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STUDIES ON NEWLY EMERGED INVASIVE INSECT PEST OF TOMATO, *TUTA ABSOLUTA* (LEAF MINER) IN INDIA.- A REVIEW

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Introduction

Tomato scientifically called *Solanum lycopersicum*, is the world's largest vegetable crop grown after potato and sweet potato, but it tops the list of canned vegetables (Olaniyi *et al.*, 2010). It is considered as highly growing & used food crops among the vegetables in India and is cultivated both under greenhouse and in field conditions. It is consumed as fresh table tomato and also utilize as a prominent raw material in of food processing industries. Tomato is being utilized in many food items like salad, chutney, paste, peeled tomatoes, diced product, juice, sauce and soup. It is rich in minerals, vitamins and antioxidants that are important to a well balanced diet. It is also an essential dietary component because it contains more amounts of lycopene, an antioxidant that reduces the risks associated with several cancers and neurodegenerative diseases. It provides much needed vitamins, essential amino acids and minerals to impoverished rural communities. Being a cash vegetable crop it brings good income to farmers particularly in urban areas. Despite of its socio-economic significance, its production has been fluctuating by many biotic and abiotic constraints. Majority among the biotic factors are diseases and insects pest which reduce yields and the quality of fruits in the market. Among the insects attacking tomato crop, leaf miner is an invasive species commonly known as South American leaf miner or South American pinworm or South American tomato borer or South American tomato moth. It has gained notoriety as significant and destructive insect in the fields of tomato, in the countries it has invaded so far. With different incidence levels, it is moreover recorde in India throughout the year (Sridhar *et al.*, 2014).

Key words : Tomato, *Tuta absoluta*, Damage, Management

Pest description

Tomato leaf miner is a pest with oligophagous nature (Siqueira *et al*., 2000) associated with solanaceous crops. The main attacking host is tomato, but it also been associated with other minor hosts which belongs to solanaceae family like brinjal, potato, tobacco, pepper and sweet pepper (Pereyra and Sánchez, 2006). Its aggressive nature, multivoltine character, high biotic potential and resistance to insecticides are the most important reasons for the insect to become key pest in new area (Desneux *et al.,* 2011). The severe infestation of tomato leaf miner causes 80-100% yield loss (Tropia Garzia *et al.,* 2012). Thus, it can create a severe risk to the tomato growers if unchecked. When heavily infested plants are disturbed, adults were found flying close to surface of the ground (EPPO, 2005).

Origin and distribution

Tomato leaf miner was earliest described in Peru in 1917 in South American continent, where the pest is measured as one among the major destructive insects for tomato since 1960s (Barrientos et al., 1998). It is then extend to Bolivia Chile Argentina, Columbia, Brazil Ecuador, Venezuela Uruguay and Paraguay from there it is multiplied to different areas in the world, often becoming a serious risk to tomato manufacture industry wherever it invades. In Europe, *T. absoluta* presence

was initially reported in Brazil between 1979 and 1980 (Muszinski *et al.,* 1982) and in the Eastern parts of Spain in late 2006 (Urbaneja *et al.,* 2007) and later in Greece, Egypt (Roditakis *et al.,* 2010), Africa, middle East and parts of Asia (Biondi *et al.,* 2018). Tomato leaf miner was foremost recorded in the continent of African countries like Tunisia, Algeria and, Morocco in the year 2007, and has since invaded about 41 African countries out of 54. In view of the high biotic potential, its ability to adapt to different climatic the invasion has impacted seriously on the trade of tomato growing farmers and also tomato related industries and agri-businesses in many places around the world. Among Asia countries, the pest spreads over Iraq, Bahrain, Iran, Israel, Jordan, Kuwait, Saudi Arabia, Lebanon, Qatar, Turkey, United Arab Emirates, Syria, Yemen (Desneux *et al.,* 2010), India (Shasank *et al.,* 2015), Nepal (Bajracharya *et al.,* 2016) and Bangladesh (Hossain *et al.,* 2016). In India, *T. absoluta* was initially discovered on October, 2014 damaging tomato crops at Dhule, Ahmednagar, Jalgaon, Satara, Nashik and Pune districts in Maharashtra (Shashank *et al.,* 2015). Subsequently *T. absoluta* was reported in Karnataka (Sridhar *et al.,* 2014; Kalleshwaraswamy *et al.,* 2015 and Ballal *et al.,* 2016), Telangana and Andhra Pradesh (Anitha *et al.,* 2015), Gujarat (Ballal *et al.,* 2016), Delhi (Shashank *et al.,* 2016), Tamil Nadu (Shanmugam *et al.,* 2016), Madhya Pradesh (Swathi *et al.,* 2017), Himachal Pradesh (Sharma and Gavkare, 2017), Punjab (Sandeep *et al.,* 2017) and Meghalaya (Sankarganesh *et al.,* 2017) causing heavy damage to tomato crops in which the pest entered in different parts of India. In 2015, *T. absoluta* was first time recorded on brinjal in Kerala (Kumar *et al.,* 2017).

Life cycle and Biology

Tomato leaf miner is a mini lepidopteran moth with heavy reproductive potentiality. The pest is multivoltine having nearly 10 to 12 generations per year and affects tomato in all growing stages. Females has high rate of fecundity and one female can able to lay a total of about 260 numbers of eggs during their lifetime on the lower or upper surface of the leaves, buds and calyxes of the green fruits. Eggs are small cylindrical about 0.35 mm long. The colour of eggs ranges from oyster-creamy colour to light yellow. Larvae come after 4-6 days of incubation period. *T. absoluta* usually have four instars. First instars were cream or whitish colored, later changes from greenish (second instar) to light pink (fourth instar) with brown head. Larva is the damaging stage which is completed within 12 to 15 days (Estay, 2000). It do not go to diapauses when food is available. The pupae were at first greenish in colour and turned to castaneous brown and then changed to dark brown before emergence as adult. Pupation takes place within the mines or on the leaf surfaces or in the soil depending up on the environmental conditions. Moths are nocturnal in habit and are usually concealed in the day time between the leaves. On an average it takes 29 to 38 days to complete its total life cycle depending on the environmental circumstances. Adult lifespan ranges between 6–7 days for males and 10–15 days for females (Desneux N *et al*., 2010). They are 5-7 mm in length with a wing span of 8-10 mm. The main significant identifying characters are the filiform antennae, silvery-grey scales and characteristic black spots present in anterior wing (Simala *et al.,* 2011) and recurved labial palps which are well developed.

Symptoms and nature of damage

The pest attacks tomato crop from seedling stage to harvesting stage. In early stage of attack freshly emerged larvae penetrates into the leaf mesophyll layer and cause damage by feeding between the upper and lower surfaces forming small transparent mines. Due to continuous larval feeding, the irregular mines combined together and eventually form galleries. The symptoms of damage of this leaf miner are differed with serpentine leaf miner (*Liriomyzatrifolii)*. The mines were filled with black fecal matter and in due time the mined areas turns to brown colour and dry up. In case of serpentine leaf miner, symptoms are observed majorly on upper surfaces of leaves,

but in *T. absoluta* leaf miner, the symptoms can be seen on both sides of leaves. In fruits, the larvae tunnel inside and leave only a pinhead size hole visible from outside and make mines just at lower portion close to the stalk. More than one hole is seen near to the calyx on fruit. Damaged tomato plants are further attacked by the other pathogens which enter the wounds previously caused by the pest (Shasank *et al.,* 2015).

Management

Tomato pin worm management is difficult because its developmental cycles depend on environmental conditions (Barrientos *et al*., 1998); existence of suitable Solanaceous host plants in southern and central India makes establishment and increase of transient populations. In addition to field crops, weeds of Solanaceae could also serve as host reservoirs for the pest which do exist in India. Difficulty in management of the pest is due to non adaptation of wide area control programmes for numerous small holdings. Integration of the pest management methods like cultural, mechanical, biological and biotechnological tools is becoming necessary in managing the pest. A zoophytophagous mirid bug, *Nesidiocoris tenuis* (Hemiptera: Miridae) was recorded as predator on eggs and early larval stages under field conditions. Singh *et al.,* in 2009 demonstrated successfully use of pheromone trap @ 20/ha. Several insecticides were used to control the pest, but none of them is suitably adapted for its control as the endophytic nature of larvae, which are protected in the leaf mesophyll or inside the fruit. Additionally, insecticidal spray can be easily washed out by rain and wind (Abbes and Chermiti, 2011 and Guedes and Picanco, 2012). New molecules of insecticides such as spinosad, deltamethrin, indoxacarb, imidacloprid and Bt var *kurstaki* have effectively used in Spain (Russel, 2009), pyrethrins and chlorpyriphos were recurrently used in Italy (Garzia *et al.* 2009), abamectin, thiacloprid, imidacloprid, spinosad, indoxacarb, and *Bt var Kurstaki* were successfully used in Malta (Mallia, 2009). Now this insect developed resistance against the insecticides which includes spinosyns, organophosphates and diamides (Jallow *et al.* 2018). Indiscriminate use of insecticides in the infected crop resulted in the development of resistance to insecticide, resurgence of pest, pollution to environment, residues of pesticides in fruits, natural enemy populations' destruction and health hazards. To overcome the problems caused by indiscriminate utilization of insecticides, using of Host Plant Resistance (HPR) is an environmentally viable alternative strategy in insect pest management. Using resistant varieties now become substitute to chemical control. The research on the mechanisms and the causes for resistance to *T. absoluta* is essential for the determination of the resistance factors necessary to add into plant breeding programmes for insect resistance and to present objective parameters for the crosses. It is therefore agreed that the sustainable and most excellent option which can control the pest is by utilization of resistant varieties of tomato (Oliveira *et al.,* 2009)

Conclusion

T. absoluta, which is a invasive destructive pest spreading rapidly in several countries of the world, posing heavy risk to tomato and also to other solanceous crops. In recent times, it emerges as a highly invasive key pest frightening the worldwide tomato production. An effective eco-friendly IPM of this leaf miner is badly needed as the pest is distributing quickly and causing nuisance. In many other countries, it has already developed resistance against several insecticides. For controlling this insect, combination of strategies like use of pheromone traps, botanicals, microbials, and eco-friendly molecules are essential. The commercialization and worldwide trade of fresh fruits and transplanting materials have increased the extent of this insect. The impact of this pest on worldwide tomato producing industries and on the livelihood of small tomato farming communities might be more severe in the coming years unless great efforts are made to bring to an end to its spread. Till now there is no longer cultivated variety resistant to this insect. The

development and cultivation of resistant tomato cultivars against this pest is very limited in India. Therefore, it is necessary to recognize the resistant tomato variety. More studies on its biology, host range, population dynamics, biodiversity and management needs to be taken up. The socioeconomic force of the pest on subsistent agriculture also needs to be included. Explosive spread and distribution of this pest is mostly co-related with import of fruits and further spread (Potting, 2009). One of the potential ways for long distance spreading of the pest might be through packaging materials (boxes) from infested countries (EPPO, 2010). Due to this, the pest becomes a heavy risk for tomato fruit producing systems worldwide.

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