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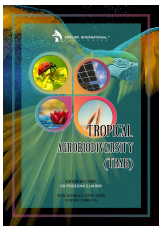

RESEARCH ARTICLE

TOMATO LEAF MINOR *TUTA ABSOLUTA* IN TOMATO & ITS CONTROL METHODS: A REVIEW

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ABSTRACT

Tomato is cultivated all over the world as it has high economic value and more demand. Tomato leaf minor is most hazardous pest of tomato all over the world. It causes high economic loss in tomato from 50-100%. Various methods like cultural, physical, biological, chemical methods are used for control of the pest. Due to excessive use of chemical pesticides, pests are gaining resistance power and pesticides are becoming less effective to control it. IPM methods, use of trap, use of neem-based pesticides are one of safe and more effective methods to control it. This review article provides information about the identification of pest, their nature of damage and different control measures of tomato leaf minor.

KEYWORDS

Tomato, *Tuta absoluta*, Control, traps

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is a popular vegetable crop used as fresh vegetable as well as in a variety of processed products such as sauce, ketchup, juice, puree, salsa etc (Meyrick, 1917; Desneux et al., 2010). It is planted all over the world and China is the largest producer followed by India and United States (FAOSTAT Database, 2016). It has been ranked in second importance after potato (Singh and Bhandari, 2015). Due to high demand and high commercial value, farmers are attracted towards tomato cultivation and production. Tomatoes are cultivated both in open and controlled environment. The South American tomato pinworm *Tuta absoluta* (Lepidoptera: Gelechiidae) is an invasive pest considered as one of the major threats to tomato cultivations worldwide (Desneux et al., 2010; Biondi et al., 2018; Meyrick, 1917). *Tuta absoluta* originated from Peru and started disseminating outside South America in the 2000s (Campos et al., 2017).

The species is now infesting tomato crops in the Caribbean, Africa, Europe and Asia, where it has rapidly been considered a priority target pest (Desneux et al., 2011; Biondi et al., 2018; Mansour et al., 2018; Verheggen and Fontus, 2019). The moth is a multivoltine species having high reproductive potential and potential to acclimatize to different climatic conditions that allows the pest population to spread very quickly (Tropea Garzia et al., 2012; Honest Machekano et al., 2018). This is a serious threat to world's tomato production in both open and protected condition (Greenhouse) (Chidege et al., 2016). Greenhouses play an important role in sustaining and promoting the pest population growth and its rapid invasion in the regions with unfavorable climatic conditions by providing shelter for overwintering pest population and by providing food when there is no food in the open field (Peng Han et al., 2018).

1.1 Objective of Study

The key objective of this study is to provide information about *Tuta absoluta* and its control methods.

2. METHODOLOGY

This review article is prepared on the basis of secondary sources of information. Many literatures, research papers from journals, magazines, books, were studied in detail and summarized for the preparation of manuscript. Necessary information related to *T. absoluta*, its origin, biology, nature of damage, control measures (physical, biological, chemical, integrated) were gathered and arranged systematically in manuscript.

3. DISCUSSION

3.1 Identification of pest

Their life cycle comprises of four stages; egg, larva, pupa and adult. Female lay eggs yellow in colour generally underside of the leaves. Adult moths are characterized by their silvery to grey scales and grey black spots on the fore wings (Retta and Berhe, - 72 – 2015; Berxolli and Shahini, 2017). They consist a pair of filiform antennae, having banded grey and dark brown color (Bajracharya et al., 2016; Ballal et al., 2016). Mature larvae are dark green in color and are distinguished by the characteristic dark band posterior to the head capsule (Ballal et al., 2016).

3.2 Damage caused by the pest

Larval stage is the most damaging stage. In this species, larvae feed on the mesophyll of aerial parts of tomato plants, mining the leaves, stems, apices, flowers and fruits, leading to heavy losses, especially in cases where management strategies are not efficiently developed (Desneux et al., 2010; González-Cabrera et al., 2011; Caparros Megido et al., 2013b; Miranda et al., 1998). Tomato leaf miner infest various plant parts including seedlings, flowers, tomato fruits and unsold fresh tomato fruits (Desneux et al., 2011). They cause blotch mines on the leaf that are visible from both abaxial and adaxial leaf surface causing the leaf to turn brown and die (Bajracharya et al., 2016).

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3.3 Control Methods

3.3.1 Physical and Cultural Methods

Mostly in this method hand picking of insects, removal of dead and infected parts of plants and destroying them, sanitation, crop rotation is done. Prophylaxis is the cheapest and the effective ways for the reducing the pest infestation (Berlinger et al., 1999). Crop rotation with non-host crops is also imperative (Robredo et al., 2008). Soil solarization has been advised in warm climates to kill pupae that remain in the soil after harvest (Balzan, and Moonen, 2012). Tomato plants potted in soil from organic farming systems had half the number of *T. absoluta* eggs when compared to tomato plants grown in soil from conventional systems (Ponti et al., 2012). One of the management tactics in greenhouses used to reduce the initial level of pest population is to keep the infested greenhouses closed after harvest to prevent the migration of adults to open-field crops (CABI., 2020).

3.3.2 Biological Methods

Different types of predators, parasites, entomopathogens can be used for biological control of tuta. Predators like *Nesidio coristenuis, Macrolophus pygmaeus* etc, parasitoids like *Trichogramma acheae*, entomopathogens like *Bacilus thuringensis* are used to control tuta. Predatory bugs such as *Macrolophus pygmaeus* and *Nesidio coristenuis* have been identified as the most promising natural enemies of *T. absoluta* in Europe as they are large consumers of eggs of the pest (Retta and Berhe, 2015). *Trichogramma acheae* has been identified as a potential biological control agent of the pest and is currently being released in commercial tomato greenhouses (Megido et al., 2013). *Bacillus thuringiensis*, an entomopathogenic bacterium has been used in the control of tomato plant pests as very effective bio-insecticide (Gozel and Kasap, 2015, Youssef and Hassan, 2013). A group researchers reported *Metarhizium anisopliae* (fungus) and *Bacillus subtilis* (bacteria) as the successful formulation to reduce the population of *T. absoluta* on tomato in America and Europe (Zekeya et al., 2017a). Entomopathogenic nematodes *Steinernema carpocapsae* and *Heterorhabditis bacteriophora* tested for the management of *T.absoluta* led to the reduction of infestation by 87-95% under laboratory and greenhouse conditions (Batalla-Carrera et al., 2010).

3.3.3 Use of Traps

Significant advances have been made in the field of semiochemicals especially sex pheromones to cope with *T. absoluta* (Desneux et al., 2010). With the help of light trap, pheromone trap with tuta lure we can control the number of tuta. Also, regular monitoring must be done. The traps need to be replaced after every 4 – 6 weeks and are placed not more than 60 cm from the ground, since *T. absoluta* is a low flying insect (Coelho and Franca, 1987). A research conducted in Tunisia by revealed greater efficacy of mass trapping over chemical control (Braham et al., 2013). The ability of female *T. absoluta* to reproduce parthenogenetically has weakened the use of such pheromone-based controls (Illakwahhi and Srivastava, 2017).

3.3.4 Chemical Control

Many of chemical pesticides are used to control tuta but many of do not show effective result. Pests are developing resistance against pesticides. Braham and Hajji reported that *T. absoluta* developed resistance against pesticides, like Abamectin, Cartap, Methamidophos and Permethrin in Brazil and against Deltamethrin and Abamectin in Argentina (Braham and Hajji, 2012). Spinosad is considered as a good alternative control of Lepidopteran pests because of its high activity at low rates, low toxic to consumers and workers and its rapid breakdown in the environment (Sparks et al., 1998). Regular use of chemical pesticide is harmful. However, neem-based pesticide are showing some effectiveness in controlling tuta. Gebremariam reported insecticidal property of botanical extract of Neem (*Azadirachta indica A. zuss.*) and Jatropha (*Jatropha curcus* L.), against eggs and larvae of tomato leaf miner causing 25% and 18% of egg mortalities four days after treatment and 33- 46.7% and 23.5 - 48.5% larval mortalities within 24 hours of treatment (Gebremariam, 2015). Also chlorantraniliprole insecticide is one of recommended chemical measures to control tomato leaf minor (PPD, 2016). Although plant extracts such as Armorex and Deffort show mild efficacy in controlling *T. absoluta* their conjunction with synthetic chemicals work as an avenue to explore in *T. absoluta* control (Braham and Hajji 2012). A group researchers proposed that considering the phyto-toxicity level, pesticides mixtures with different mode of action can delay the onset of resistance developing in pest population (Bielza et al., 2009).

3.3.5 Integrated control

Integrating physical, cultural, biological methods, uses of different types of traps, less use of chemicals (IPM) techniques will be safe for control to this pest. Most of the IPM strategies developed against *T. absoluta* utilize pheromones combined with other techniques such as light trap, water trap to mass trap both adult males and females (Megido et al., 2013). Several studies recommend use of Integrated Pest Management (IPM) strategy for effective management of T. absoluta (Miranda, 2005). Using tolerant cultivars in plant breeding programs may reduce the use of chemical insecticides as well as problems of resistance to many active ingredients (Gharekhani and Salek-Ebrahimi, 2014).

4. Conclusion

Tuta absoluta is a serious major economic pest of tomato all over the world which can cause up to 100% yield loss in uncontrolled situation. It has created a serious urge for immediate control of the pest in order to reduce the loss of tomato production. Farmers are unknowingly using over dose of chemicals to reduce this loss but excessive use of chemical are harmful as the pest is increasing its resistance towards chemical pesticides. However, we can use neem-based pesticide as the result of this pesticide is satisfactory. Removal of affected plant parts, insects, crop rotation, removal of alternate host, use of different types of traps are some methods that can be followed for control of this pest. We can follow integrated methods. Physical, cultural, bio-control methods combinedly can show effective control towards this pest. However, if the pest is out of control, we can use chemical pesticides in limited amount. Furthermore, research must be done on habit, control and management of tuta. Rather than being fully dependent on chemical pesticides, farmers should follow IPM. Many of farmers are unknown about IPM techniques and controlled use of pesticide, so different kind of awareness, training program must be conducted for farmer. Government of each country must take immediate and effective action against this hazardous pest.

Authors Contribution

Both authors gave equal contribution for the preparation of manuscript.

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