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Possible Development of *Tuta absoluta* (Meyrick) on Different Host Plants in the Republic of Srpska (Bosnia and Herzegovina)

Zorica Đurić[1], Snježana Hrnčić[2],
Siniša Mitrić[1], Petar Nikolić[1]

[1]*Faculty of Agriculture, University of Banja Luka, Republic of Srpska, BiH*
[2]*Biotechnical Faculty, University of Montenegro, Montenegro*

Abstract

Tomato leaf miner – *Tuta absoluta* Meyrick (Lepidoptera, Gelechiidae) is a serious pest of tomato. A study on possible grown host plants of *T. absoluta* was conducted during 2015 and 2016 in a greenhouse in the area of Banja Luka (Republic of Srpska, Bosnia and Herzegovina - BiH). As host plants the following were used: *Solanum lycopersicum* – tomato, *Solanum tuberosum* – potato, *Solanum melongena* – eggplant and *Phaseolus vulgaris* – green bean. The plants were placed into entomological cages and exposed to infestation of 10 adults of *Tuta absoluta*. Feeding damages by all larval instars and the number of developed generations per year at different host plants were observed under greenhouse conditions. The study showed that tomato is a preferable host plant. This paper is the first record of green bean as an incompatible host plant for *T. absoluta* in BiH.

Key words: tomato leaf miner, Banja Luka, host plant, life cycle

Introduction

Tomato leaf miner – *Tuta absoluta* (Meyrick, 1917) (Lepidoptera, Gelechiidae) is a very destructive insect pest with strong preferences for tomato plants, stems and fruit both in a greenhouse and in an open field crop (Desneux et al., 2010). It is also reported to attack potato (*Solanum tuberosum* L.), eggplant (*Solanum melongena* L.), pepper (*Capsicum annum* L.), some weeds *(Datura stramonium* L., *Nicotiana glauca* G.) (Korycinska & Moran, 2009) and some non-solenaeous crop plants like green beans (*Phaseolus vulgaris* L.) (EPPO, 2009) or *Malva* spp. (Tropea-Garzia et al., 2012). Tomato leaf miner is native to South America and its first record was from Peru in 1917 when it was described as *Phthorimaea absoluta* (Meyrick, 1917) (Desneux et al., 2010). In 2006, it was for the first time detected in Europe, in Spain (EPPO, 2008). Since then, *T. absoluta* has spread rapidly to the European and the North African Mediterranean Basin countries where it has become a major threat to tomato production (Desneux et al., 2011).

Shortly afterwards, it has spread to other countries including Albania, Algeria, Bahrain, Bulgaria, Cyprus, Denmark, Egypt, France, Germany, Greece, Hungary, Israel, Iraq, Italy, Jordan, Kuwait, Libya, Lithuania, Malta, Morocco, Netherlands, Portugal, Romania, Russia (Krasnodar area), Saudi Arabia, Switzerland, Syria, Tunisia, Turkey, and United Kingdom (Buhl et al., 2010; Desneux et al., 2010; Erler et al., 2010; Kilic¸ 2010; Ostrauskas & Ivinskis, 2010; Seplyarsky et al. 2010; Izhevsky et al. 2011).

The expansion has continued in central and north Europe and according to Tonnang et al. (2015) model predictions suggest that *T. absoluta* represents an important threat to Africa, Asia, Australia, Northern Europe, New Zealand, Russian Federation and the United States of America. Besides, *T. absoluta* has been recorded in countries bordering Bosnia and Herzegovina (BiH): in Slovenia (Knapič & Marolt, 2009, cited Ostrauskas & Ivinskis, 2010), Croatia (Gotlin Čuljak et al., 2010), Serbia (Toševski et al., 2011) and Montenegro (Hrnčić & Radonjić, 2011). In Bosnia and Herzegovina, the Republic of Srpska, the presence of *T. absoluta* was confirmed for the first time in 2010 in the area of Banja Luka (Đurić & Hrnčić, 2010).

This pest is of great economic importance and can decrease fruit quality and causes 50 to 100% yield losses (EPPO, 2005: Viggiani et al., 2009; Desneux et al., 2010). The species can overwinter in the egg, pupal, or adult stage (EPPO, 2005; Korycinska & Moran, 2009).

It has a rapid rate of reproduction and can overlap 12 generations per year depending on environmental conditions (Vargas, 1970, cit. Pereyra & Sanchez, 2006; EPPO, 2005), although 5 generations per year have been observed in Argentina (Korycinska & Moran, 2009) or seven to eight according to Vargas (1970, cit. Pereyra & Sanchez, 2006) in the Arica Valley in Chile.

Due to to the above, *T. absoluta* has been considered a serious pest for the entire Europe. Most of the life cycle studies are from South American countries which are incompatible to Europe in terms of climate conditions and natural diversity of flora and fauna. Since there is not enough data on its host plant and life cycle in BiH, a detailed study has been conducted in the Republic of Srpska (BiH).

Materials and Methods

A study to determine the possible host plants of *T. absoluta* was conducted during 2015 and 2016 in a greenhouse in Banja Luka (BiH). During 2015 we managed to establish stable and high numbered population of *T. absoluta* in entomological cadges. Feeding damages by all larval instars on different host plants were observed in 2015 and 2016, under greenhouse conditions. The following cultivated plants were used as host plants: *Solanum lycopersicum* - tomato, *Solanum tuberosum*- potato, *Solanum melongena* - eggplant and *Phaseolus vulgaris* - green bean. The plants were grown in pots (diameter 20 cm) being watered, fertilized and to which pesticides were applied as needed. There was not additional heating or cooling of the greenhouse.

Daily air temperature was measured using a thermometer. For the purpose of overwintering we put four pots of each host plant into entomological cages (insect tent) (Fig. 1) and exposed plants to the infestation level of 10 adults of *T. absoluta*.

In 2016, the number of developed generations was observed in entomological cages at different host plants. Newly emerged adults were collected using mouth aspirator and moved to another cage on new uninfested host plants, the same or other ones. Adults were fed with a sugar solution.

Results and Discussion

This is first study on host plants and the development of *T. absoluta* in BiH. This pest causes damage throughout an entire tomato plant including leaves, apical buds, stems, flowers and fruit and those damages are confirmed by many authors (Deseneux et al., 2010, USDA, 2011, Balzan & Moonen, 2012).

Larval activity resulted forming irregular mines as big as larval instars usually becoming necrotic (Fig. 2).

Fig. 1. Insect tent in greenhouse
Ентомолошки кавез у пластенику

Fig. 2. *T. absoluta* mines on eggplant
Мине T. absoluta на патлицану

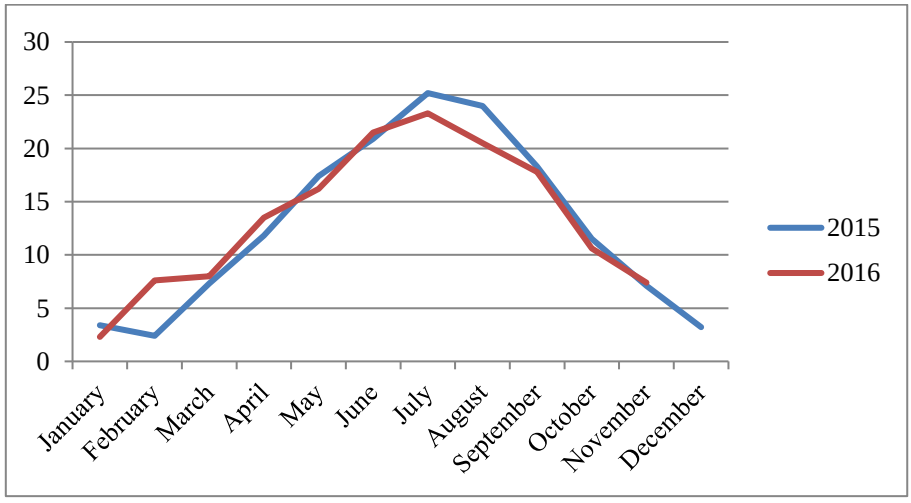
On stem and fruit, *T. absoluta* caused galleries which may be filled with black frass. Often fruit galleries became entry ways for secondary pathogens (Fig. 3). However, in our experiment on potato and eggplant as host plant *T. absoluta* caused damages only on leaves. Since there were no damages on stems or fruit, it implicates those host plants are less attractive for this pest than tomato, which is in accordance with many authors (Deseneux et al., 2010; Salama et al., 2015).

Fig. 3. *T. absoluta* galleries with secondary pathogens on tomato fruit
Ходници T. absoluta и секундарни патогени на плоду парадајза

Fig. 4. Dead larvae of *T. absoluta* on bean
Угинуле ларве T. absoluta на пасуљу

Also, Unlu (2012) claimed that *T. absoluta* could cause economic damages on potato if there was absence of tomato as a host plant. However, in our experiment there were no results of establishing *T. absoluta* population or any larval activity on green bean, which is contrary to many authors (EPPO, 2009; Tropea-Garzia et al., 2012; Bayram et al., 2015). During this part of the experiment, all larva ended up dead without feeding at all, even after several attempts of importing the third or fourth larva instars directly on leaves (Fig. 4).

According to the observation, *T. absoluta* overwintered on every host plant, except on green bean. In both years adult flight began in first days of March. We found this data unusual for this climate and assumed it happened because of higher average temperature in February. In February 2015 average temperature was 2.4 ºC and 7.6 ºC in 2016 (Graph 1.)



Graph 1. Monthly average temperatures in 2015 and 2016
Средње мјесечне температуре у 2015. и 2016. години

First adults emerged from tomato plants on 1 March, than from potato plants on 6 March and from eggplant plants on 7 March 2016. After that, *T. absoluta* continued the development through all development stages on tomato and potato. In our experiment, six generations in tomato were recorded and those data are in correspondence with Allache et al. (2015). On the other hand, in Italy, *T. absoluta* can reach up to nine generations per year, while in Spain it has been estimated that the pest could develop through up to 13 generations (Tropea-Garzia *et al*., 2012).

T. absoluta in our experiment developed through five generations in potato. Also, the pest maintained life cycle without changes during the transfer of newly emerged adults from tomato to eggplant or otherwise. In addition, we recorded all development stages in eggplant, but the pest could not estimate constant development generation by generation. According to this result we can assume that eggplant can make use of an alternative host plant, but after completed generations there is need for some preferable host plant.

Conclusion

T. absoluta is the pest that makes feeding damages in all larval instars on tomato, potato and eggplant. On tomato, damages are present through the entire tomato plant including leaves, apical buds, stems, flowers and fruit. Damages on potato and eggplant are mainly on leaves.

The study showed that tomato is a preferable host plant and the pest completed six generations in 2016. On potato, the pest developed through five generations in 2016 and we found potato as the secondary host plant. In our study eggplant tends to be an alternative host plant. This paper is the first record of green bean as an incompatible host plant for *T. absoluta* in Bosnia and Herzegovina.

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Могућност развића *Tuta absoluta* (Meyrick) на различитим биљкама домаћинима у Републици Српској (Босна и Херцеговина)

Зорица Ђурић[1], Сњежана Хрнчић[2],
Синиша Митрић[1], Петар Николић[1]

[1]*Пољопривредни факултет, Универзитет у Бањој Луци, Република Српска, БиХ*
[2]*Биотехнички факултет, Универзитет Црне Горе, Црна Гора*

Сажетак

Мољац парадајза - *Tuta absoluta* Meyrick (Lepidoptera, Gelechiidae) је значајна штеточина парадајза. Током 2015. и 2016. године у пластенику на подручју Бања Луке (Република Српка, Босна и Херцеговина) спроведено је истраживање о могућим гајеним биљкама домаћинима мољца парадајза. Испитивање је спроведено на сљедећим биљкама домаћинима: *Solanum lycopersicum* – парадајз, *Solanum tuberosum* – кромпир, *Solanum melongena* – патлицан и *Phaseolus vulgaris* – пасуљ. Биљке су смјештене у ентомолошке кавезе у које је унесено по 10 одраслих јединки мољца парадајза. У условима који владају у пластенику праћена су оштећења која узрокују различити ступњеви ларве мољца парадајза, као и број развијених генерација у току године на различитим биљкама домаћинима. Испитивањем је утврђено да је парадајз примарна биљка домаћин за мољца парадајза. Овим истраживањем по први пут су изнесени подаци да пасуљ није одговарајућа биљка домаћин за развиће мољца парадајза у БиХ.

Кључне ријечи: мољац парадајза, Бања Лука, биљка домаћин, циклус развоја

Zorica Đurić
E-mail address: zorica.djuric@agrofabl.org

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