Effectiveness of pheromone traps against *Tuta absoluta*

Ettaib Refki, Belkadhi Mohamed Sadok, Ben Belgacem Ali, Aoun Faouzi, Verheggen François Jean and Caparros Megido Rudy

**Abstract**

In the Tunisian south, the heated greenhouses are an important axis of development of agriculture thanks to the big geothermal potential of this zone. Currently, this sector suffers from several phytosanitary problems. In the last years, a new insect, *Tuta absoluta*, threaten the cultures of cultivated tomatoes in heated greenhouses.

To control *T. absoluta*, the effectiveness of pheromone traps (associated or not with a source of light) and luminous traps (associated or not with water, with limed buckets for limed covers) were compared. The results show that the traps with pheromones significantly catch more adults of *T. absoluta* compared to all the other types of traps (average number of trapped adults of *T. absoluta* = 73.4 (± 142)).

The luminous traps associated with water, with limed buckets as with limed covers show, as for them, an intermediate effectiveness. In spite of this slightly less effectiveness, the luminous traps have the advantage of low costs of production as well as the advantage of simultaneously capturing males and females of *T. absoluta*.

**Keywords:** Tomato, *Tuta absoluta*, heated greenhouses, luminous traps, pheromone, control

1. Introduction

To recompense the water deficit of the oases of the Tunisian South, the exploitation of the tablecloth of the Continental Guide was planned. This geothermal water, naturally hot with a temperature between 67 and 70 °C, allowed the development of a new crenel of agricultural production in the areas of Gabes, Kebili and Tozeur oasis. The latter is only the exploitation of geothermal energy for the production of early products in greenhouse. It is from the crop year of 1985-1986 that the first greenhouses were installed close to the oases of Jemna and Limagues in the governorship of Kebili. Since then, there have been fast developments of the use of the greenhouses heated by geothermic water in these zones. The tomato is the principal culture. It is regarded as a key element of the economy because a considerable quantity of its production is exported towards Europe during the cold period. The heated greenhouses constitute a microclimate presenting particular conditions a very high temperature and moisture. These conditions support the appearance of several types of damage caused by nematodes, mushrooms (of the mildews, oïdiums...), bacterial and viral diseases as well as devastating insects. Among the devastating insects, *Tuta absoluta* (Lepidoptera: Gelechiidae) is an emerging ravageur of tomato and is the object of a very detailed attention.

The tomato mineuse, *T. absoluta* is a ravageur of tomato coming from South America. At the end of 2006, the presence of *T. absoluta* was reported, in Spain, for the first time. Then, it was detected in several European and North-African countries, mainly in Mediterranean region. At the present time, it is quickly propagated apart from the Mediterranean region. Most damage are concentrated in the apical and median parts of plants it is able to cause up to 80% or 100% of losses. Since 2008, after these production losses, the price of tomato recorded a big raise in several countries. In order to fight against the ravager of tomato, the Ministry of Agriculture in Tunisia launched a biological campaign of fight concentrated on the use of diffusers of pheromones, a method of control very much used against *T. absoluta*. The traps with pheromones have the shapes of traps composed of female sexual pheromones which make it possible to attract and capture adult males, one can distinguished several types of traps; trap with pheromone of the type Delta, trap with water, the colors of the traps also interfere in the attraction of the adults of *T. absoluta*. However, these traps are expensive and their real effectiveness is put in doubt by the phenomenon of parthenogenesis.
Among the tools of the physical fights against *T. absoluta* one finds the traps luminous which are very marketed, but their effectiveness is little studied of Rodrigues *et al.* (2008) \(^{[19]}\) compared several standard luminous traps between each other but not with the other types of the traps. They showed that lamps BLB are most effective. The goal of our study is to compare the effectiveness of the pheromone traps (associated or not with a source of light) and luminous traps (associates or not with water, limed buckets or limed covers).

### 2. Materials and methods

#### 2.1 Trapping

![Fig 1: Trap with water with capsule of pheromone (P+E)](image1)

Our tests were carried out from April 25th to 27th 2010; in three greenhouses of the geothermic site of Bazma in the Tunisian South. Nine traps were tested within a tomato culture uninterrupted. The counting of the trapped adults of *T. absoluta* using the various systems was operated daily during three days.

The various traps consisted of a common part which was not other than a trap with water formed of a plate filled with water and a small quantity of vegetable oil (trap E). This basic trap, were also associated: a capsule of pheromone (P+E), (figure 1), a source of light (L+E), a source of light and a capsule of pheromone (P+L+E) as well as a bucket limed of grease (S), and it was itself combined with one or two sources of light (S+L and S+2L). The source of light was always made up of a supplied lamp of photovoltaic cells having a luminous intensity of 2 W. the last two traps consisted of a limed plastic cover of grease associated or not with a source of light (G and G+L). The formed trap by the plastic cover consisted of a limed cover on its side part on surface of 1 m² with 1.5 meter of surface of the ground (figure 2). Four surfaces were limed in the two interior long limits of the greenhouses. The sources of light were hung outside the greenhouse, opposite to the limed surface.

#### 2.2 Statistical Analysis

The conditions for applications (normality of the population and homoscedasticity) of the ANOVA were not being met. So, the test of Kruskal-Wallis was carried out and followed by comparisons of Mann-Whitney of the pairs of samples. All the statistical tests were carried out by the means of the software Minitab® v. 18 (http://www.minitab.com).

### 3. Results

The average number of adults of *T. absoluta* trapped during 3 days by each type of traps is represented in figure 3. The test of Kruskal-Wallis indicates that there are significant differences between the various treatments (H\(_8\) = 66.32; \(P = 0.001\)). The comparisons of Mann-Whitney on the pairs of samples indicate that the traps with pheromones provided or not with a source of light significantly captured more insects than all the other types of traps (Table 1). In the case of the pheromones traps, the use of a source of light does not show a significant difference in effectiveness. Traps S+L and G+L show an intermediate and similar effectiveness between them. Trap L+E shows an effectiveness less than the last two traps but not significantly different from that of G+L. The traps E, S+2L and G show a low effectiveness whereas the trap S shows a very low effectiveness (Table 1).

![Fig 3: Comparing the averages of each type of traps.](image3)
4. Discussion

The significant differences between the various treatments show the utility of several used combination. The different combinations have the aim to improve of the types of T. absoluta trappings.

The traps with pheromones (provided or not with a source of light) captured more insects than all the other types of traps. Indeed the insects are attracted by the sexual pheromone more than the Light, even when the source of Light (S+2L) was doubled. The addition of trap with pheromone with a source of light (L+P+E) does not show any more effectiveness; even minimized the effect of the capsules with pheromones, but that remains no significant. Traps (S+L) and (G+L) show an intermediate and similar effectiveness between them. These two types of traps are at least effective, especially when one compares them with the traps with pheromones. The effectiveness of the light becomes lower if the latter is associated with water (L+E), but remains always no significant while comparing with (G+L). Then we can conclude that generally even by modifying the support of gluing of the adults of T. absoluta the effectiveness of the light remains almost the same one. But by comparing the effectiveness and the period of life of the luminous trap, we notice that the latter remains relatively effective especially with a weak population. Concerning the traps E, S+2L and G the rate of trapping is very weak compared to the latter traps, this make in evidence also that the doubling of the light has a negative effect on the effectiveness of the trap, because while comparing (S+L) and (S+2L), the difference is very significant.

The pheromone traps as well as the traps luminous become more effective when the greenhouses are protected by nets "insect-proof" [20]. Within the framework of monitoring the density of trap with pheromone should be 20 to 25 traps/ha inside greenhouses (30 traps/ha in greenhouses of vegetable multiplication) and by 40 to 50 traps/ha in full field and this density must be increased if the number exceeds 30 individuals per trap during one week [21, 22]. The approximate lifetime of this kind of trap is from 4 to 6 weeks [23]. Since the sexual communication of T. absoluta is guided by the attraction of the males towards a female sexual pheromone, the traps with pheromones catch only the male individuals, which decrease their effectiveness [15]. Moreover, the males of T. absoluta are polygenic and reproduce on average of 6.5 times [24]. A big proportion of males must thus be removed before the number of eggs laid, in a population, starts to decrease [25, 15]. Finally, Caparros Megido et al. (2012) [18] showed that the females were able to lay not fertilized eggs what can decrease the effectiveness of this kind of trap.

Luminous traps, although being less effective than the traps with pheromones have a capacity to attract at the same time males and females of T. absoluta. Moreover, the capsules of pheromones have one limited lifetime. On the other hand, the source of light is more permanent can even live for more years if the lamp is supplied with photovoltaic cells, like the case of the traps tested in our study.

Although the traps with pheromones appeared more effective, the use of the luminous traps could be recommended within the framework of a fight plan against T. absoluta in geothermic greenhouses. The success of a strategy or another is base not only on the types of the traps but is also based on the co-operation of the producer [20] as well as the control measures in the stations from packing [27].

5. References


