LASIOPTERA TOMATICOLA (Yukawa et Harris) (*DIPTERA: CECIDOMYIIDAE*) A NEW PEST IN TOMATO AND CUCUMBER CROP FROM SOUTH WESTERN PART OF ROMANIA

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Abstract. *The purpose of this work is to report the presence of the new pest, Lasioptera tomaticola (Yukawa et Harris) in tomato and cucumber crops from the southwest and western part of Romania. In the last three years (2020-2022) the tomato and cucumber crops from Dolj and Timiș counties were invaded by the new pest, known as Lasioptera tomaticola (Mediterranean tomato gall midge), classified in Class Insecta, Order Diptera, Family Cecidomyiidae, Subfamily Cecidomyiinae, Supertribe: Lasiopteridae, Tribe: Lasiopterini, Genus: Lasioptera. The origin of the species is uncertain, but the studies carried out for dating were frame it to the Palearctic ecozone as place of origin. So far, the species has been reported on two continents: Asia and Europe (Japan, Turkey, Greece and Romania). The species was reported for the first time in 2001, in Greece. In Romania, the first signs of the attack, produced by the Mediterranean tomato gall midge, were observed in 2011 by Mirela Cean. Lasioptera tomaticola (Mediterranean tomato gall midge) attacks plants belonging to the family Solanaceae (such as Solanum lycopersicum) and Cucurbitaceae (Cucumis sativus). Observations carried out on the territory of Romania, during three years (2020-2022), highlighted the presence of the species on tomato and cucumber plants in greenhouses. Damage caused by Lasioptera tomaticola (Mediterranean tomato gall midge) determinates quality damage and yield losses. The attack produced by Lasioptera tomaticola is manifesting by the appearance of necrosis on the stem, shoots, petiole, peduncle (at the point of insertion of the fruit) and on the fruit (under the receptacle). Attacked plants are stagnating in growth, later are wilting and drying out. The stems break. We believe that it is necessary to study this species in Romania, to establish its distribution, biology, ecology, host plants, the damage produced as well as to investigate control methods.*

Keywords*:* ***Lasioptera tomaticola, Mediterranean tomato gall midge, pest, tomato, cucumber****.*

INTRODUCTION

Cucumis sativus L. *(Cucurbitaceae)* alongside with *Lycopersicon esculentum* Mill. *(Solanceae)* are some of the most important vegetables, being cultivated in several countries, including Romania. Tomato cultivation in Romania occupies approximately 39.5 thousand hectares (2020), while cucumber cultivation occupies only 12.9 thousand hectares (I.N.S., 2021). Romania's tomato and cucumber production was 712.2 thousand tons and respectively 188.3 thousand tons in 2020 according to the data from the National Institute of Statistics (I.N.S., 2021). The production of these vegetables is limited by the existence of pathogens and harmful species (CĂRĂBEȚ et al., 2008). The main pests that diminish the tomato production, grown greenhouses or in open field, in Romania are*: Gryllotalpa gryllotalpa, Tetranychus urticae, Polyphagotarsonemus latus, Macrosiphon euphorbiae sin. Aphis solani, Myzus persicae, Helicoverpa armigera, Tuta absoluta, Liriomyza trifolii, Trialeurodes vaporariorum, Thrips tabaci, Frankliniella occidentalis, Agriotes spp., Meloidogyne sp., Nezara viridula, Delia platura* and *Lasioptera sp.* (GROZEA, 2006).

Lasioptera sp. (Diptera: Cecidomyiidae) is the newest pest insect species that limit tomato production.

The family *Cecidomyiidae*, which includes *Lasioptera* sp., is one of the largest families of the order *Diptera* (GAGNÉ, 2004). This family includes 736 genera and 6,203 known species (GAGNÉ and JASCHHOF, 2014).

The genus *Lasioptera*, which is part of the subfamily *Cecidomyiinae*, contains about 130 species, most of them being present in Europe, Japan, Russia, India and in some areas from North America and Australia (GAGNÉ and JASCHHOF, 2014). Most species of this genus are forming stem galls on various plants, while others are forming galls on leaf veins, petiole, leaf blade, and flower peduncle. Several species of *Lasioptera* have also been reported as living in galls formed previously by other species (YUKAWA and HAITSUKA, 1994; GAGNÉ and JASCHHOF, 2014).

In the spring of 2001 (Table 1), in the area of Trifylia from Western Peloponnese area, (southern Greece), the first damage to greenhouse cucumbers was recorded, attributed to the attack of the larvae of an unidentified gall midge species from the genus *Lasioptera*, family *Cecidomyiidae* (*Diptera*) (PERDIKIS et al., 2011).

In the following years, both in autumn and spring, similar damage was recorded in tomato and cucumber crops in greenhouses near Athens. In 2010 in the northern Japanese island of Hokkaido, an unidentified necrosis was reported on the stems of tomato plants in one farmer's greenhouses, and in 2012 in other farmers' greenhouses, the stem and fruit damage of tomatoes caused by the attack of a gall midge from the same genus *Lasioptera* was reported (HASHIMOTO et al. 2018), popularly called the Japanese tomato gall gall midge. In 2012, in the Mersin district from Turkey, similar stems and fruits damage in tomato injured the crop from greenhouses (BÜYÜKÖZTÜRK et al., 2016).

The species reported by the authors listed in Table 1 was identified after the date of their report. The species was identified by a group of researchers led by Yukawa, as a result of genetic analyses of a number of *Lasioptera* insects from Greece, Romania, Turkey and Japan (YUKAWA et al., 2020). They described two new species belonging to the genus *Lasioptera* (Diptera: C*ecidomyiidae)*, respectively *Lasioptera tomaticola* (Yukawa and Harris) infesting tomatoes in the Mediterranean region and *Lasioptera yoichiensis* (Yukawa and Kim) infesting tomatoes in Japan.

Table 1

Reporting chronology of *Lasioptera tomaticola*

Species	Country	Year of report	Crop	Source
Lasioptera tomaticola	Greece	2001	*Cucumis sativus L.*	Perdikis et al., 2011
	Japan	2010	*Lycopersicon esculentum* Mill.	Hashimoto et al. 2018
	Romania	2011	*Lycopersicon esculentum* Mill. *Cucumis sativus L.*	Cean Mirela (report)
	Turkey	2012	*Lycopersicon esculentum* Mill.	Büyüköztürk et al., 2016

From the material genetically analysed by YUKAWA et al in 2020, 8 haplotypes were identified, from which 3 haplotypes in Turkey (2 in south and 1 in west), 3 haplotypes in Greece, 1 haplotype in Romania and 1 in Japan. Shall be mentioned that the haplotype discovered in Romania is identical as the one from western Turkey. The haplotypes from southern Turkey differed genetically compared to the haplotypes discovered in Romania and in western Turkey with a rate of 3.6 - 4.1 %. Genetic differences between the haplotypes from Greece were very small (0.2 - 0.3 %). These doesn’t coincide with those from Turkey and from

Romania (YUKAWA et al., 2020). However, YUKAWA et al. (2020) mentions that the existence of six haplotypes in the *Lasioptera tomaticola* populations, this indicates that the pest was present in the Mediterranean Region by a considerable period of time before the infestations were observed.

Currently the species *Lasioptera tomaticola* is spread over the continents: Asia and Europe (Figure 1). In Europe it is present in: Greece, Turkey and Romania (Figure 2).

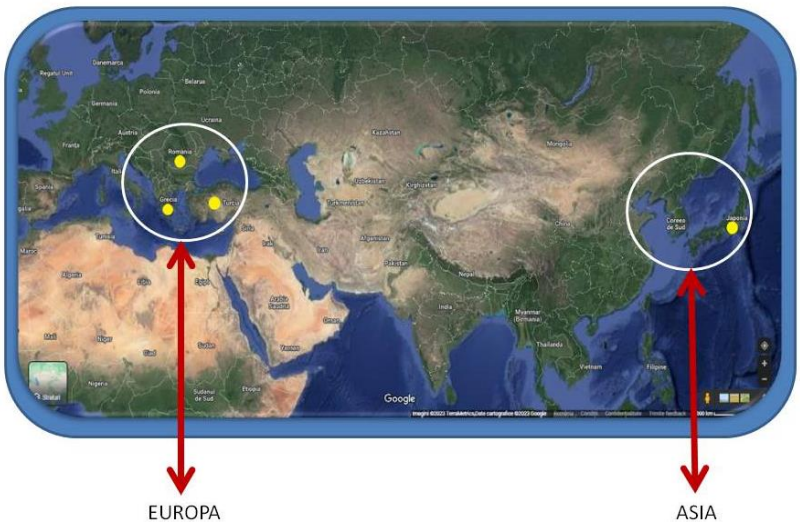

Figure 1. Distribution of *Lasioptera tomaticola* on continents (map source: https://www.google.com/maps/@35.0643724,73.0089906,3z/, highlighting of the distribution was performed by ȘTEF R. and COTUNA O. according with the bibliographic information)

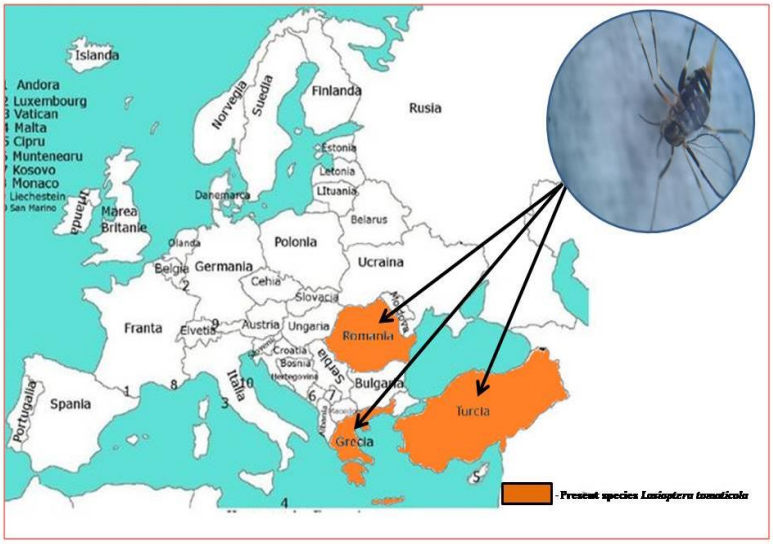

Figure 2. Distribution of *Lasioptera tomaticola* in Europe (map source: http://www.profudegeogra.eu/harta-muta-europei/, highlighting of the distribution was performed by ȘTEF R. and COTUNA O. according with the bibliographic information)

The aim of the present study is to report the *Lasioptera tomaticola* species in tomato and cucumber crops, from greenhouses, in the south and south-west of Romania.

MATERIAL AND METHODS

The presence of the species *Lasioptera tomaticola* in the southern and southwestern part of Romania was established by direct observations (in greenhouses from Timiș county) and indirectly (by receiving samples). The study was carried out during the period (2020-2022). For the identification of Mediterranean tomato gall midge present in tomato and cucumber crops, there were harvested plants from greenhouses from the South-West part of Romania, which were later transported to specialized laboratories. The analysis and identification of the species was carried out in the laboratory of Phytosanitary Protection and Expertise from University of Life Sciences "King Michael I" from Timișoara and in the Laboratory of Plant Protection from Agriculture Research and Development Station Lovrin. The larvae were observed and subjected to microscopic study by sectioning the tomato and cucumber stems (Figure 3). For more accurate identification, pupae were extracted from tomato stems, later they were placed in growth chambers to obtain adults. Along with the macroscopic and microscopic observations made, the bibliographic method was also used, by studying various publications related with this topic (ȘTEF et al., 2021; ȘTEF et al.,2021).

The data regarding the presence and attack frequency of the species *Lasioptera tomaticola* were collected in September from Biled locality area (Timiș County). The investigated tomato plants were 130-180 cm tall. 20 plants were observed to determine attack frequency. The attacked plants were harvested and transported to the laboratory for a complete study of the mode of damage.

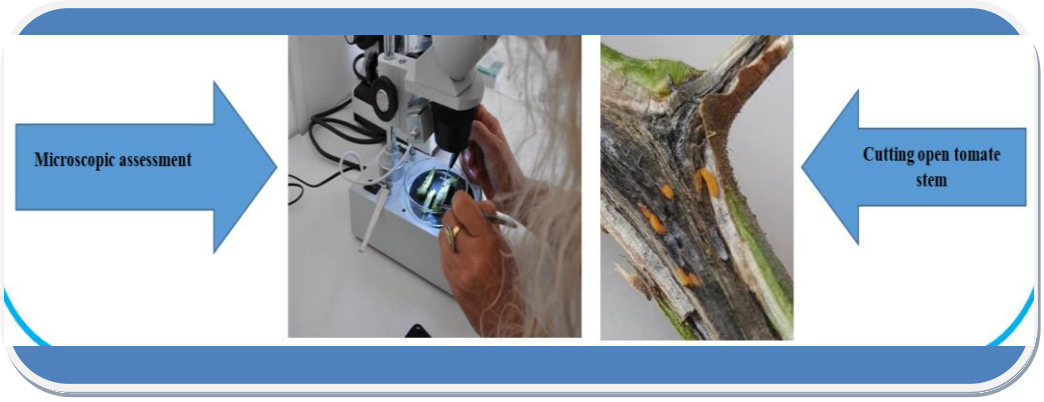

Figure 3. Microscopic assessment and sampling (Source: original by COTUNA O. and ȘTEF R.)

RESULTS AND DISCUSSIONS

In Romania, the first attacks, later attributed to the species *Lasioptera tomaticola*, were observed in Dâmbovița County in 2011 and 2013 by M. Cean (National Phytosanitary Authority) and M. Nicolae. In 2019, based on the genetic analysis of several *Lasioptera* insects from Greece, Romania, Turkey and Japan, a group of researchers coordinated by Yukawa (YUKAWA et al., 2020) described two new species belonging to the *Lasioptera* genus (*Cecidomyiidae*), respectively *Lasioptera tomaticola* (Yukawa and Harris) that infests tomatoes in the Mediterranean region and *Lasioptera yoichiensis* (Yukawa and Kim) that infests tomatoes in Japan. The next report was made by COTUNA OTILIA (2020) by identifying the

species in the samples (tomatoes and cucumbers) sent by the agronomist Dragu Robert Cosmin from Dolj county, locality Șimnicu de Sus. In 2021 and 2022, the team of this study identified the presence of the pest in greenhouses from Biled locality (Timiș county).

Currently we can assume that Mediterranean tomato gall midge is present in Romania in three counties: Dâmbovița, Dolj and Timiș (Figure 4).

Figure 4. Distribution of the species *Lasioptera tomaticola* in Romania (map source: http://www.hartaromanieionline.ro/harta-judete/, highlighting of the distribution was performed by ȘTEF R. and COTUNA O. according with the bibliographic information)

Brief description of the species *Lasioptera tomaticola*

The adult is black (Figure 5), male has wing length of 1.8-2.6 mm and females 2.0-2.7 mm (HASHIMOTO et al., 2018), with scales. The number of antennal segments of males is 13-14, and of females 15-17 (YUKAWA et al. 2020).

The egg is transparent white, 0.5 mm in size and elliptical in shape (NURDAN and UTKU, 2016). They are deposited in the wounds of the tomatoes and cucumbers stems and shoots that appeared as a result of maintenance works (pruning or defoliation).

The larva (Figure 6) is apodous, yellow, in the first larval stages. The mature larva is orange in colour. The size of *Lasioptera tomaticola* larvae is 3 mm (ANONIMOUS, 2013, BÜYÜKÖZTÜRK et. al., 2013; BÜYÜKÖZTÜRK et. al., 2016, NURDAN and UTKU, 2016). It presents 3 larval stages. The larvae are developing inside the stems of tomatoes and cucumbers, but also in the tomato fruits under the receptacle (BEK DILAN, 2018). The larvae of the first age are gregarious, starting from the second age they move inside the plant.

Groups of 5-6 larvae were the most frequently encountered.

Pupal stage occurs in a gallery that the larvae is drilling into the tissues of the plant. The pupa initially has the colour of the mature larva, respectively orange, then turns black (BÜYÜKÖZTÜRK et. al., 2016).

Figure 5. Adult of *Lasioptera tomaticola* (Source: original photo by COTUNA O., 2021).

Figure 6. Larva of *Lasioptera tomaticola* (Source: original photo by COTUNA O., 2021).

Host plants and damage

The damage produced by *Lasioptera tomaticola* (Mediterranean tomato gall midge) is manifested by quality deterioration and decreased production. The attack produced by

Lasioptera tomaticola first has a necrosis appearance on the stem, shoots, petiole, peduncle (at the insertion point of the fruit) and on the fruit (under the receptacle) (Figure 7). The attack of *Lasioptera tomaticola* can easily be confused with the attack produced by fungal pathogens (COTUNA O., 2021). Attacked plants stagnate in growth, later is induced wilting followed by the stem breakage.

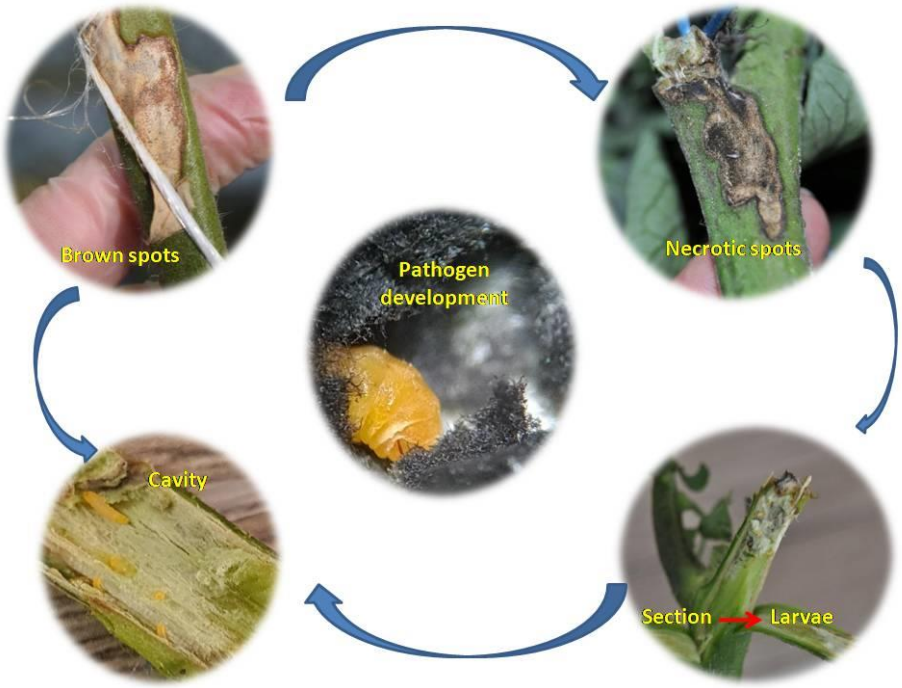

Figure 7. Attack mode of *Lasioptera tomaticola* on tomato (Source: original photo by COTUNA O., 2021).

Lasioptera tomaticola is a vector for the fungal symbionts. At the time of laying the eggs, the female also introduces the spores of some fungi into the wounds of the host plants. In literature, the existence of some trophic relationships between the insects from the *Cecidomyiidae* family, fungi and the host plant are emphasized. All species of the genus *Lasioptera*, *L. tomaticola* belonging too, present organs adapted for the transport of fungal conidia called mycangia, on the post-abdomen and the ovipositor of the adult female. Females collect the spores of the symbiotic fungus and are depositing them with the eggs in the host plant.

Lasioptera tomaticola attacks tomato (*Solanaceae*) and cucumber (*Cucurbitaceae*) plants (Table 2). 130 species of *Lasioptera* are inventoried worldwide. The host plants are also recorded for 109 species. 88 (81.7%) from all of them have a single host/plant, 12 (11.0%) have hosts from a single genus, 4 (3.7%) have hosts from a plant family and 4.6% are oligophagous or polyphagous, having species from different families as host plants. In this context, the existence of species associated with more than one plant family cannot be ignored (YUKAWA et al., 2014; GAGNE et JASCHHOF, 2017).

In the year 2021, in the greenhouse from Biled (Timiș County) there was a 70% attack rate of *Lasioptera tomaticola* on tomato plants (Table 3), and the average number of larvae counted/sample was 4.55.

Table 2

Host plants of the *Lasioptera tomaticola* species identified in Romania

Species	Author	Year	Host	Botanical family
Lasioptera tomaticola	Mirela Cean and M. Nicolae	2011, 2013	*Lycopersicum esculentum*	*Solanaceae*
	Cotuna Otilia	2020	*Lycopersicum esculentum*	*Solanaceae*
	Cotuna Otilia	2020	*Cucumis sativus*	*Cucurbitaceae*
	Cotuna Vlad et al.	2021	*Lycopersicum esculentum*	*Solanaceae*
	Cotuna Vlad et al.	2022	*Lycopersicum esculentum*	*Solanaceae*

Table 3

Lasioptera tomaticola aggressiveness of the attack

Location	Observed samples	Attack signalling	Average larvae/sample
Biled (Timiș)	P1	**	0
	P2	***	7
	P3	***	6
	P4	***	6
	P5	**	0
	P6	***	8
	P7	***	8
	P8	***	5
	P9	**	0
	P10	**	0
	P11	**	0
	P12	**	0
	P13	***	4
	P14	***	5
	P15	***	5
	P16	***	10
	P17	***	12
	P18	***	5
	P19	***	5
	P20	***	5
AVERAGE		F% = 70 %	4,55

Note: **no presence; ***present –Lasioptera tomaticola

CONCLUSIONS

The bibliographic study and the observations performed highlights the fact that the species *Lasioptera tomaticola* is spreading on the territory of Romania.

The impact of this pest due to the stagnation of the plant growth (with consequences on the considerable diminishing of the number and size of fruits per plant) and the chromatic and qualitative damage of the fruits, leads to a decrease in the valorisation of the products and of the income of farmers. The information from this reporting document confirms the need for further studies on this pest.

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