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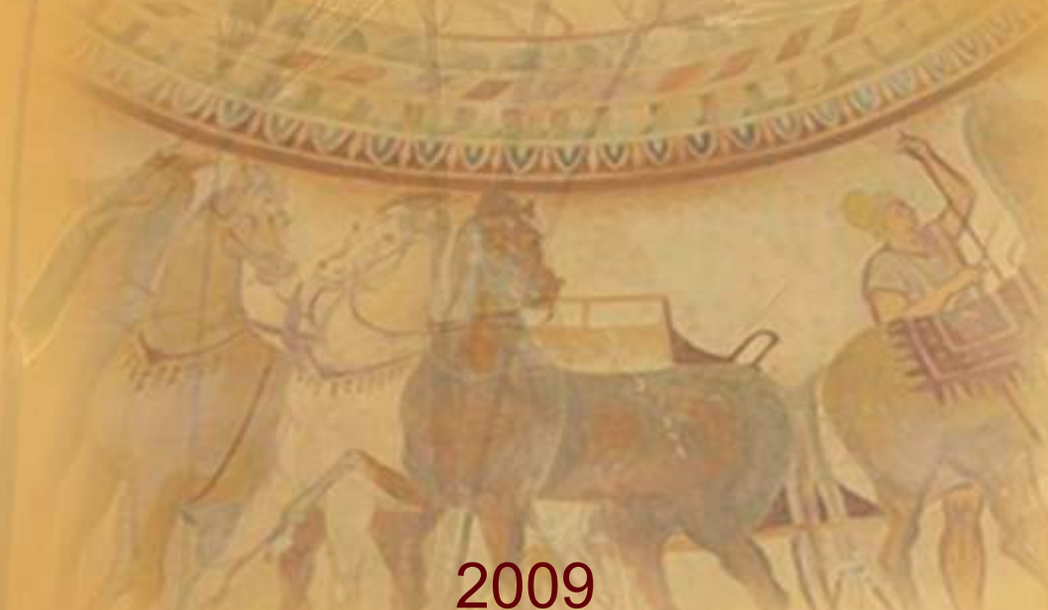

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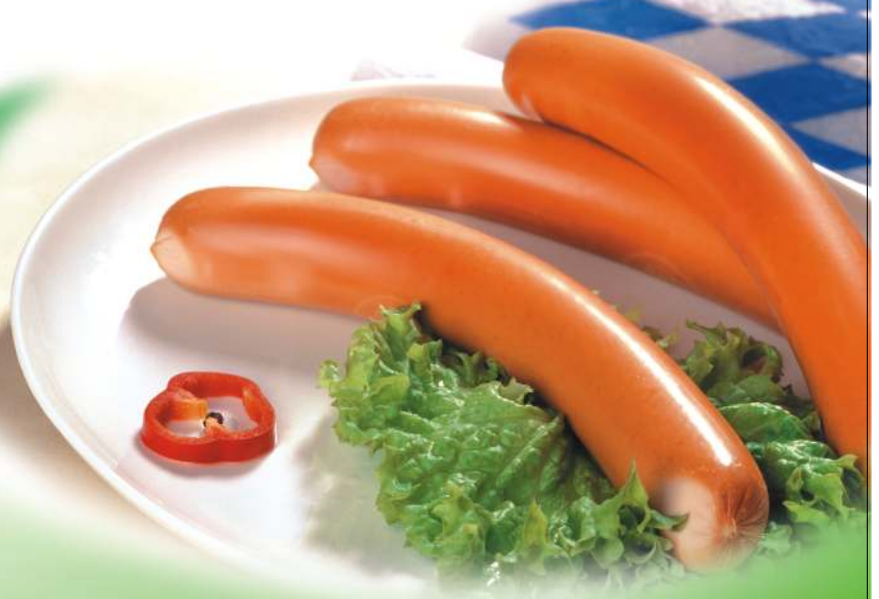

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Tomato leaf miner, T*uta absoluta* (Povolny) (Lepidoptera: gelechiidae) – first record in Bulgaria

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(Manuscript received 16 October 2009; accepted for publication 30 October 2009)

Abstract. *The tomato leaf miner Tuta absoluta (Povolny) is the most damaging pest of tomatoes in South America. In 2006 the pest was introduced by accident in Spain and since then it has invaded many countries in South Europe and the Mediterranean region. In 2009 there were official reports for new invasions from Greece, Switzerland, Malta, Portugal, Albania, France, Italy, Libya and countries from the Gulf region – Bahrain and Kuwait. In Bulgaria the National Service of Plant Protection (NSPP) undertook a national survey for the detection of the tomato leaf miner using pheromone traps. On 16 October 2009 an official statement was published on the website of NSPP for the presence of the tomato leaf miner in several glasshouses and in the field in South Bulgaria. At a glasshouse with tomatoes near Plovdiv we observed a severe infestation by the pest which has rapidly spread after the last treatment with pesticides at the end of August. The leaves were the most heavily damaged plant parts with an average of 9.42 and 8.75 mines per leaflet on the middle and upper layer of the canopy resp., followed by the fruits. No damage on the stems was observed. Description of the pest stages, behavior, monitoring, prevention and control of the pest are discussed.*

Keywords: Leaf miner, Tuta absoluta, tomato, glasshouse, damage, behavior

Introduction

Host plants

Tomato (Lycopersicon esculentum) is the main host plant of T. absoluta, which attacks its leaves, buds, stems and fruit. It also attacks other members of the Solanaceae family like potato (Solanum tuberosum), eggplant (Solanum melongena), weeds (Datura stramonium, Lycium chilense, Solanum nigrum and Nicotiana glauca). Recently there was a report from the National Organization of Plant Protection of Italy to the Secretariat of EPPO that Tuta absoluta was found also on beans (Phaseolus vulgaris), in Sicily. It creates concerns about the possibility the pest to attack also artichoke.

Origin and geographical distribution.

The tomato leaf miner T. absoluta belongs to the family Gelechiidae (Lepidoptera). It is also known as South American tomato moth, tomato borer, South American tomato pinworm. The species originates from South America and was first mentioned in Argentina in 1964 (Garcia & Espul, 1982) where it was introduced from Chile. The species is common in Bolivia, Brazil, Colombia, Ecuador, Peru, Paraguay, Uruguay, Venezuella, but only in regions with altitudes less than 1000 m as low temperature is a limiting factor for its survival (Notz, 1992).

In 2004, when the tomato leaf miner Tuta absoluta (Povolny, 1994) was alien for Europe it was categorized by EPPO in A1 action list as no. 321 (OEPP/EPPO Bulletin, 2005) as recommended for regulation as quarantine pest. The first record in Europe is from the end of 2006 on tomatoes in the province Castellón (Comunidad Valenciana) in Spain (FERA, 2009). In less than three years the pest has been recorded in Portugal, Italy, France, Malta, Switzerland, Greece, Albania, as in some countries in the Mediterranean region - Algeria, Tunisia, Morocco, Libya. In Bahrain and Kuwait in July 2009 the presence of the pest has been confirmed in glasshouses. Both countries have been importing vegetables also from Spain and Morocco. In the UK, the Netherlands, Denmark and Russia the pest has been found in packing stations on tomatoes imported from Spain.

In 2009 the National Service of Plant Protection of Bulgaria has initiated a national survey for early detection of the tomato leaf miner in greenhouses, growing tomatoes and storages by application of pheromone traps. Quarantine inspectors from the Regional Service of Plant Protection in Plovdiv collected samples of damaged leaves and adult moths from a tomato growing glasshouse in the vicinity of Plovdiv and after identification, the Central lab of Plant Quarantine confirmed the identity of the pest as T. absoluta. The initial invasion most probably started from a storage house in the immediate vicinity of the glasshouse in which fruits and vegetables imported from Spain were stored. The pest invaded the glasshouse during the summer months but due to the behavior of the adults which are nocturnal insects and during the day are hiding under the leaves, it was not noticed until the damages on the leaves appeared. At the same time the Regional Service of Plant Protection has already circled an information about the pest to the producers of tomatoes. The pest was found also in the region of Rakovski, Pazardjik, and Sofia (NSPP, 2009).

The seriousness of the damage and the fact that the pest is new for Bulgaria provoked the decision to make initial observations on the morphology, behavior and damage, and to present the experience of other countries in its control.

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Material and methods

The observations were made in a glasshouse of 2,3 Ha of tomatoes, cv. Velocity in the vicinity of Plovdiv. The seeds were sown on 3-4 April, the transplanting was made from 24 May to 10 June, and the collecting of fruits – from 28 June to 20 October. The first mines on the leaves were observed in the beginning of August but were attributed to leaf-mining flies. After an inspection by a specialist from the regional Service of Plant Protection on 27 August and the identification of T. absoluta the plants were no longer sprayed with chemicals. The percentage of damaged leaves quickly increased. The leaves for our experiment were collected in the beginning of October. Samples of leaves were collected from the middle and upper layer of the canopy and placed separately in plastic bags for transportation to the lab. The mines on 60 leaflets were counted for each of the layers. Percentage of damaged fruits was calculated after checking for mines on 100 ripening fruit. Observations on the behavior of the larvae and adults were made during daytime. Leaves with mines were collected and taken in plastic bags to the lab for observations on the different stages. Adults were collected in glass tubes. At laboratory conditions the leaves were checked for the presence of eggs under stereomicroscope. Larvae of different instars, pupae and the adults were kept in a freezer for 30 min and after that were measured and observed under stereomicroscope.

Results and discussion

Description.

The egg is oval-cylindrical, usually laid on the lower side of the leaf (Figure 1), the buds and green fruit. It is creamy-white to yellow, long about 0.4 mm. The larva is creamy-white in the beginning (Figure 2) and after that becomes green or pinkish with dark brown head in later instars (Figure 3). The prothoracic shield has paler patches with variable markings. The pupa is greenish-brown at the beginning (Figure 4) and later becomes dark brown. The length is up to 6 mm. The adult moths are quite small, less than 7 mm in length. They are with grey to brown scales and black spots on anterior wings (Figure 5).

Biology and behavior.

According to Barrientos et al. (1998) the biological cycle is completed in 76.3 days at 14oC, 39.8 days at 19.7oC and 23.8 at 27.1oC. Under favorable conditions the pest could develop 8-12 generations per year. A female lays an average of 230- 260 eggs. Hatching begins 4-6 days after egg laying. The larva passes through 4 larval instars, usually for 12-15 days. It feeds mainly on tomatoes, damaging all the aerial parts of the plant. When food is available the species may develop without diapause. Pupation takes place in soil, on the leaves or in the mines. T. absoluta overwinters as egg, pupa or adult. There is no evidence that in South Europe the species may overwinter outside the glasshouse. The adults are nocturnal and during the day are hiding under the leaves. In cloudy days we observed mass copulation on the stems or the lower side of the leaves (Figure 6) and flight in short distances even when not disturbed. The larvae are actively moving from leaf to leaf, producing silk thread. When disturbed they quickly leave the mine and hide in the canopy.

Damage.

The damage is caused by the larva which makes broad blotch mines on the leaves (Figures 7, 8), and in the green and ripe fruits (Figures 9, 10). Damage on the stems, as reported by other authors, was not observed in the glasshouse we visited. The leaves from the lowest layer of the canopy were not damaged. Obviously this is due to the fact that the pest invaded the glasshouse later in the season when these leaves were already old. The leaves from the middle layer of the canopy were heavily damaged with an average of 9.42 mines per leaflet (Table. 1) with minimum of 1 and maximum of 33 mines. In few cases mines from leaf-mining flies were observed, but

Figure 1. Egg of *Tuta absoluta*

Figure 2. Larva 1st instar

Figure 3. Larva last instar

Figure 4. Pupa

Figure 5. Adult

Figure 6. Mating during the day

Figure 7. Damage on the middle leaves

Figure 8. Damage on the top leaves

Fig. 9. Damage on green fruit

Fig. 10. Damage on a ripe fruit

Table 1. Average number of mines on the leaflets from the different layers of the canopy of tomatoes cv. Velocity

Canopy layer	Number on mines per leaflet					
	n	min	max	mean	Std. error of mean	Std. dev.
Middle of the canopy	60	1	33	9.42	0.76	5.89
Top of the canopy	60	5	16	8.75	0.37	2.85

were not included in the total number. The leaves from the upper layer of the canopy were smaller in general and extremely heavily damaged. The average number of mines per leaflet was 8.75. Though the number of the mines was lower than on the leaflets from the middle layer of the canopy, these leaves were dying, with almost completely destroyed parenchyma.

A total of 4,3% of the fruits were damaged a week before the crop was destroyed. According to other authors both yield and fruit quality can be significantly reduced by the direct feeding of the pest and the secondary pathogens which may enter through the wounds made by the leaf miner (EPPO Bulletin, 2005). When feeding on potatoes it does not damage the tubers.

Conclusions

According to our observations the leaves were the most damaged plant parts, and though the average number of mines per leaflet was greater on the middle layer of the canopy, the effect on the leaves of the upper layer of the canopy was more detrimental.

Since the pest is new for Bulgaria, there are no officially registered pesticides for control and we shall give recommendations based on the experience of other countries. The pest can be carried by plants for planting and fruits of tomato. The pest is easily detected by the use of synthetic sex pheromones. IPM strategies are being developed in which prevention and biological control are of major importance. The preventive measures which are recommended usually include destroying the old plants and damaged parts, securing the ventilation opening with netting, creating a double door at the entrance, etc. Use of pheromone traps in the glasshouse helps the early detection and reduction of the population (Benvenga et al., 2007). Chemical control is not always effective partially due to the resistance problems or to the habits of the pest, living most of the time inside plant or soil. Resistance to pesticides has been reported to abamectin, cartap and permethrin (Siquera et al., 2000). Imidacloprid still could be used (Collavino & Gimenez, 2008). To spinosad and indoxicarb there is still no resistance. A lot of studies are being conducted on the efficacy of biocontrol agents like the egg parasitoids *Trichogramma pretiosum, T. nerudai* or braconid species (Marchiori et al., 2004; Tezze and Botto, 2004; Pratissoli et al., 2005; Faria et al., 2007). Predators like the predatory bugs *Podisus nigrispinus* (Torres et al., 2002; Vivan et al., 2002; Vivan et al., 2003), *Macrolophus caliginosus* and *Nesidiocoris tenuis* are recommended as quite effective. Good results are reported about the application of *Bacillus thuringiensis* or entomopathogenic fungi like *Metharhizium anisopliae* or *Beauveria bassiana* (Rodriguez et al., 2006). Larvae move in and out of the mines and galleries several times during their development and at that moment they are very vulnerable to an infection by the bacteria or the fungi. Cultural practices (rotation with non-solanaceous crops, destruction of the infected plants and of the plant debris, etc.) give good results.

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