Current status of the tomato pinworm, *Tuta absoluta* (Meyrick) in the Indian sub-continent: Challenges ahead

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The tomato pinworm, *Tuta absoluta* is an oligophagous pest, infesting economically important solanaceous crops (Sridhar *et al.*, 2014; Nitin *et al.*, 2019). In India, for the first time it was reported on tomato from the south Indian state, Karnataka (Sridhar *et al.*, 2014). Rapidly it invaded all the other south Indian states *viz*. Telangana (Kumari *et al.*, 2015), Tamil Nadu (Shanmugam *et al.*, 2016), Kerala (Sivakumar *et al.*, 2017), Andhra Pradesh (Rasheed *et al.* 2018) and North Indian states *viz*., Maharashtra (Shashank *et al.*, 2015), Gujarat (Chavan *et al.*, 2016), New Delhi (Shashank *et al.*, 2016), Madhya Pradesh (Swathi *et al.*, 2017), Punjab (Sandeep *et al.*, 2017), Meghalaya (Sankarganesh *et al.*, 2017), Himachal Pradesh (Sharma and Gavkare 2017), Uttarakhand (Singh and Panchbhaiya 2018), Chhattisgarh (Balaji *et al.*, 2018), Uttar Pradesh (Halder *et al.*, 2019), Bihar and Odisha (Sridhar and Srinivas 2019) (Fig. 1). This indicates that *T. absoluta* has now established itself in almost all parts of India in just about 5 years. This could be attributed to the un-regulated transportation of solanaceous fruits and plants especially tomatoes across the country. There are no reports of *T. absoluta* infestations from Rajasthan, Jammu and Kashmir. This may be because of upheaval climato-geographic conditions of these regions and solanaceous plants not being major crops there. In Jharkhand and other north eastern states extensive surveys could perhaps confirm *T. absoluta* infestation as these regions possesses favourable conditions during certain months of the year.

The tomato pinworm, *T. absoluta* has the potential to occur throughout the year in Indian agro-climatic conditions (Nitin *et al.*, 2017; Nayana *et al.*, 2018). Their activity and population increase with the increase in atmospheric temperature upto certain extent, (36^{o}c) (Nitin *et al.*, 2018), with significant damage to tomato production. Researchers have investigated COI gene sequences of *T. absoluta* and found that it is 100% homologous with the sequences deposited by researchers in NCBI database (Sankarganesh *et al.*, 2017; Shashank *et al.*, 2018), indicating

spread of *T. absoluta* from a single source. Genetic variations in *Tuta* populations are not yet detected.

Indian farmers are using pheromone traps for the early detection, monitoring and mass trapping of *T. absoluta* in their fields (Bhanu *et al.*, 2017). Along with the pheromone traps, solar traps also give promising results by trapping female *T. absoluta* (Sridhar *et al.*, 2019). Farmers are using synthetic insecticides as a primary control measure for *T. absoluta* management in spite of its drawbacks like environmental pollution, non-target effects and chance of developing insecticide resistance by the pest. Chemicals such as spinetoram, cyantraniliprole, flubendiamide and spinosad have given promising results in managing this pest both during vegetative and fruiting stages (Sridhar *et al.,* 2016). In some countries *T. absoluta* has developed resistance to diamide (Roditakis *et al.,* 2015), chlorantraniliprole (Silva *et al.,* 2016) and organophosphate and pyrethroid insecticides (Zibaee *et al.,* 2018), but in India *T. absoluta* showed reduced susceptibility to certain commonly used insecticide (Prasanna kumar *et al.,* 2020). *Tuta absoluta* management failure by chemical control is predicted to appear in future leading to adoption of an integrated pest management approach comprising eco-friendly methods. Integrated pest management approaches comprising of pheromones, microbials, natural enemies and eco-friendly molecules are more promising in controlling *T. absoluta* both environmentally and economically (Ballal *et al.,* 2016; Nitin *et al.,* 2018; Buragohain *et al.,* 2020). Along with these trials, researcher also found that the usage of yellow incandescent bulb traps to be very effective in attracting *T. absoluta* followed by blue light traps that captures both males and females (Sridhar *et al.,* 2019).

For the successful management of this noxious pest, Indian researchers should concentrate towards developing commercial genetically modified (GM) crop varieties that are resistant to *T. absoluta*, exploiting novel techniques such as RNA interference (RNAi) to silence the genes that result in impaired growth and/or development and even mortality of the pest. Sterile insect technique (SIT) can be employed for the management in a mass region as it is species-specific, environmentally friendly, and can be combined with other management options. Along with these interventions, legislations also play an important role in the management of invasive pests. Listing *T. absoluta* under quarantine species list, implementing cross-border quarantine facilities across the states, bringing public awareness through campaigns, conducting

farmers meets with the experts and sharing the knowledge among the stakeholders help in managing this invasive pest. Frequent exposure to insecticides, short lifecycle and generation period and higher rates of invasiveness are challenges to come in future.

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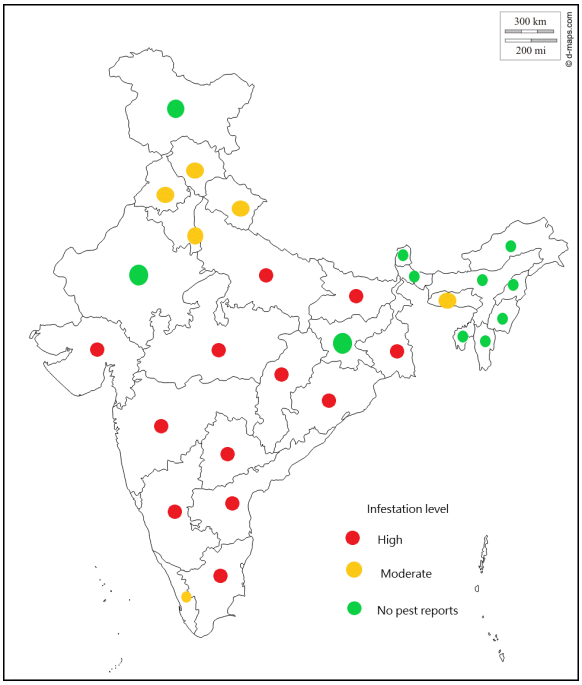

Fig 1. Indian states with *Tuta absoluta* infestation

Fig 2. Eggs of *Tuta absoluta*

Fig 3. *Tuta absoluta* infested eggplant

Fig. 4. *Tuta absoluta* infested tomato plant

Fig. 5. *Tuta absoluta* infested tomato fruit

Fig. 6. *Tuta absoluta* larval instars