



Comparison of strains of *Nesidiocoris tenuis* against *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) under geothermal greenhouses in southern Tunisia

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Abstract

Heated greenhouse cultivation in southern Tunisia constitutes a very important axis of agricultural development. Among the problems that are prejudicial to glasshouse tomato crops heated by geothermal waters, the newly introduced *Tuta absoluta* insect remains little studied in this agro-ecosystem. Biological means in the context of an integrated fight against this formidable pest to better understand the geothermal sector and contribute to the study of this new problem. The monitoring of a population of a native strain of *Nesidiocoris tenuis* installed naturally in the geothermal greenhouse and a population of one strain introduced into another greenhouse, showed the performance of the indigenous strain which multiplied rapidly and remained until the end of cultivation with a large population arriving at the total elimination of *Tuta absoluta*.

1. INTRODUCTION

The heated greenhouses sector has grown very rapidly. It has helped to promote production, create jobs and export to European markets in winter. This technique started in 1984 for the production of melon and tomato off season.

The creation of of geothermal drilling aquifer to fill the deficit of irrigation water in the oases and to allow the development of irrigated perimeters was exploited to develop a new agricultural sector in the oasis regions; it is the production of greenhouses under glass heated by geothermal waters. Indeed, from its beginning in the 80s, the sector has experienced a rapid development. However, in order to prepare a sector development strategy, the latter stagnated from 1994 to resume a few years later, currently reaching 251.80 ha exploited. This area is distributed over the three main geoserricultural regions namely; the region of Gabes represented by 24652.1 (t) is 82% of the total production,

followed by the region of Kebili represented by 3868.75 (t) is 13% of the total production, and finally the region of Tozeur with 1561 (t) representing 5% of the total production (CTCPG, 2019).

Greenhouse crops are more vulnerable to fungal and viral diseases and pest attacks due to humidity and ambient temperature. Infestation can occur on aerial organs (stems, leaves, flowers, fruits) and / or on roots in an isolated or generalized manner. The main pests that develop on tomatoes are nematodes, insects or other arthropods (LANGE & BRONSON, 1981). Tomato growers in Tunisia are confronted with a new and formidable pest, known as *Tuta absoluta* (MEYRICK 1917), because of the considerable damage done to this greenhouse crop and in the open field (BADAOUÏ & BERKANI, 2010). The low efficiency of the chemical pesticides used (LIETTI et al., 2005, SANTOS et al., 2011). This pest is

considered a big obstacle to tomato production, due to its life cycle modeled on the cycle of tomato cultivation and the resulting losses that can reach 100% (LOURENÇÃO et al., 1985).

The newly introduced pest finds Mediterranean coasts as a new habitat favorable for its multiplication (DESNEUX et al., 2010). It was discovered for the first time in the province of Castellon in Spain in 2006. This pest was quickly established in all Mediterranean and European countries (HARIZANOVA et al., 2009, STRATEN et al., 2011). In Tunisia, the first observations were noted in October 2008.

The appearance of *Tuta absoluta* has led to the involvement of the agricultural and scientific sector in research aimed at controlling it by various appropriate methods.

Various means of protection against this pest have been reported (DESNEUX et al 2010). Prophylaxis and good management of this pest are essential. Chemical control is often doomed because of the resistance of *Tuta absoluta* to many pesticides but also because much of its development takes place inside the plant or in the soil, outside of the soil. treatment attainment. In terms of biological protection, several auxiliaries are reported and have proved effective. It is within this framework that we undertook this study which aims to highlight the performance of a predator chosen against *Tuta absoluta*,

Mainly found in tropical regions *N. tenuis* is a small green bugs, appearing spontaneously in greenhouses or tunnels where few insecticides are applied. It has long legs with which she moves quickly, even on the hairy leaves of the tomato.

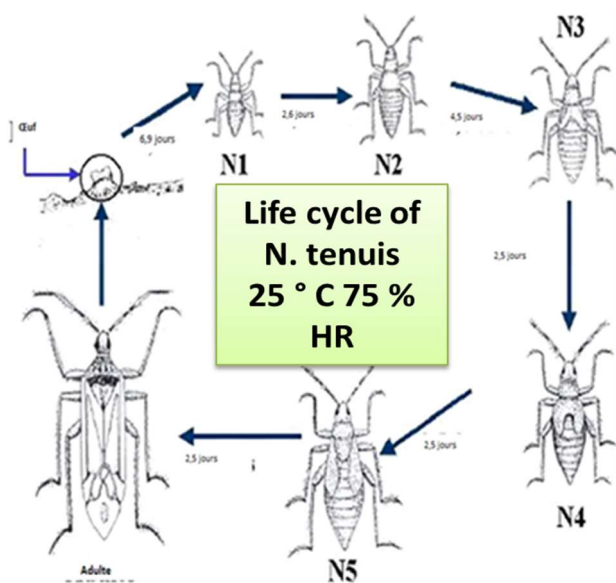


Fig.1.Life cycle of *N. tenuis* (El Dessouki, et al, 1976).

The life cycle of *N. tenuis* comprises three stages: egg, nymph and adult (El Dessouki El I, et al, 1976),(Fig 1) .The eggs are oval concave and transparent in color. The female lays its eggs in the plant tissue of the leaf. After about ten days, the nymphs release eggs. There are five nymphal stages. In the early stages, nymphs are yellow-green, but older nymphs turn bright green, and look like adults, but without wings (El Dessouki et al., 1976).

In the last two stages, we see the beginning of wing development. The five nymphal stages last a total of twenty days at a temperature of 25 ° C. Females live about 40 days, but males can live a little longer. A female lays in total between 100 and 250 eggs, depending on the temperature and the food.

The purpose of this experiment is to compare the efficacy of two strains of *N. tenuis*, a predator of *T. absoluta*, one native to naturally established geothermal greenhouses at the El Khbayett site, and the other is introduced into a greenhouse in the Bazma geothermal site.

2. MATERIAL AND METHODS

1000 adult *N. tenuis* individuals were introduced into a 500 m² greenhouse at the Bazma geothermal site at Kebili. This greenhouse is grown continuously tomato with 1200 plants spread over 8 lines twinned. The adults of the predator are distributed in the greenhouse in a homogeneous way.

Follow-up began three days after the introduction of *N. tenuis*. Each line was divided into 4 identical micro plots, from each micro plot a plant was selected for sampling where 3 leaves were pulled out at the 3 levels of the plant (low, medium and high). The samples of each plant are put in a plastic bag bearing all the necessary indications. In total there are 48 samples to be analyzed in the laboratory under a binocular loupe. The analysis consists of counting *T. absoluta* larvae present in the leaves as well as lymphocytes and adults of *N. tenuis*.

In parallel with this monitoring, the same sampling protocol was applied in the greenhouse of the El Khbayet geothermal site. But in this case the predator has been already installed naturally. For this reason, the evaluation of the population at the start of the follow-up was carried out in order to compare it with the strain introduced.

3. RESULTS

Two strains of *N. tenuis*, predator of *T. absoluta*, one of which is indigenous naturally established in the geothermal greenhouses at Khbayett site, and the other introduced into a greenhouse at Bazma geothermal site, have object of the follow-up for the comparison of their potential of control of the population of *Tuta absoluta*.

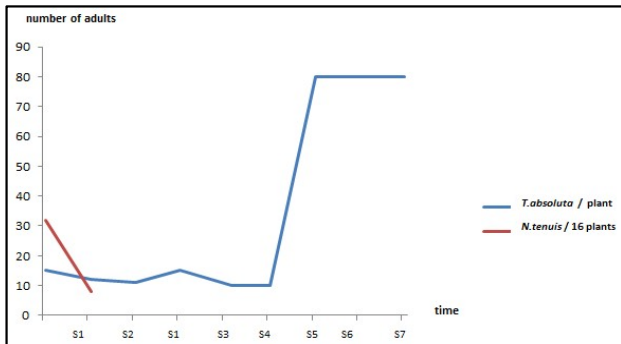


Fig.2.Evolution of adult populations of *T. absoluta* and *N. tenuis* introduced.

Concerning the introduced strain of the predator, the analysis of the evolution curve of its population following its introduction into the greenhouse grown tomato infested by *Tuta absoluta*, shows a total disappearance of the whole population introduced during a week. Moreover, despite the presence of different stages of development of *Tuta absoluta* on which *N. tenuis* can multiply, no descendant of the introduced population has been encountered.(Fig 2) This shows that the introduced adults suffered a shock as soon as they were placed in the greenhouse before they even started egg-laying. The rapid disappearance of individuals introduced from *N. tenuis* could be the consequence of factors inherent in the strain itself (sensitivity to one of the abiotic factors, lack of adaptability, etc.).

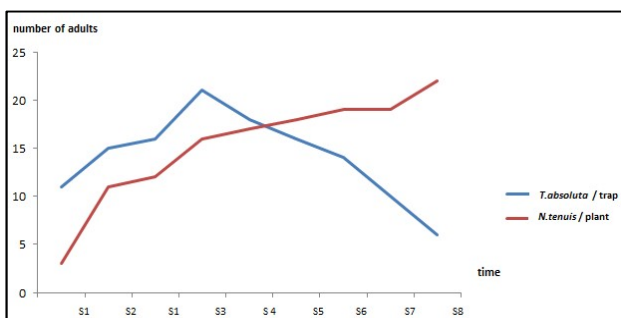


Fig.3.Evolution of adult populations of *T. absoluta* and native *N. tenuis*

According to the evolution curve of *T. absoluta* populations, we also note that the introduction of this strain of *N. tenuis* coincided with a population of *T. absoluta* represented almost completely by the egg stage. Indeed, the emergence of adults of *Tuta absoluta* was brutal after about a month, enough time to go from the egg to the adult, the date of introduction of the predator, (Fig 3). The dominance of the egg stage in the population of *Tuta absoluta* during the introduction of *N. tenuis*, could also be at the origin of its abrupt and total disappearance.

In the case of the local strain of *N. tenuis*, the analysis of evolution of its population dice of its appearance in the greenhouse, shows that the population of the latter increases rapidly with the increase of the population of *Tuta absoluta*. From the fourth week, the pest population decreases rapidly, while that of the predator increases remarkably

4. Discussion

Nesidiocoris tenuis is an important predator of the three main pests of tobacco crops: *Trialeuro desvaporariorum*, *Bemisia tabaci* and *Myzuspersicae* (Valderrama et al, 2007).The effectiveness of the use of native *N. tenuis* at various stages of development, was evaluated, indeed; adults and nymphs of *N. tenuis* placed in all stages of development of *T. absoluta*, feed with a high preference on eggs (total eggs and L1 were 17.75 ± 0.95 and $3, 25 \pm 0.50$, respectively $p = 0.019 < 0.05$, as evidenced by the drastic decrease in predation in the advance of pest development. On the other hand, the third nymph of the predator presented the largest effect on larval L1 and L2 larvae, (1.5 ± 0.57 and 1.25 ± 0.50 predated individuals, respectively) compared to other nymphs and adults of *N. tenuis* (Ettaib et al 2016).

The native strain of *Nesidiocoris tenuis*, predator of *T. absoluta*, naturally installed in the geothermal greenhouse, showed its performance to multiply rapidly and to maintain itself until the end of the crop. During its life cycle, an *N. tenuis* is able to attack about 25 individuals (Ettaib et al, 2016), regardless of the stage of development of *Tuta absoluta*. Indeed, the study of the biotic potential of *T. absoluta* has shown that the descendants of a *T. absoluta* couple are on average 250 adults. We can deduce that 10

individuals of *N. tenuis* are sufficient to completely destroy the descendants of a couple of this pest.

Noting that a couple of *N. tenuis* gives about 200 individuals, (El Dessouki, et al, 1976) they are able to attack 5000 individuals of *T. absoluta*, which are the descendants of 20 pairs. According to these results the introduction of *N. tenuis* as a predator in the context of integrated control can be effective with well-defined doses in relation to the population of *T. absoluta* occupying the geothermal greenhouse. Indeed, the application of the necessary dose of *N. tenuis* protects greenhouse culture from the phytophage effect of our predator.

At the end of cultivation, the population of *T. absoluta* became nil, while that of the predator, became very important so that it began to feed on the different parts of the culture thus becoming phytophagous and causing damage on tomato fruit on leaves and stems. This phytophagous behavior of *N. tenuis* was observed when the population of the latter has exceeded 18 adults per plant.

CONCLUSION

The monitoring of a population of a native strain naturally installed in the geothermal greenhouse and a population of a strain introduced into another greenhouse, showed the performance of the indigenous strain which multiplied rapidly and remained at the end of cultivation with a strong population arriving at the total elimination of *Tuta absoluta*.

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