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Mini Review

Tomato Leaf Miner, *Tuta Absoluta* Meyrick: A Menace to Tomato Production in Ethiopia

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ABSTRACT

Tomato is one of the commonly grown vegetable crops in Ethiopia. The crop has many biotic and abiotic production constraints. Among the biotic constraints, tomato leaf miner, *Tuta absoluta*, is the most limiting factor of tomato production in Ethiopia. The insect is believed to have been introduced into Ethiopia via the eastern part of the country. Nowadays, the insect has spread too many tomato-producing regions of the world. Factors such as the insect's high biotic potential, large host range, and human transportation have contributed much to the wider dispersal of *T. absoluta*. The insect is highly devastating in its both native and introduced areas and can cause total yield loss if left unmanaged. Though many control methods exist, early detection and monitoring are the best strategies to quarantine the insect on the spot area. Using effective bio-rational insecticides combined with other integrated pest management components is an alternative way of managing *T. absoluta* when the other control methods failed to manage it.

Keywords: *T. absoluta*; Tomato leaf miner; Control; Solanaceous crops

INTRODUCTION

Tomato *Lycopersicon esculentum* L. is one of the most important vegetable crops in Ethiopia grown for fresh market and processed tomato. It is the third most important vegetable crop after red pepper and Ethiopian cabbage with acreage and production share of 4.53% and 10.82%, respectively [1]. Nevertheless, the average yield of tomatoes in Ethiopia is low, ranging from 6.5-24.0 Mg ha-1 compared with average yields of 51, 41, and 36 Mg ha-1 in America, Europe, and Asia respectively [2]. This is because tomato production is highly constrained by several factors including insect pests and disease [3]. Of the most important insect pests that are constraining tomato production, tomato leaf miner *Tuta absoluta* is one [4-5].

T. absoluta is a significant insect pest of tomato and other solanaceous crops. It is believed to have entered Ethiopia in 2012 via the northern part of the country likely from Yemen [6]. Hence, the insect started infecting tomato farms in the northern part of Ethiopia and spread over to the Somali and Oromia regions, the latter of which accounts for most of the country's tomato production [6]. Tomato leaf miner spread by seedlings, infested tomato fruit, and via containers. Outdoor markets, vegetable repacking, and distribution centers are potential introduction points in the spread of this insect [7]. Thus, this paper aims at reviewing some research works on tomato leaf miner with the main focus in Ethiopia.

DISCUSSION

Economic importance of tomato leaf miner in Ethiopia

T. absoluta was first found in Ethiopia in 2012 in open-field tomato fields [8]. Since its introduction, the insect has spread quickly and it is currently considered a key challenge on tomato production. The insect has devastated a large proportion of the tomato farm, especially in Raya and Alamata, in eastern Tigray, Awash, central, and eastern Shewa, including Meki and Ziway [9]. 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 [10].

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The economic impact of the insect is reflected by an increase in the cost of tomato production, crop yield loss of tomato fruits, and loss of consumer preferences. *T. absoluta* can cause a yield loss of 80-100% in protected and unprotected tomato fields in its native and introduced area [11].

Fruit quality loss is considerably impacted by direct feeding of the insect and hosting secondary pathogens through wounds made by the insect [12].

Origin and geographical distribution of tomato leaf miner

The species of *T. absoluta* is thought to be originated from Chile and have spread to regions of South America, Southeast Asia, and Mediterranean shores into Africa on different solanaceous crops [13-15]. According to [16], *T. absoluta* has been reported in countries such as Albania, Algeria, Argentina, Austria, Bahrain, Belgium, Bolivia, Brazil, Bulgaria, Cayman Islands, Chile, Colombia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Estonia, Ethiopia, Finland, France, Germany, Greece, Hungary, Iran, Iraq, Ireland, Israel, Italy, Jordan, Kosovo, Kuwait, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Malta, Morocco, Netherlands, Palestinian Authority (West Bank), Panama, Paraguay, Peru, Poland, Portugal (including the Azores), Qatar, Romania, Russia, Saudi Arabia, Senegal, Slovakia, Slovenia, Spain (including the Canary Islands), Sudan, Sweden, Switzerland, Syria, Tunisia, Turkey, United Kingdom (all regions), Uruguay, Venezuela, and Western Sahara.

The rapid distribution of *T. absoluta* over wide geographic areas is because of various factors such as its high biotic potential, large host range, overwintering potential, transportation, resistance development to insecticides and the absence of co-evolved natural enemies [11, 15, 17-21].

Biology and behavior of tomato leaf miner

T. absoluta is a holometabolous insect with a high rate of reproduction. Its life-cycle comprises four developmental stages viz. egg, larva, pupa, and adult, and is completed within 24 days at 270C [8]. According to [22], the insect is a micro lepidopteron moth with high reproductive potential. There are about 10-12 generations per year and complete each generation within 30-35 days. Adults are nocturnal and hide between leaves during the daytime. They are 5-7 mm long with a wingspan of 8-10 mm. Mature females can lay up to 260 eggs throughout their lifetime. Eggs are small cylindrical, creamy white to yellow 0.35 mm long and. are laid on leaves, veins, stems, sepals, and fruits. The Larvae is cream in color with a characteristic dark head [23]. Pupation takes place in the soil, on the leaf surface, or within mines. *T absoluta* overwinters as eggs, pupae, or adults depending on environmental conditions. The most important identifying characteristics are the filiform antenna, silverfish-grey scales, and characteristic black spots present in the anterior wing. The larvae become greenish to light pink in the second to fourth instars. The larval period is the most damaging period which is completed within 12-15 days [22].

Host plants of tomato leaf miner

Although *T. absoluta* is an oligophagous insect pest with a strong preference for tomato, it can also attack other solanaceous crops such as potato, eggplant, pepino, pepper, tobacco, and other cultivated plants including common bean and Solanaceous weeds [24-26].

MANAGEMENT OF TOMATO LEAF MINER

Different management options exist for the control of *T. absoluta*. Some of the management options include detection, identification, physical control methods, chemical control methods, biological control methods, cultural methods, and Integrated Pest Management (IPM) [13].

Detection and identification

The use of pheromone traps is a reliable method to detect the presence of *T. absoluta*. Pheromone trap data give early warning of the infestation and also will alert the user to low levels of populations before they become serious [13].

Physical controls

Screening of vents in the roof and sides of greenhouses and the disciplined use of double-entry doors can reduce the migration of pests into the greenhouse. Outward-facing fans inside the double-entry porch can blow back any flying insect pests, which might otherwise be 'sucked' into the crop on thermal currents when the outside door opens. Removal of infested leaves with caterpillar discontinues the life cycle; the action made with careful consideration for natural enemies [24].

Biological control methods

The biological control agents are considered as one possible solution to the *T. absoluta* crisis [5,11,27]. This strategy offers a more sustainable and less expensive alternative to chemicals [28-30].

Good agricultural practices

T. absoluta can be through good agricultural practices like crop rotation with non-solanaceous crops, adequate fertilization, irrigation, selective removal and destruction of infected plants and post-harvest plant debris [31]. Removal of wild host plants also plays a great role to prevent the further buildup of a potential population of the pest.

Integrated Pest Management (IPM) Strategies

The best recommended IPM to control *T. absoluta* employs massive trapping before planting, clearing the soil of crop residues, the application of insecticides in the irrigation water 8-10 days after planting, the application of either Spinosad or Indoxacarb if occasional individuals of the insect are observed and, elimination of the remnants of the crop immediately after the last fruits have been harvested [32-34].

Chemical control

Because of the serious drawbacks of synthetic insecticides on the environment, human and natural enemies and, their cost, chemical control of *T. absoluta* is not usually recommended [32, 35]. Besides, the efficiency of chemical control of *T. absoluta* infestations has been poor because of the endophytic habit of its larvae, which are protected in the leaf mesophyll or inside fruits [36], and pest resistance against several applied insecticides [14-15,18].

However, using environmentally sound insecticides as an alternative control is inevitable when the other control strategies fail to manage the insect. The use of sex pheromones and botanical insecticides such as Nimbicidine and Azadirachtin are safe to manage *T. absoluta* [37].

CONCLUSION

Tomato is one of the most important edible and nutritious vegetable crops in Ethiopia. Tomato leaf miner, *Tuta absoluta* is the most limiting factor of tomato production in Ethiopia. The insect can cause total yield loss if left unmanaged. The rapid distribution of *T. absoluta* over wide geographic areas is a result of various factors as among which the insect's high biotic potential, large host range, and the intra-continental dispersal facilitation due to human transportation. Early detection and monitoring are best to quarantine the insect on the spot area. Using effective environmentally friendly insecticides can be employed when the other control methods failed to manage *T. absoluta*.T

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