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Short Communication

Occurrence and Population Dynamics of Tomato Leaf Miner [*Tuta absoluta* (Meyrick), Lepidoptera: Gelechiidae] in Eastern Ethiopia

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Abstract: The dangerous tomato leaf miner pest (*Tuta absoluta*), which was reported to have crossed into Ethiopia via the Sudan in 2012, has scared tomato producing farmers across the country. Therefore, a study was conducted using pheromone traps to elucidate the occurrence of the insect pest and to monitor its population build-up in eastern Ethiopia. Pheromone traps were placed in the greenhouse for two months (February - March 2014) and in the open-field tomato crops for one week to monitor the tomato leaf miner moth. Examination of the traps was carried out at seven-day intervals, and the dispenser was replaced every 15 days. There was a linear increment in the number of captured moths during the surveyed time both in the greenhouse and in the open-field tomato crops. The number of moths captured ranged from 27 - 47 and 103 - 255 in the open-field and in the greenhouse, respectively. Thus, based on the examination of the traps, the presence of *Tuta absoluta* was confirmed for the first time in eastern Ethiopia. In the greenhouse, the larvae of the tomato leaf miner inflicted a heavy damage on young tomato plants. As a result, young plants died before flowering. The results of the study have revealed that the pest is likely to cause heavy losses in tomato crops on an unprecedented scale in the Eastern part of the country. Therefore, monitoring the pest in all tomato producing regions of the country is a vital step towards early detection and decision-making to take integrated management measures against the outbreak of the infestation.

Keywords: Larvae; Leaf Miner; Moth; Pheromone Trap; Population Dynamics; Pupation; Tomato; *Tuta absoluta*

1. Introduction

Tomato (*Lycopersiconesculentum* Mill) is an important vegetable crop grown both under irrigation and rain-fed conditions in Ethiopia (Lemma, 2002). However, the production of the crop is constrained by several biotic and abiotic factors. Among the abiotic factors are unfavorable climatic conditions and soil physico-chemical properties; and biotic factors limiting the yield of the crop are weeds, insect pests, and diseases. More than 23 species of arthropod pests are known to inflict damage on tomato in Ethiopia. Of these, fruit worms, African bollworm [*Helicoverpa armigera* (Hubner)] and the potato tuber moth (*Phthorimaea operculella*) are considered as the major insect pests (Tsedeke and Gashawbeza, 1997).

The tomato leaf miner [*Tuta absoluta* (Meyrick), Lepidoptera: Gelechiidae] first devastated tomatoes in South America (Barrientos *et al.,* 1998). The pest then spread to Europe. It was initially reported in Eastern Spain in the late 2006 (EPPO, 2008), and subsequently spread throughout the Mediterranean Basin, Europe and North African countries (EPPO, 2009b; Potting 2009). The insect was reported in Ethiopia for the first time in 2013 and suspected to have entered the country via the Sudan (Gashawbeza and Abiy, 2012). The insect pest has been responsible for losses of 80-100% in tomato plantations in both protected cultivation and open fields. It attacks all aerial parts of the host (leaves, stems, and fruits). Once introduced, *T. absoluta* can be spread with seedlings, infested vines with tomato fruit, tomato fruit, and used containers. Outdoor markets, vegetable repacking and distribution centers are potential entry or introduction points in the spread of this pest (CFIA, 2010). Currently, the pest is recognized as a worldwide threat to tomato production (Desneux *et al.,* 2010).

Since the introduction of the dangerous tomato leaf miner and occurrence in Ethiopia, it has devastated a large proportion of the nation's tomatoes, especially in Raya and Alamata, in Eastern Tigray; Awash, Central and Eastern Shewa, including Meki and Ziway (Addis Fortune, 2013). However, its occurrence in Ethiopia was not reported until it caused heavy losses on tomatoes in the Central Rift Valley region of the country in February 2013 (Gashawbeza and Abiy, 2012). The Ministry of Agriculture received an alert from Pest.net in 2012 when the pest was invading the

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Sudan. However, the information was simply shelved (Addis Fortune, 2013).

Although *T. absoluta* is an oligophagous pest with a strong preference for tomato, it can also attack potato (*Solanum tuberosum* L.), eggplant (*S. melogena*), pepino (*S. muricatum*), pepper (*Capsicum* spp.), tobacco (*Nicotiana tabacum* L.) and other cultivated plants, including common bean (*Phaseolus vulgaris* L.) and *Solanaceous* weeds (CIP, 1996; Korycinska and Moran, 2009; EPPO, 2009a).

The economic impact of the devastation caused by the tomato leaf miner is reflected by an increase in the cost of tomato production (additional costs for crop protection), crop yield loss (lower marketable tomato fruits), and loss of consumer preferences as well as potential loss of markets if it were to become established. It is also very challenging to manage and limit the spread of the tomato leaf miner (NAPPO, 2012).

Tuta absoluta has been wreaking havoc to tomato crops in Ethiopia, elevating costs of production beyond the capacity of smallholder farmers and prices beyond the purchasing power of the average consumer. In 2013, the price of tomato increased by about 300% (personal observation), which could be mainly attributed to the fruit damage and quality loss caused by the insect pest.

Early monitoring of invasive pests and notifying farmers and growers to recognize the associated risks will limit the damage and losses caused by the pest (Witzgall*et al.,* 2010). The use of pheromone traps is considered as a reliable method for timely detection and population monitoring of *T. absoluta* (Al-Zaidi, 2009; Witzgall*et al.,* 2010). According to Harizanova *et al.* (2009), pheromones enable early detection and warn the presence of pests at low densities of populations and absence of symptoms. The use of pheromone traps is considered as a reliable method for timely detection of *T. absoluta* (Al-Zaidi, 2009).

The objective of this study was to detect the occurrence of the pest and to monitor the build-up of its population in eastern Ethiopia.

2. Materials and Methods

The study was conducted on the main campus of Haramaya University (09.0^0N and 42^0E), Eastern Ethiopia. To detect the occurrence of *T. absoluta*, pheromone traps were placed in tomato crops grown in a greenhouse and in an open field. Sex pheromones are species-specific and widely used for detection, whether a specific insect is present and for population monitoring (Al-Zaidi, 2009; Witzgall *et al.,* 2010). Both the open field and the greenhouse experiments were superimposed on the already established tomato plants, variety Marglobe intended for other purposes. The trap used was *Tuta absoluta* - Optima PH-937- OPT1 (TUA–Optima®) obtained from Russell IPM, United Kingdom. Pheromone lures were coupled with Delta traps (Hassan *et al.,* 2010; Russell IPM, 2012). The surveyed area of the greenhouse did not exceed 2500 m^2; accordingly, only one pheromone trap was placed. Similarly, one trap was set up for the open field having an area of 0.4 ha (Al-Zaidi, 2009).

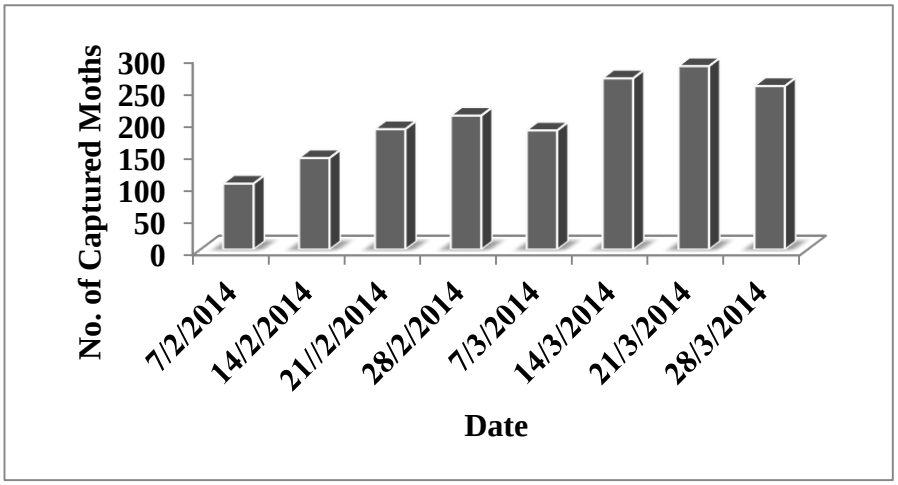
The trap was placed in the greenhouse for two months (February - March 2014) and in an open tomato field for one week (late January to early March 2014). Data collection was started during the vegetative growth stage of tomato plants. Pheromone traps capture only male adult insects (Witzgall *et al.,* 2010). Accordingly, data were collected on the number of male adults trapped at the interval of seven days and trapped males were removed from the trap after counting. The dispenser was replaced every 15 days.

3. Results and Discussion

Based on examination of the pheromone traps, the presence of *T. absoluta* was confirmed for the first time in the area. Records of the occurrence of *T. absoluta* from the greenhouse and open field studies are depicted in Figures 1 and 2. The number of moths captured in the open field ranged from 27 - 47. There was a linear increment in the number of captured moths in the open-field tomato crops although the monitoring was conducted for only one week. After a week's period, the field was sprayed with Tracer 240 SC (Spinosad) at the rate of 250 ml/hectare and could no longer be monitored. Before monitoring the population, the leaves of the surveyed tomato plants were found to be slightly mined by the larvae of the leaf miner (Figure 3). The mining indicated a typical infestation symptom of the tomato plant by *T. absoluta.* Initially, the number of trapped males in the greenhouse was relatively low (about 103 per week) but reached a maximum of 255 adults per week at the end of the monitoring period. Likewise, the population of the leaf miner increased with time (Figure 2). This could be ascribed to the continuous availability of tomato plants in the greenhouse as a source of food for the pest, which would promote its reproduction and multiplication. This finding is concordant with the report of Torres *et al.* (2001) that with the availability of host plants, the adult moths continue ovipositing. The authors also suggested that total destruction of residue of the host plants after harvesting potentially reduces

the population of *T. absoluta*. Al-Zaidi (2009) also reported that *T. absoluta* can be found year-round in greenhouses since it can perennate on remnant and volunteer plants.

The larvae of *T. absoluta* caused heavy damage on foliage and young plants of tomato grown in the greenhouse (Figure 3). Consequently, young plants died before flowering. The significant damage strongly suggested that *T. absoluta* is, indeed, already well-established in this area. A similar result was reported on tomato grown in the greenhouses in Khartoum (Mohamed *et al.,* 2012).



Figue 1. Number of captured tomato leaf miner moths in the greenhouse tomato crop at Haramaya in 2014.

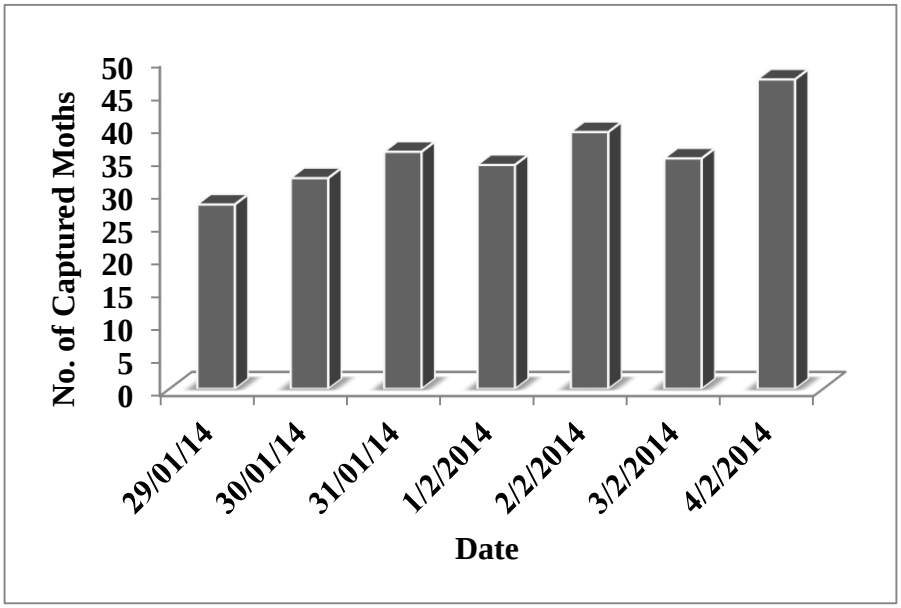


Figure 2. Number of captured tomato leaf miner moths in an open-field tomato crop at Haramaya in 2014.

In addition, during the first occurrence and outbreak of *T. absoluta* in Ethiopia in 2013, up to 100% losses were recorded in tomato crops at several locations in the Central Rift Valley region of Ethiopia (Gashawbeza and Abiy, 2012; Addis Fortune, 2013). Farmers in eastern Ethiopia, for instance in Harbo, lament the extensive damage caused by the tomato leaf miner on their tomato crops (Personal communication).

Figure 3. Early damage symptom (leaft) and heavily damaged tomato (right) crop by Tuta absoluta at Haramaya

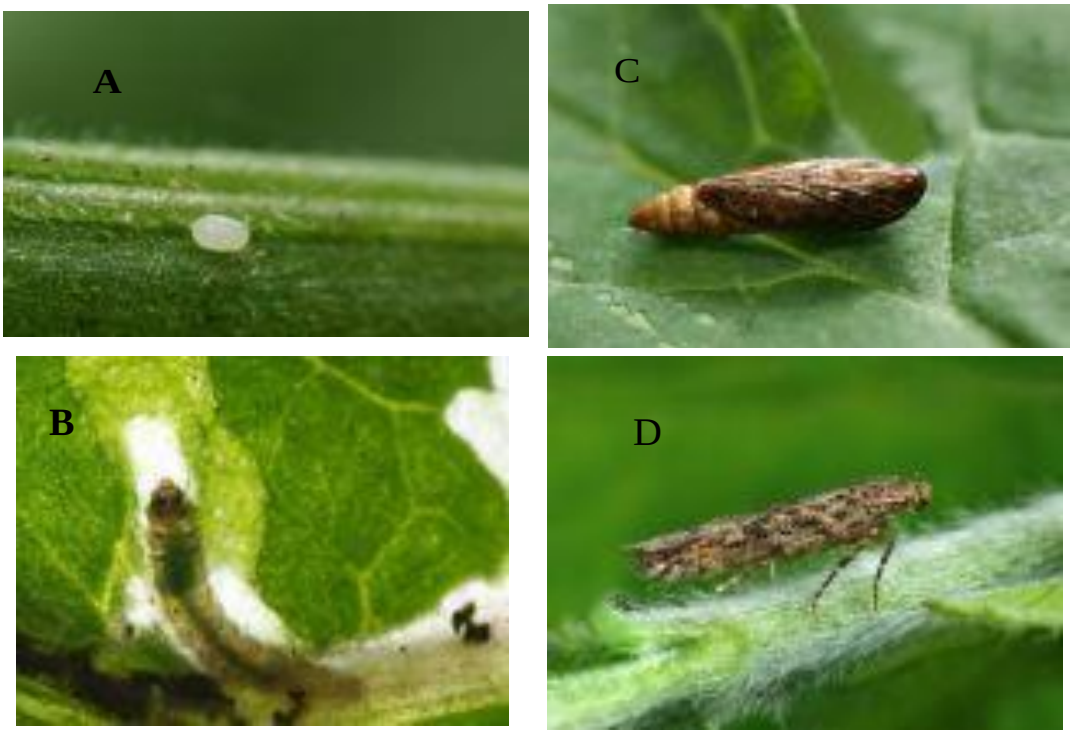


Figure 4. The different life stages of *Tutaabsoluta*: A) Egg; B) Larva; C) Pupa: D) Adult (pictures accessed from Goggle in March 2014).

4. Conclusion

This study has confirmed the occurrence of tomato leaf miner in Eastern Ethiopia. Monitoring and identifying the presence and outbreak of the insect pest as early as possible is important to take appropriate measures to manage the problem and avert sever crop damage and yield losses. From the present preliminary study, it can be concluded that the use of pheromone traps is a reliable monitoring method to detect the presence of *T. absoluta*. It is necessary to continue monitoring the abundance, distribution, and development cycle of *T. absoluta* in different agro-ecologies of the country to develop sustainable management methods and contain its spread. In addition, Subject Matter Specialists (SMS), Development Agents (DAs), farmers, and tomato growers should be alerted and trained to act against the tomato leaf miner to limit its spread and damage.

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