences were found. The simple correlation (r) and regression coefficient value (b) were adopted to clarify the change in quantity of the annual production of tomato fruits due to change in the mean

numbers of *T. absoluta* and the mean values compared with the least significant differences (LSD) as well as, SAS program (SAS Institute 1988).

Results and discussion

Experiments were carried out to evaluation effect of infested tomato plants *Solanum lycopersicum* (Fam. Solanaceae) by Tomato leafminers, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on quantity of the annual production of tomato fruits under plastic greenhouses. Experiments were carried out at two different areas (governorates), Perakash zone (Giza Governorate) and Tokh zone (Qaliobyha Governorate) during season 2022

Results obtained and tabulated in Table (1) show population fluctuation of *T. absoluta* during season 2022 on the three successive varieties of tomato plants at both of the two successive areas (Giza and Qaliobyha governorates) compared to control (tomato plants did not infest by *T. absoluta*).

Table 1: Population fluctuation of *T. absoluta* infested tomato plants (three varieties) compared to control at Giza and Qaliobyha Governorates during season 2022

| Date | Giza Governorate | | | | Qaliobyha Governorate | | | |
|-----------|-------------------|-------------------|-------------------|-------------------|-----------------------|-------------------|-------------------|-------------------|
| | Mader | Preged | Floraded | Control | Mader | Preged | Floraded | Control |
| 1/2/2022 | 25.5 ^d | 17.3 ^c | 12.5 ^b | 2.8 ^a | 22.9 ^d | 13.3 ^c | 9.5 ^b | 0.2 ^a |
| 8/2/2022 | 29.8 ^d | 20.5 ^c | 15.7 ^b | 4.7 ^a | 25.5 ^d | 15.7 ^c | 11.9 ^b | 1.7 ^a |
| 15/2/2022 | 35.9 ^d | 23.2 ^c | 17.4 ^b | 5.5 ^a | 28.5 ^d | 18.3 ^c | 13.5 ^b | 2.3 ^a |
| 22/2/2022 | 38.3 ^d | 27.5 ^c | 20.2 ^b | 7.2 ^a | 32.7 ^d | 22.5 ^c | 16.7 ^b | 4.5 ^a |
| 1/3/2022 | 43.5 ^d | 33.6 ^c | 23.5 ^b | 9.5 ^a | 35.9 ^d | 26.1 ^c | 19.5 ^b | 5.2 ^a |
| 8/3/2022 | 47.3 ^d | 35.1 ^c | 26.7 ^b | 10.2 ^a | 38.5 ^d | 29.8 ^c | 22.2 ^b | 7.5 ^a |
| 15/3/2022 | 50.6 ^d | 39.7 ^c | 29.5 ^b | 12.5 ^a | 40.4 ^d | 32.2 ^c | 25.6 ^b | 9.8 ^a |
| 22/3/2022 | 53.5 ^d | 43.5 ^c | 32.2 ^b | 13.7 ^a | 43.5 ^d | 35.4 ^c | 27.5 ^b | 11.5 ^a |
| 29/3/2022 | 57.4 ^d | 45.3 ^c | 35.1 ^b | 15.1 ^a | 45.6 ^d | 37.5 ^c | 30.7 ^b | 12.9 ^a |
| 5/4/2022 | 50.3 ^d | 40.5 ^c | 30.5 ^b | 9.5 ^a | 42.5 ^d | 32.1 ^c | 26.5 ^b | 7.5 ^a |
| 12/4/2022 | 43.7 ^d | 37.8 ^c | 26.6 ^b | 6.6 ^a | 39.3 ^d | 28.4 ^c | 22.1 ^b | 3.7 ^a |
| 19/4/2022 | 40.9 ^d | 32.5 ^c | 21.3 ^b | 3.2 ^a | 33.5 ^d | 25.3 ^c | 19.5 ^b | 2.5 ^a |
| 26/4/2022 | 37.6 ^d | 28.7 ^c | 18.5 ^b | 34.5 ^a | 28.7 ^d | 21.8 ^c | 17.7 ^b | 1.7 ^a |
| Total | 695.2 | 528.0 | 309.7 | 100.5 | 457.5 | 338.4 | 262.9 | 71.0 |
| Mean | 38.6 | 29.3 | 23.8 | 7.3 | 35.2 | 26.0 | 20.2 | 5.4 |
| F(0.05) | 576.32 | | | | 425.31 | | | |
| L.S.D | 1.035 | | | | 1.023 | | | |

Means within columns bearing different subscripts are significantly different (P<0.05)

Results obtained show that tomato variety Mader was higher infested by *T. absoluta* than other varieties, then Preged variety then Floraded variety respectively at both of the two successive areas. Whereas in Giza Governorate the mean number of *T. absoluta* infested Mader variety was 38.6 individual/leaf, mean number infested Preged variety was 29.3 individual/leaf and mean number infested Floraded variety was 23.8 individual /leaf compared to control whereas it was 7.3 individual /leaf. While in Qaliobyha Governorate the mean number of *T. absoluta* infested Mader variety was 35.2 individual/leaf, mean number infested Preged variety was 26.0 individual /leaf and mean number infested Floraded variety was 20.2 individual /leaf compared to control whereas it was 5.4 individual/leaf. Statically analysis show that were highly significantly differences between the mean numbers of *T. absoluta* which infested the three successive varieties of tomato at both of the two successive areas whereas F(0.05) and L.S.D values in Giza Governorate were (576.32, 1.035), respectively. While F(0.05) and L.S.D values in Qaliobyha Governorate were(425.31,1.023)respectively. Results obtained also and tabulated at Table (2) and Figures (1)@ (2) show quantity of

the annual production of tomato fruits at both of the three successive varieties of tomato (Floraded, Preged and Mader) infested with *T. absoluta* compared to control at both of the two successive areas. Whereas at Giza Governorate quantity of the annual production of tomato fruits in control plants was (13.5 kgm/ m²), the annual production in Floraded variety was (12.0kgm/m²), the annual production in Preged variety was (10.8 kgm/m²) and the annual production in Mader variety was (9.7 kgm/m²). While in Qaliobyha Governorate quantity of the annual production of tomato fruits in control plants was (13.9 kgm/m²), the annual production in Floraded variety was (12.5 kgm/m²), the annual production in Preged variety was (11.3 kgm/ m²) and the annual production in Mader varietywas(10.1kgm/m²). Statically analysis showed that were highly significantly differences between quantity of the annual production of tomato fruits in tomato varieties infested with *T. absoluta* compared to control in both of the two successive areas. Whereas F(0.05) and L.S.D values in Giza Governorate were (415.23, 1.022) respectively. While F(0.05) and L.S.D values in Qaliobyha Governorate were (342.65, 1.035), respectively By linking between Table (1) and Table (2)

results obtained indicate to that the infestation by *T. absoluta* at the three varieties of tomato affected directly on the annual production of tomato fruits whereas in Giza Governorate quantity of the annual production of tomato fruits in Floraded variety (low infestation by *T. absoluta*)

decreased by 11.2% compared to control, quantity of the annual production in Preged variety (medium infestation by *T. absoluta*) decreased by 19.8% compared to control and quantity of the annual production in Mader variety (high infestation by *T. absoluta*)

Table (2): Quantity of the annual production of tomato fruits (three varieties) which infested by *T. absoluta* compared to control at Giza and Qaliobya Governorates during season 2022

| Date | Giza Governorate | | | | Qaliobya Governorate | | | |
|---------------------------------------|--------------------|--------------------|--------------------|--------------------|----------------------|--------------------|--------------------|--------------------|
| | Control | Floraded | Preged | Mader | Control | Floraded | Preged | Mader |
| Total | 100.5 ^a | 309.7 ^b | 528.0 ^c | 695.2 ^d | 71.0 ^a | 262.9 ^b | 338.4 ^c | 457.5 ^d |
| Mean | 7.3 ^a | 23.8 ^b | 29.3 ^c | 38.6 ^d | 5.4 ^a | 20.2 ^b | 26.0 ^c | 35.2 ^d |
| Annual production kgm/ m ² | 13.5 ^a | 12.0 ^b | 10.8 ^c | 9.7 ^d | 13.9 ^a | 12.5 ^b | 11.3 ^c | 10.1 ^d |
| Annual production ton/fed. | 56.7 ^a | 50.4 ^b | 45.4 ^c | 40.7 ^d | 58.4 ^a | 52.5 ^b | 47.5 ^c | 42.4 ^d |
| Reduction percentage% | - | 11.2 | 19.8 | 28.2 | - | 10.1 | 18.7 | 27.4 |
| F(0.05) | 415.23 | | | | 342.65 | | | |
| L.S.D | 1.022 | | | | 1.035 | | | |

Means within columns bearing different subscripts are significantly different (P<0.05)

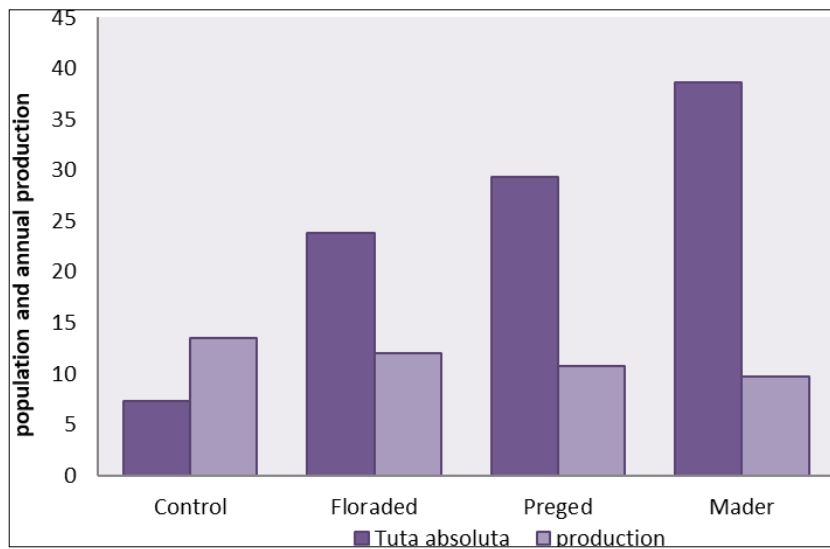


Fig 1: Mean numbers of *T. absoluta* and quantity of the annual production of tomato fruits (three varieties) compared to control at Giza Governorate during season 2022

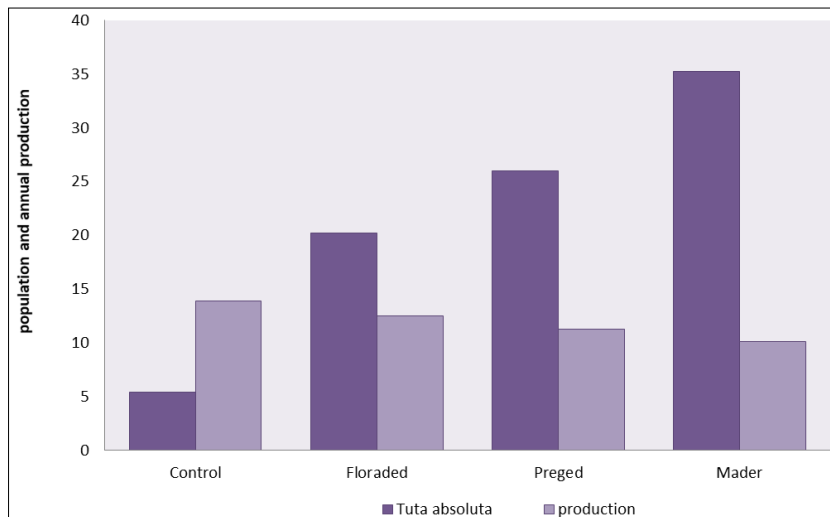


Fig 2: Mean numbers of *T. absoluta* and quantity of the annual production of tomato fruits (three varieties) compared to control at Qaliobya Governorate during season 2022

decreased by 28.2% compared to control. And the same trend was achieved at Qaliobya Governorate whereas quantity of the annual production of tomato fruits in Floraded variety (low infestation by *T. absoluta*) decreased

by 10.1% compared to control, quantity of the annual production in Preged variety (medium infestation by *T. absoluta*) decreased by 18.7% compared to control and quantity of the annual production in Mader variety (high

infestation by *T. absoluta*) decreased by 27.4% compared to control. Results obtained agreement with those obtained by Gebrelibanos (2015) who indicated that tomato is very important vegetable crop of the world and the production of this important vegetable crop is facing unprecedented challenge from Tomato borer, *T. absoluta* and also indicated that Tomato borer *T. absoluta* is a devastating pest of tomato and other Solanaceous crops and under heavy infestation tomato yield loss in the range of 80- 100% is common. Never *et al.* (2016) ^[2] indicated to that tomato (*Solanum lycopersicum* L.) an important vegetable crop for income, food and nutrition in Africa and its production is currently threatened by Tomato borer, *T. absoluta* and indicated also that heavy infestation by that pest has been reported to cause yield losses ranging from 80-100%. Veerle *et al.* (2015) ^[16] referred to The South American tomato leafminer, *T. absoluta* is a devastating pest in tomato crops after having spread rapidly in Mediterranean area since its first detection in 2006 and it has recently become serious dangerous to tomato crops whereas in the heavy infestation yield (tomato production) loss by 70-80%. Bekheit (2011) ^[4] in Egypt indicated that Tomato borer, *T. absoluta* was found for the first time in Egypt at Nubaria zone (Beheira Governorates) during season 2009. Namvar and Gharaei (2019) ^[9] indicated that Tomato borer, *T. absoluta* which has recorded a new pest has fast and wide distribution and became one of the most serious pest of tomato crop especially in open fields. Chiara *et al.* (2019) ^[6] indicated that The tomato leafminer, *T. absoluta* represents a global threat to commercial tomato (*Solanum lycopersicum*) production both in open field and greenhouse and it spread over the Mediterranean Basin, Europe, Africa and many parts of Asia in only 12 years, and currently it is reported in over 80 countries. Also, the obtained results were agreement with those obtained by Thierry *et al.* (2014) ^[15] who indicated to Tomato leaf miners, *T. absoluta* is a devastating and serious pest of tomato and other Solanaceous growing around the world, and it has become a major economical pest and causes serious damage to tomato crop. Rosa *et al.* (2014) ^[13] indicated to that Tomato borer *T. absoluta* is an invasive pest that produces significant damage to tomato crops in the Mediterranean area. Also, Abila *et al.* (2023) ^[1] studied evaluation sensitivity of some tomato varieties to the insect infestation by Tomato leaf miners, *T. absoluta* and found the successive varieties of tomato were arranged ascending in terms of the infestation by *T. absoluta* as follow; Floraded, Preged and Mader respectively. And Hamadttu (2020) ^[8] indicated that The South American tomato, *T. absoluta* is a serious dangerous pest to tomato crop and the moth can cause 100% damage in tomato crop in both greenhouses and open fields if control measures are not carried out.

Conclusion

Results obtained show that the average of the infestation by the successive insect *Tuta absoluta* (Meyrick) in both of the two successive different areas (Giza and Qaliobyha Governorates) in tomato varieties were arranged ascending as follow; Floraded, Preged and Mader respectively compared to control while the vice versa in terms of quantity of the annual production of tomato fruits whereas it was arranged descending as follow; Floraded, Preged and Mader respectively compared to control.

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