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Fight against *Tuta absoluta* (Meyrick, 1917) by using the traps Pheromone on round tomato and cherry tomato in greenhouse

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ABSTRACT
Two types of round tomatoes " Pristyla " and cherry " Sarah " grafted on " Beaufort'' are chosen to fight massively a gainst *Tita absoluta* using pheromone traps. During the study months; the largest number of capture is recorded in the round tomato greenhouse with 8126 butterflies. It is captured 3419 individuals with yellow adhesive traps, 2464 adults with light traps and 2243 adults with water plates. However, during the same study period, a low number 3258 of *Tuta absoluta* adults were recorded in the cherry tomato greenhouse using the same trapping techniques. In the latter case, it is captured a number of 1282 individuals with light traps, 1256 adults with yellow adhesive traps and 720 adults with water plates. Catches by these techniques show that the level of infestation is greater in the round type tomato compared to the cherry type. The peak of the pest's outbreak was early on the variety " Pristyla " in April and late on the variety " Sarah " in May. Rustic varieties such as rootstocks and cerasiforme tomatoes have an appearance of resistance to the *T. absoluta* pest.

KEYWORDS: *Tuta absoluta*, round tomato, cherry tomato, pheromone trapping techniques.

INTRODUCTION

The tomato leafminer (*Tuta absoluta*), Lepidoptera (Gelechiidae) with nocturnal habits originated in Latin America [21]. It is a real threat to the production of tomatoes in the world and in Algeria in particular because of its strong outbreaks. In fact, each female lays between 100 and 200 eggs [13], most often on the underside of leaves, tender young stems, sepals of flowers and immature fruits. *T. absoluta* settles on the tomato under cover and in the field, but also on other wild or cultivated solanaceous plants such as eggplant (*Solanum melongena*), potato *Solanum tuberosum*), tobacco (*Nicotiana tabacum*) And pepper (*Capsicum annuum*) [7,18,9]. Its damage in larval galleries in tomato leaves is already reported by [11] in Mostaganem (Algeria). The percentage of damage can reach 100% on tomato crops under glass and field [1]. In order to combat this pest several protocols have been put in place amongst others chemical control, biological control and integrated pest management. The physical struggle associated with biotechnology using sex pheromones are the first aspects you should undertake. According to [3], the greenhouse protected with insect-proof netting and pheromone traps is less infested than the unprotected greenhouse. According to [5], a greenhouse controlled by 100 pheromone traps per hectare can have a decline in infestation level from 57% to 85% throughout the cycle. In this work, attention is focused on the effectiveness of different techniques of mass catches of *Tuta absoluta* on two types of tomatoes.

It is shown that the two varieties of *Solanum esculentum* are not equally infested. This aspect deserves to be deepened.

MATERIAL AND METHODS

1.1- Presentation of the study station:

The study is carried out in the farm of vegetable productions above ground in Almeria Canarian greenhouses of one hectare, within the private company " CeviAgro ". This farm is located in the region of Hamiz which belongs to the eastern part of Mitidja (36 ° 43 'N, 3 ° 13' E.). The soil of this farm is marshy, heavy. It is for this reason that the above-ground planting is adopted. The station belongs to the subhumid bioclimatic stage in mild winter. In Mediterranean climate, temperatures are high in summer and low in winter. The average annual temperature is 26.5 to 28.2 ° C. Precipitation is between 600 and 900 mm per year.

1.2- Plant material:

Two types of tomatoes are selected, round tomato and cherry tomato. The first is represented by the variety " Pristyla " and the second by the variety, " Sarah " whose fruits have the form of date.

1.3- Methodology of experimentation:

Two greenhouses of tomato, one cultivated by the variety of round type and the other by a variety of cherry type are concerned by this study. It is placed in each of these greenhouses, three different types of traps. The first concerns six yellow plates placed on the ground between the lines of the tomato at equal distances, so as to cover the entire surface of the greenhouse. Each of these plates is provided with a capsule containing the pheromone. The second type is that of light traps. Four traps of this type carrying also pheromone are suspended; One at the re-entry of the greenhouse, another at the center and two at the ends of the greenhouse. The third technique involves the use of four yellow pheromone adhesive traps 1.5 m long and 0.15 m wide. The latter were fixed at the distance of 1 meter from the ground. Counting of captured individuals is done on a daily basis for each trap type from early March to late May. After each count, Tuta absoluta is removed from the traps by a cotton stem soaked with a little water on all the traps. Adhesive traps and sticky plates of light traps are changed when the sticky surface becomes very small or dirty. Water and detergent additives are replaced when the contents are low or dirty.

Results:

Within this study, it is found that yellow adhesive traps are the most attractive for *T. absoluta* butterflies on round tomato crop. The number of individuals caught with these is 3419 adults, followed by light traps with 2464 individuals and then water plates with 2243 individuals. On the other hand, in the greenhouse containing the cherry tomato, it is the pheromone light traps that are more attractive with a catch of 1282 adults. They are followed by yellow adhesive traps with 1256 individuals. The catch by the water plates for it recorded a lower number with 720 adults. The variance analysis for the round tomato shows a highly significant difference ($P = 0.003$) between the types of trapping. The one made for the cherry tomato shows a significant difference ($P = 0.040$) between the same types of traps. It is important to note that during the three months of study using the three techniques, the highest number of leafminer individuals is captured on the round tomato crop with 8126 versus that obtained on the tomato Cherry which is of the order of 3258. The analysis of the applied variance showed a very highly significant difference between the two types of tomato ($P = 0.00$). During the study period, it is noted that on the 'Pristyla' tomato the largest number of individuals of *T absoluta* is 3144 is caught in April followed by 2952 adults in May and 2030 in March . In contrast to the variety " Sarah ", it was during May that the highest number was recorded with 1219 individuals. On this same variety, it is obtained 1054 in March and 985 in April. Analysis of the variance revealed a highly significant difference ($P = 0.013$) between the months for Pristyla tomato. In the case of the variety 'Sarah' variety, the analysis showed that it has no significant difference ($P = 0.40$).

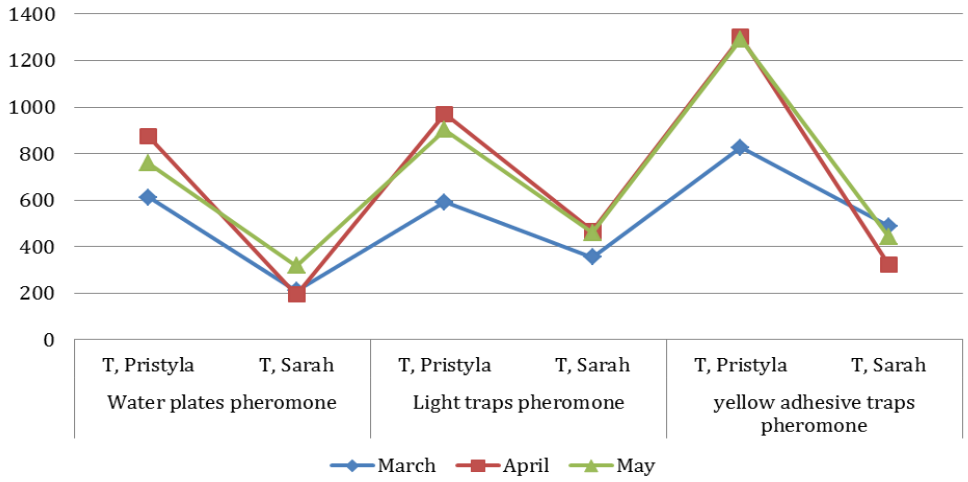

Fig. 1: Number of individuals of Tuta absoluta caught with tree traps technical on round and cherry tomatoes

Table 1: Anova applied to the different types of trapping for the variety "Pristyla"

Effect	SC	Deg. of freedom	MC	F	P
Trap types	304457	3	101486	14,36	0,003809
Month	340885	2	170442	24,117	0,001354
Error	42403	6	7067		

Table 2: Anova applied to the different types of trapping for the variety "Sarah"

Effect	SC	Deg. of freedom	MC	F	P
Trap types	67667	3	22556	5,2429	0,04099
Month	9167	2	4583	1,0653	0,401858
Error	25813	6	4302		

Table 3: Anova applied to different types of tomatoes and types of trapping

Effect	SC	Deg, of freedom	MC	F	P
types of tomatoes	1560090	1	1560090	59,6782	0,000001
types of traps	2721176	3	90725	3,4705	0,041057
types of tomatoes*types of traps	99947	3	33316	1,2744	0,316787
Error	418267	16	26142		

Discussion:

As soon as the tomato leafminer appears, several methods are adopted to combat this pest and to minimize this damage. In its area of origin, the species showed resistance to many phytosanitary products. In Algeria, pheromone traps are proposed as the first method of alternative control against *Tuta absoluta* [15]. Pheromone traps are also used as indicators of adult male of *Tuta absoluta* to control the farm [10]. In Iran the pheromone traps used for tomato crop monitoring and identification of the species [2]. In Sudan, [16]; Pheromone traps were used in several plots of different crops to detect the host plants of *Tuta absoluta.* In this study, these traps are used to compare the level of attractiveness of the different types of traps carrying the *Tuta absoluta* pheromones and to see the degree of infestation of two types of round and cherry tomatoes; also for purpose of a massive capture serving the physical struggle against leafminer. It was found that yellow adhesive traps are the most attractive for *T. absoluta* butterflies, followed by light traps and water plates, respectively. A total of 8126 of leafminer adults are captured by the three traps types in the round-type of tomato during the three-months of catch. The number is too high; indicating the high level of infestation of the crop. A study done by [17] comparing a level of infestation of two tomatoes varieties which are of the same round type, they used pheromone sex traps. They recorded a very large catch percentage of male adults of *Tuta absoluta* on the variety " Agora " and " Doucen ", respectively 29.09% and 23.19%. In this study, the analysis of the variance between the different techniques showed a highly significant difference (P = 0.003) in the greenhouse of the round type tomato. The technique of using yellow adhesive traps is very attractive to adults of the leafminer; It is probably due to the yallow color which turns yellowish-greenish by the reflection of light and the greenery of the crops. According to [20], whatever the type of trap used in the catch of insects; The yellow color is the most attractive one. Add to this the yellow adhesive traps especially pushed an angled and shiny surface, that is relatively plays an important role in the catching. Also, the range of traps in the greenhouse plays an important role in mass capture. The yellow adhesive traps in this study are positioned in the greenhouse at a height of one meter from the ground. According to [4], who worked on insects of the bean crops, insect activity in general is located in and on the middle parts of the plant. The middle parts of this indeterminate tomato is from one meter in height

in relation to the ground; Due to the technique of trellising and sleepings technical plants applied to the crop in March to June. For this reason that this traps caught the significant number of adults of *Tuta absoluta*. Within this study; In the greenhouse of the cherry tomato, unlike the round tomato, it is the pheromone light traps that are the most attractive followed by the yellow adhesive traps and the water plates. A total of 3258 butterflies of *T. absoluta* were captured through these three techniques. The number is quite low compared to the number caught in the greenhouse of the round tomato, indicating a lower level of infestation of the crop. The cherry tomato is known for its rusticity, its vegetative growth rate and its rate of productivity. According to [14] cherry tomatoes are often more productive, earlier and more resistant to diseases than larger varieties. Also a study by [6] on eight varieties of cherry tomatoes all showed good coverage of bio-aggressor resistance. The analysis of the variance showed a significant difference (P = 0.040) between the different types of traps used in the greenhouse of the cherry tomato. It turns out that the technique of using light is moste importante in catching the leafminer individuels in cherry greenhouse. This is probably due to the lower level of infestation of the crop; The captured individuals are those who make the nuptial flight during the nights. Adding to this; The foliage of the cherry tomato is less dense and less thick compared to the foliage of the round tomato and this is why the crop is less attacked and the yellow adhesive traps have not caught enough ; despite their near distance to the vegetation. The light traps according to [19] are used solely in the surveillance of *T absoluta* flights, they pay less attention to massive catches. It is important to note that the analysis of the variance applied between the different capture techniques used in the two greenhouses and between the two types of tomato showed a very highly significant difference between the two types of tomato (P = 0.00) and between different techniques of trapping. During the study period, it is noticed that on tomato " Pristyla " the largest number of individuals of *T absoluta* is caught in April. However, on the variety " Sarah ", the highest number was recorded during the month of May. The analysis of the variance revealed a highly significant difference (P = 0.013) between the months concerning the " Pristyla " tomato in contrast to the variety " Sarah ", the analysis showed that it had no significant difference (P = 0.40). This explains why the attack on the greenhouse of the round tomato by *Tuta absoluta* was too early compared to the greenhouse of cherry tomato; despite the same dates of planting and that the females of *Tuta absoluta* prefer the varieties to broad and thick leaves as Those of round pristyla tomatoes. Unlike the cherry tomato " Sarah " leaves that are a little narrower and less thick. Moreover, a study made in the laboratory in Venezuela by [8]; Find that the variety "rome gigante" which is a round tomato is preferred by *Tuta absoluta* for oviposition and favors the larval development and clearly leaves the cherry variety "cerasiforme". Another study confirming the preference of round varieties by the tomato leafminer is by [12]. The latter followed the biological characteristics of *T. absoluta*: egg hatching, mortality, weight of pupae and proportion of females on tomato *Lycopersicon esculentum* and *L. hirsutum* which is a wild tomato. The results showed the higher oviposition, higher hatching rate, lower mortality, a shorter development period and the higher proportion of females than *L. hirsutum*. Furthermore, during the present study it was noted that the leaves of the rootstocks of the tomato do not receive *Tuta absoluta*. Even the rare eggs emitted on the leaves of Beaufort-type rootstocks can give rise to L1 larvae which never develop in L2.

Conclusion:

The use of mass capture techniques of *Tuta absoluta* individuals is very important in the tomatoes production farms. Yellow adhesive traps and pheromone light traps are the most attractive when compared to water plates. The fight against the tomato leafminer by the pheromone traps as part of the massive capture or control it is important to associate a physical attraction " the yellow color ". However

catches by these techniques show that the level of infestation is greater in the round type tomato compared to the cherry type. Rustic varieties such as rootstocks and cerasiforme tomatoes have an appearance of resistance to the *T. absoluta* pest, or this same species prefers the varieties of tomato type round large and medium size.

Prospects:

Despite all the studies on sex pheromone capture techniques, this work remains a necessary step in choosing to apply a control protocol.

It is important to follow the physicochemical aspect of the leaf constituents of cerasiforme tomato species in order to prove the true causes of tolerance or resistance of these species.

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