Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

MONITORING AND CONTROL OF THE PEST *TUTA ABSOLUTA* (MEYRICK) IN TOMATO CROPS UNDER HIGH PLASTIC TUNNELS

Simona Hogea[1*]

[1] Research and Development Institute for Vegetable and Flower Growing, Vidra, Calea București, no.22, Ilfov, Romania

Abstract
Tuta absoluta – tomato leafminer (Meyrick) (Lepidoptera: Gelechiidae) is a major pest of tomato crops in protected areas, which attacks both foliage and fruit, in all phases of plant growth. Its invasion has led to yield and quality decrease, increased costs to control and high dependence on chemical insecticides. With pheromone traps it is possible to monitor and reduce the density of the pest population. The experience was established in 2020, at a farmer in Dobreni village (Giurgiu county). In the first and second crop cycle, the population of the pest Tuta absoluta was monitored, by placing Delta pheromone traps in tomato crops. The Sahmat F1 tomato hybrid was planted in both crop cycles. Pest monitoring was performed weekly, by changing the adhesive plates with pheromones from Delta traps, on the dates: 03.06, 10.06, 17.06, 24.06, 01.07, 08.07, 15.07, 22.07 in the first cycle of crop and on the dates: 29.07, 05.08, 12.08, 19.08, 02.09 , 09.09, 16.09, 23.09 in the second cycle. The appearance and evolution of the attack were recorded in the both crop cycles and its influence on production was established.

Keywords: attack, Delta trap, pheromone, tomato, tomato leafminer

1. INTRODUCTION

Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) known as tomato leafminer, is an important pest of tomato crops (Braham and Hajji, 2012; Hogea, 2020), which attacks both foliage and fruit, in all phases of plant growth (Hogea, 2020). It is considered a dangerous pest of tomato crops in greenhouse and fields (Cocco et al., 2012; Hogea, 2020).

T. absoluta is an invasive species with a high potential for reproduction, with the ability to spread and adapt quickly in newly invaded areas. It is a multivoltine species that winters in greenhouses and has a high tolerance to high summer temperatures, which makes the pest population maintain and grow rapidly over the years (Tropea Garzia et al. 2012; Damme et al. 2015; Han și colab., 2018).

The invasion of this pest has led to decreased yields and fruit quality, increased costs to control and high dependence on chemical insecticides with potential side effects on natural predators which led to the disruption of local IPM programs in newly invaded areas. Combining preventive and control tactics against *T. absoluta* pest, the new IPM packages must be established by researchers and

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

applied by growers in the invaded areas. The most common biological control method used is the release of parasites and natural predators of the pest (Ismoilov et al., 2020).
Under optimal development conditions (temperature of 30°C), the pest can have 10 - 12 generations /year (Desneux et al., 2010; Hogea, 2020). Depending on the temperature, the biological cycle varies between 26 and 75 days (Biondi et al., 2016) and includes four stages of development: egg, larva, pupa and adult (Desneux et al., 2010; Hogea, 2020).
Chemical control remains, for the time being, the most effective way to control the pest. However, it was found that the pest has become resistant to most insecticides used (Hogea, 2020), so it is recommended to apply them alternately.
The experience established in 2020, at a farmer from Dobreni village (Giurgiu county) had as purpose the monitoring of *T. absoluta* pest population, in the first and second crop cycles, by placing pheromone traps (Delta traps) in tomato crops.

2. MATERIALS AND METHODS

In 2020, at a tomato farmer (cycles I and II) Dobreni village, Giurgiu county, Delta pheromone traps were placed to monitor and reduce the population of the *T. absoluta* pest. The biological material was represented by the early hybrid Sahmat F1, with undetermined growth, with fruits of 220 - 240 grams, firm and sweet taste (www.marcoser.ro).
Delta traps include a pheromone bait with the active substance (3E, 8Z, 11Z)-3,8,11-Tetradecatrienyl acetate, placed in a rubber stopper. The number of adults caught on the sticky tray of the trap was reported weekly, which was reported on its surface, of 397.75 cm^2 (21.5 x 18.5 cm).
The occurrence and evolution of the attack (frequency and intensity of the attack) were recorded once every 10 days, in both crop cycles and finally the degree of attack was evaluated, the effectiveness of the sequence of treatments performed and was recorded the yield obtained compared to the untreated control variant.

3. RESULTS AND DISCUSSIONS

In the first cycle, the planting was done on May 9th, 2020. Pest monitoring was performed weekly, and plates with pheromone from Delta traps were changed on the dates: 03.06, 10.06, 17.06, 24.06, 01.07, 08.07, 15.07, 22.07 (fig. 1).

Figure 1. Plates with captured adults
10.06.2020 ***15.07.2020***

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

At the beginning of the monitoring, it was not necessary to change the pheromone plates due to the small number of captured adults (fig. 2), so they were changed at 4-6 weeks.

Figure 2. Plate with captured adults – 27.05.2020 (Hogea and Costache, 2020)

During the growing season, 8 treatments were applied, at intervals of 7 days, with the following products Coragen 0.0175% (chlorantraniliprol 200 g/l), Alverde 0.1% (metaflumizone 240 g/l), Affirm 0.15 % (emamectin benzoate 9.5 g/kg), Benevia 0.0125% (cyantranilitrol 100 g/l), Laser 240 SC 0.05% (spinosad 240 g/l), Coragen 0.0175%, Benevia 0.0125 % (cyantranilitrol 100 g/l) and Voliam Targo 0.08% (abamectin 18 g/l + chlorantraniliprol 45 g/l), applied successively.

Figure 3. The aspect of tomato crop on 22.07.2020

In the first cycle of crop, the number of captured adults varied between 52 and 508 (fig. 4). The degree of attack on leaves ranged from 0.3% to 14.3%, and the frequency of attack on fruits from 2.3% to 4.3% (table 1).

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

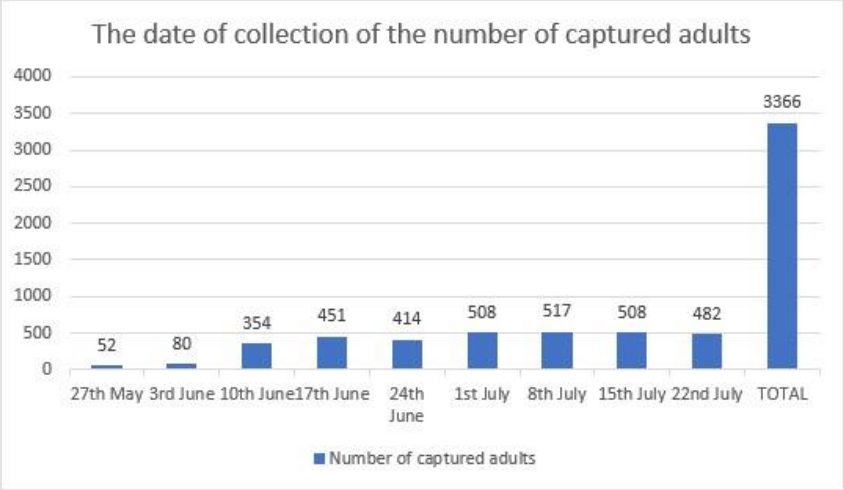

Figure 4. Dynamics of captured adults on the pheromone plate (cycle I)

Table 1

The appearance and evolution of the pest attack T. absoluta on the tomato crop in the high plastic tunnel (cycle I, 2020)

Climatic factors / Pest	The date of attack		Degree of attack (%) and the frequency of the attacked fruits (%)								
			April	May			June			July	
			III	I	II	III	I	II	III	I	II
Tuta absoluta	6.05	DA treated (%)	0	0	0.3	0.5	1.1	1.9	3.2	8.2	14.3
		DA untreated (%)	0	0	7.8	15.3	19.3	26.6	39.4	43.1	55.4
		FA treated (%)	0	0	0	0	0	0	0	2.3	4.3
		FA untreated (%)	0	0	0	0	0	0.9	3.5	7.9	12.8
Minimum T. (ºC)	-	-	10.9	12.4	14.5	10.4	12.2	16.8	16.3	17.9	15.5
Average T. (ºC)	-	-	18.8	23.3	26.1	20.2	23.5	24.9	27.9	29.7	27.0
Maximum T. (ºC)	-	-	29.2	36.3	39.4	34.5	37.2	37.8	40.6	41.7	39.6
Minimum U.R. (%)	-	-	22.7	23.3	25.2	31.8	30.4	42.1	30.2	25.8	24.8
Average U.R. (%)	-	-	50.7	52.1	54.6	66.1	64.3	74.8	62.7	55.9	54.8
Maximum U.R. (%)	-	-	82.3	83.4	86.2	93.1	96.7	96.7	93.9	89.9	88.3

The second cycle was established in the third decade of July, on July 23rd. In this cycle, the plates with pheromone were changed on 29.07, 05.08, 12.08, 19.08, 02.09, 09.09, 16.09, 23.09 (fig. 5).

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Ten treatments were applied, at intervals of 7 days, with the products Alverde 0.1%, Affirm 0.15%, Benevia 0.0125%, Laser 240 SC 0.05%, Coragen 0.0175%, Benevia 0, 0125%, Laser 240 SC 0.05%, Coragen 0.0175%, Alverde 0.1% and Voliam Targo 0.08%, in succession.

Figure 5. Plates with captured adults

29.07.2020 ***09.09.2020***

The number of captured adults in the second cycle of crop varied between 129 and 609 (fig. 6). Climatic factors have influenced the evolution of the pest attack. It is observed the decrease of the population density, towards the end of the growing period, with the decrease of the temperature. The degree of attack recorded at the end of the crop cycle was 19.3%, compared to untreated control where it was 78.4% (table 2). The attack level of the crop at the end of the experiment is shown in fig. 7.

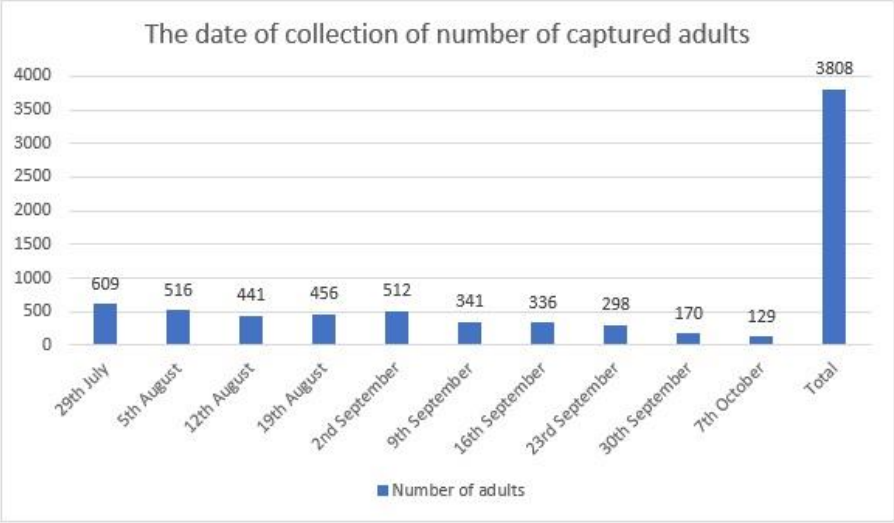

Figure 6. Dynamics of captured adults on the pheromone plate (cycle II)

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Table 2

The appearance and evolution of the pest attack T. absoluta on the tomato crop in the high plastic tunnel (cycle II, 2020)

Climatic factors / Pest	The date of attack	Degree of attack (%) and the frequency of the attacked fruits (%)							
			July	August			September			October
			III	I	II	III	I	II	III	I
Tuta absoluta	29.07	DA treated (%)	0.9	2.8	4.5	8.2	9.4	11.5	15.8	19.3
		DA untreated (%)	4.2	14.0	17.5	22.2	37.4	42.5	55.6	78.4
		FA treated (%)	0	0	0.2	1.5	2.2	3.6	4.4	5.4
		FA untreated (%)	0	1.2	3.3	4.6	6.2	8.1	13.2	18.3
Minimum T. (ºC)	-	-	18.1	17.6	16.7	16.7	16.0	13.7	12.4	13.3
Average T. (ºC)	-	-	29.6	29.9	26.9	28.7	26.7	24.2	21.3	20.1
Maximum T. (ºC)	-	-	43.0	42.2	40.5	43.4	40.8	38.5	33.8	30.5
Minimum U.R. (%)	-	-	24.6	18.6	24.5	17.5	24.7	20.8	32.4	44.6
Average U.R. (%)	-	-	58.7	44.4	57.6	52.7	57.5	51.7	62.5	74.5
Maximum U.R. (%)	-	-	91.9	77.8	87.5	89.4	87.8	85.1	89.2	93.9

Figure 7. The level of attack on the crop at the end of the experience

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Table 3

Yield obtained in the 2 crop cycles (2020)

Variant	Yield					
	kg/m^2		Difference from untreated control (kg/m^2)		% to the untreated control	
	Cycle I	Cycle II	Cycle I	Cycle II	Cycle I	Cycle II
V1. Treated*)	6.950	6.050	+0.57	+0.94	108.9	118.4
V2. Untreated control	6.380	5.110	-	-	100.0	100.0

*) succession of treatments

In the first cycle of crop, the yield obtained (6.950 kg/m^2) was higher due to the less favorable conditions for the appearance and evolution of the pest attack. In this cycle, the difference in yield compared to the untreated control (6.380 kg/m^2) was + 0.57 kg/m^2 (table 3).
More adults (3808) were caught in the second cycle of crop than in the first cycle (3366), which means that the pest attack was stronger in this cycle, reaching a degree of attack of 78.4% compared to 55.4% in the first cycle, at the untreated control variant. At the same time, a lower yield was obtained (6.380 kg/m^2) compared to the untreated control (5.110 kg/m^2).

4. CONCLUSIONS

- Pest monitoring for tomato crops in high plastic tunnels was performed using Delta pheromone traps, placed in both crop cycles. In order to control the pest, in both crop cycles, treatments were applied, in succession, with products based on chlorantraniliprol, metaflumizone, emamectin benzoate, cyantranilitrol, spinosad and abamectin + chlorantraniliprol.
- In the first cycle, 3366 adults were captured, fewer than in the second cycle (3808).
- The degree of attack on the leaves reached in the first cycle at the variant with treatments at 14.3%, compared to the untreated control 55.4%, and the yield obtained was 6.950 kg/m^2.
- In the second cycle, the pest attack was stronger, the degree of attack at the treatment variant reached 19.3%, compared to the untreated control variant where it was 78.4%. The yield obtained in this cycle was lower, 6.380 kg/m^2.

5. ACKNOWLEDGEMENTS

Work carried out within the Sectorial Plan for Rural Research-Development ADER 2020, financed by MADR, Project 7.3.15. ”Establishing measures and means for integrated pest prevention and control Tuta absoluta, the mining moth in tomato crops in protected areas” (contract nr. 7.3.15/16.09.2019).

6. REFERENCES

Biondi, A., Guedes, R.N.C., Wan, F-H., Desneux, N. (2016). Ecology, Worldwide Spread and Management of the Invasive South American Tomato Pinworm, *Tuta absoluta*: Past, Present and Future. *Annual Review of Entomology*, *63*, 239–58.

Braham, M., Hajji, L. (2012). Management of *Tuta absoluta* (Lepidoptera, Gelechiidae) with Insecticides on Tomatoes. *Insecticides - Pest Engineering*, ISBN: 978-953-307895-3.

Cocco, A., Deliperi, S., Delrio, G. (2012). Control of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in greenhousetomato crops using the mating disruption technique. *J. Appl. Entomol.*, doi: 10.1111/j.1439-0418.2012.01735.x.

*Corresponding author, E-mail address: hogea.simona@yahoo.com

Current Trends in Natural Sciences
Vol. 10, Issue 20, pp. 85-92, 2021
https://doi.org/10.47068/ctns.2021.v10i20.012
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Damme, V.V., Berkvens, N., Moerkens, R. et al (2015). Overwintering potential of the invasive leafminer *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) as a pest in greenhouse tomato production in Western Europe. *J. Pest. Sci.* 88:533–541.

Desneux, N., Wajnberg, E., Wyckhuys, K.A.G., Burgio, G., Arpaia, S., Narvaez-Vasquez, C.A., Gonzalez-Cabrera, J., Ruescas D.C., Tabone, E., Frandon, J., Pizzol, J., Poncet, C., Cabello, T., Urbaneja, A. (2010). Biological invasions of European tomato crops by *Tuta absoluta:* ecology, geographic expansion and prospects for biological control. *J. Pest. Sci. 83*, 197-215.

Han, P., Bayram, Y., Shaltiel-Harpaz, L., Sohrabi, F., Saji, A., Esenali, U.T., Jalilov, A., Ali, A., Shashank, P.R., Ismoilov, K., Lu, Z., Wang, S., Zhang, G., Wan, F., Biondi, A., Desneux, N. (2018). *Tuta absoluta* continues to disperse in Asia: damage, ongoing management and future challenges. *Journal of Pest Science* https://doi.org/10.1007/s10340-018-1062-1.

Hogea, S. (2020). *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) – biology, ecology, prevention and control measures and means in greenhouse tomato crops. A review. *Current Trends in Natural Sciences*, Vol. 9, Issue 17, pp. 222-231.

Hogea, S., Costache, M. (2020). Aspects regarding monitoring of the pest *Tuta absoluta* (tomato leafminer) on tomato crops under high plastic tunnels and efficacy of some insecticides tested for its control. *Romanian Journal of Horticulture* Vol. 1, 25 – 30, DOI 10.51258/RJH.2020.03.

Ismoilov, K., Wang, M., Jalilov, A., Zhang, X., Lu, Z., Saidov, A., Sun, X., Han, P. (2020). First report using a native lacewing species to control *Tuta absoluta:* from laboratory trials to field assessment. *Insects*, *11*, 286, doi:10.3390/insects11050286.

Tropea, G.G., Siscaro, G., Biondi, A., Zappalà, L. (2012). *Tuta absoluta*, a South American pest of tomato now in the EPPO region: Biology, distribution and damage. *EPPO Bulletin*. 42, 205-210.

*Corresponding author, E-mail address: hogea.simona@yahoo.com