The Tomato Borer Tuta Absoluta Meyrick (Lepidoptera, Gelechidae) Invading The Region of Ouargla (Desert of Algeria): Biology and Damage

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Abstract

Tuta absoluta (Meyrick) is an invasive pest of tomato native to South America, where it is responsible for extensive damage. The study of this bioaggressor under greenhouse tomato in the region of Ouargla by pheromone traps showed that the global dynamics of populations T. absoluta 5 shows the difference in successive generations of six months is the growth cycle of tomato. There were a maximum of 1922 individuals in the three greenhouses studied. The life cycle of T. absoluta in tomato plants (T: 34 ° C H%: 50 - 60%) lasts 23.85 days. This pest has caused losses of up to 100% in leaves and fruits of tomato in February. Observation and direct capture to identify the natural enemies of T. absoluta as Chrysoperla carnea, Coccinella algerica, and the parasitoid Trichogramma sp. Damage is directly related to the reduction of plants photosynthetic capacity and of production levels in tomato crops; indirect damage can be also caused by secondary infections, with pathogens developing on the infested plant and fruit tissues.

Keywords: Tuta absoluta, Tomato, Ouargla , Pheromone traps, Damage.

1. Introduction

The tomato (Lycopersicon esculentum MILL.) is the first vegetable cultivated in the world with a production of about 90 million tons, of which an important part of which is destined for processing [1]. It is widely consumed by the Algerian population. The tomato (family of solanaceae) is an annual herbaceous plant annual plant very cultivated for its fruit consumed fresh or processed.

The culture of the tomato is attacked by several pests (Mites, thrips, aphids and etc..) and currently we report attacks of a bio destroyer of the culture in Algeria are reported never reported before is Tuta absoluta. The tomato borer, Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae), is one of the most harmful pests of solanaceous crops.

The our study aimed to knowledge of the biology of Tuta absoluta in tomato greenhouses of region of Ouargla, we placed pheromone traps in tomato greenhouses and we tried to follow the life cycle of Tuta absoluta and the estimation of the damage of this one on leaves and fruits of the plants.
2. Presentation of the study area

Hassi Ben Abdallah is located at 26 km northeast of Ouargla covering an area of 761.63 ha with 52,262 date palms [7]. It is located at 157 m altitude (32° 52'E.; 5° 26' N.). This region presents diversified vegetation, in addition to the palm tree date (Phoenix dactylifera) of which 80% are Deglet-Nour and 20% of Ghars. It also includes one hectare of plasticulture consisting of greenhouses of type 50 m x 8 m greenhouses, housing the vegetable crops like a tomato.

3. Materials and Methods

Three tomato greenhouses are chosen to carry out this study, at the level of the agricultural area of Hassi Ben Abdallah. In each greenhouse we cultivated two varieties of tomato Zahra and Nedjma; this choice allows us to make a comparative approach on the distribution of the pest Tuta absoluta, in these three greenhouses. The first tomato greenhouse contains 740 plants of tomato which are distributed in seven lines. In the second tomato greenhouse, with a heating system (with hot water circulating in plastic pipes) are cultivated 744 plants of the variety Zahra and Nedjma and the third greenhouse is occupied by 734 plants.

The sex pheromone traps of type Delta, water traps and MC Phail are the three methods used to monitor population fluctuations of the tomato leafminer population tomato in the greenhouses studied in Ouargla. The different pheromone traps were placed in the first and second pheromone traps were placed in the first and second greenhouse but the third greenhouse was left as a control. We have estimated monthly the damage of T. absoluta the leaves and fruits of tomatoes cultivated under the greenhouses. The extractions of genitalia are morphological processes more and more used in systematics, essentially at the level of the species. With a pair entomological pin the abdomen is detached. The organ to be studied is placed in potash (KOH at 10%) heated for 5 to 8 minutes for degreasing according to the method of MARTOJA and MARTOJA.

The damage of T. absoluta on the leaves and fruits of tomatoes in each greenhouse, plants were randomly selected plants, we counted the rate of leaves affected by the of the tomato borer, in relation to the total of 300 leaves sampled. At the time of fruiting, it is estimated that damage of T. absoluta on fruits in three greenhouses by counting the number of affected fruits into healthy fruit on plants, the total is 20 tomato fruits [8].

In an effort to find natural enemies of the tomato leafminer, we made boxes made cardboard boxes with a tight cardboard boxes, of which only one opening is only one opening covered by a transparent test tube and a light source. In the boxes we put leaves or fruits affected by this pest. By the phenomenon of phototropism the parasites move towards the luminous part. (I think it is not necessary as long as I have used écart-type).

4. Results and Discussion

The capture of adults of Tuta absoluta by the Delta pheromone trap during the period of one month is 398 individuals, the 380 individuals were captured by the pheromone trap type MC Phail. On the other hand, this value increases in the third method by a value close to 9000 male moths. The water trap with pheromone water trap is the most effective in capturing large numbers of the tomato borer moths.

The female genitalia extracted from the individuals from the breeding shows that it is difficult to show the copulatory bursa; therefore the extraction and spreading of this female organ was a successful (Fig.1). The copulatory canal of T. absoluta is independent of the copulatory bursa. The copulatory bursa is conical in shape in its two thirds. The reproductive system of the males consists of several parts: the vinculum and the penis.

![Male and female genitalia of Tuta absoluta Grx100.](image)

(1.Penis or Edeage, 2. Vinculum, 3. Papille anale, 4.Apophyse, 5. Canal copulateur)

The life cycle of Tuta absoluta from egg to imago lasts 23.85 days at a temperature of 34°C and humidity between 50-60% humidity (egg 6 d; L₁ 3.25d; L₂ 2.7d; L₃ 2.15d; L₄ 1d and pupa 8.75d). The following table summarizes the cycle (Tab.1).
Table 1. Duration of the different life stages of *Tuta absoluta* monitored on tomato plants

| Life stages | E  | L1  | L2  | L3  | L4  | Pupa | Total |
|-------------|----|-----|-----|-----|-----|------|-------|
| N           | 8  | 19  | 14  | 18  | 12  | 15   |       |
| Average (A) | 6  | 3.25| 2.71| 2.15| 1   | 8.75 | 23.85 |
| A ± écart-type | 6±1.58 | 3.25±0.47 | 2.71±0.53 | 2.15±0.84 | 1±0.45 | 8.75±1.25 | 23.85 |

After the hatching of the eggs of color white-cream, the young larvae are of color cream (1st stage), then become greenish and light pink and penetrate the leaves, stems or leaves, stems or fruits whatever the stage of development of the tomato plant. The caterpillars dig galleries in which they develop and can emerge from their mine to pierce others. Once the larval development is larval development completed at the boat of 4 successive stages, the caterpillars are transformed into chrysalises of green color then become brown either in the galleries, or on the surface of the host plants rolled up in the leaves or in the soil. The L4 followed on the sampled tomato plants form their pupae on the inner surface of the pots. The larvae usually move by a thread.

The population dynamics of *Tuta absoluta* in the three tomato greenhouses in the region of Ouargla showed that the number of *Tuta* individuals’ increases progressively from one month to another and the maximum of the leaf miner is recorded in January with 1922 individuals (Fig.2). It is during this period that a high population of eggs, larvae, pupae and butterflies.

![Figure 2](image2.png)  
*Figure 2.* Evolution of *Tuta absoluta* populations in tomato greenhouses at Ouargla.

![Figure 3](image3.png)  
*Figure 3.* Fluctuation of male *T. absoluta* populations in tomato greenhouses in Ouargla.

The explanatory curve shows successive generations of *T.absoluta* correspond to 5 generations during the cycle of tomato crop. We counted a maximum of the leafminer in the month of January with 450 individuals. It is during this period that we record a high population of adult males (Fig.3).[9], in the region of Dar el Beida in counts 8 generations for a year on the tomato crop.

The infestations of *Tuta absoluta* recorded on the leaves of tomato are gradually increasing progressively from one month to another. They are 2.92% in the month of November in the greenhouse1, 8.07% in the heated greenhouse and 8.96% in the greenhouse3. In December, it increases 15.92% and 31.02% in January. The highest rate is recorded in the month of February with 100% (Fig.4).
The infestations of *Tuta absoluta* populations on tomato fruits are 4.3% in January in greenhouse 1 to reach a maximum of 100% in the month of October, to reach the maximum of 100% in February. On the other hand, in the heated greenhouse the infestation rate is important at 36% in January and the total infestation of the greenhouse (100%) in February. The infestation is less important in the last greenhouse with 16.3% and increases abruptly to reach 100% in February. Our results are comparable to those found by CHOUIBANI in 2008, who estimated the damage of the larvae of *T. absoluta* larvae on tomato leaves and fruits tomato ranging from 50 to 100%. In the tomato greenhouse in M’Rara (El Oued) reported that the rate of leaf surfaces attacked by the miner is 6.41%. Similarly in the commune of [11], mention that some greenhouses are completely devastated and the losses are close to 100%.

Daily observation of tomato greenhouses and the use of the positive phototropism method allowed the capture of the following predators and parasitoid: *Chrysoperla carnea* (Neuroptera, Chrysopidae), *Coccinella algerica* (Coleoptera, Coccinellidae) and *Trichogramma* sp. (Hymenopera, Trichogrammatidae). Similarly, [12] noted the presence of *Trichogramma* sp. in market garden crops in the region of Ouargla in Algeria.

**Conclusion**

In order to know the bioecology of the tomato borer *Tuta absoluta*, the fluctuation of the populations was studied by capturing moths with pheromone traps. Peaks were found, which correspond to the increase of the populations and the succession of the generations on which a maximum of 336 male adults was counted (greenhouse 1), and in the heated greenhouse 472 at the beginning of January. The capture is more important in the second greenhouse which is heated compared to the first one. The overall population dynamics of *T. absoluta* showed 5 successive generations in the six-month gap that is the cycle of the tomato crop. A maximum of 765, 912 and 245 individuals were counted respectively in the three greenhouses.

The estimation of *T. absoluta* damage on tomato leaves in the three greenhouses shows that the infestation rate increases progressively from one month to another and from one greenhouse to another. The maximum is reached in February with 100% in the three greenhouses studied. *Tuta absoluta* caused losses of up to 100% on tomato fruits. The sampling allowed to capture some predators and parasitoid like *Chrysoperla carnea* and *Trichogramma* sp.

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