



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: Sarswati Negi

CO - AUTHOR:

THEME NAME: IOBC Tuta absoluta Working Group Workshop

PRESENTATION TYPE: Poster

PRESENTER NAME: Sarswati Negi

EMAIL: sarunegi1212@gmail.com

ADDRESS: India

TITLE: Functional response of indigenous species *Nesidiocoris tenuis* (Reuter) to invasive leafminer, *Tuta absoluta* (Meyrick)

DESCRIPTION: *Tuta absoluta* (Meyrick), one of the most destructive pests of tomato, invaded India in 2014 and has now emerged as a serious threat to the crop both in open fields and polyhouses. In the present study functional response of a naturally occurring predator, *Nesidiocoris tenuis* (Reuter) to *T. absoluta* has been studied at 25 ± 0.5 °C, $70\pm 5\%$ RH and 12L:12D photoperiod to understand the density responsiveness of the predator to the pest. All the active life stages of the predator exhibited Type-II functional response to eggs and first-instar larvae of the pest. Predator's attack rate increased and the handling time decreased with the advancement of the development stage. Based on Rogers's random predator equation, predator's attack rate on host eggs and neonate larvae was lowest (0.052 and 0.092, respectively) in the first-instar nymphs and highest (0.193 and 0.180, respectively) in the adults. Handling times of the adult and the fifth-instar for host eggs (0.368 and 0.503 h, respectively) and larvae (0.506 and 0.545h, respectively) were much shorter than other stages. The maximum number of host eggs and larvae that could be consumed over a period of 24h by the first, second, third, fourth, fifth-instar and adult of *N. tenuis* was estimated to be 22.35, 40, 36.19, 44.28, 47.71 and 65.22; and 12.28, 20.22, 24.22, 27.62, 44.04 and 47.43 per predator, respectively. Functional response parameters indicate that adults and fifth-instar nymphs were the voracious feeders and could be important for biological control of the pest.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: Rangaswamy Muniappan

CO - AUTHOR:

THEME NAME: IOBC Tuta absoluta Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: Rangaswamy Muniappan

EMAIL: rmuni@vt.edu

ADDRESS: USA

TITLE: Role of IPM Innovation Lab in Management of *Tuta absoluta*

DESCRIPTION: When the South American tomato leafminer, *Tuta absoluta*, invaded Senegal in 2012, the IPM Innovation Lab organized a regional awareness workshop for the West and Central African countries in Dakar, Senegal in May 2013. In the workshop, presentations on the biology, ecology, spread, monitoring, and control methods of *T. absoluta* were conducted. Pheromone lures and traps were distributed to the participants for monitoring in their respective countries. In November 2013, another regional awareness and management workshop in Addis Ababa, Ethiopia for the East African and South Asian countries was conducted. In this workshop, representatives from India and Nepal participated. Upon returning to India, the representatives produced *T. absoluta* pheromone lures and traps and prepared to distribute them to the farmers when the pest was introduced in November 2014. In 2015, the IPM Innovation Lab conducted awareness workshops in Nepal and Bangladesh and followed up with management workshops when the pest invaded in early 2016. Recognizing the inevitable spread of *T. absoluta* into Cambodia in the near future, the Lab conducted two awareness workshops in early 2017. In addition, several *T. absoluta* symposia in regional and international meetings and conferences in Africa, Asia, Europe, and U.S.A have been conducted. In October 2015, a *T. absoluta* Working Group was formed under the auspices of the International Association for the Plant Protection Sciences.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: PL Sharma

CO - AUTHOR: S. Negi, SC Verma,

THEME NAME: IOBC *Tuta absoluta* Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: PL Sharma

EMAIL: sharma.pl@rediffmail.com

ADDRESS: India

TITLE: Thermal requirements of *Tuta absoluta* (Meyrick) and influence of temperature on its population growth on tomato

DESCRIPTION: Temperature-dependent phenology models are important to examine the influence of temperature on the geographical distribution, population dynamics and management of a particular insect. The present study deals with the impact of temperature on development, survival, reproduction and population growth of a recently invaded and the most destructive pest of tomato, *Tuta absoluta* (Meyrick) with the aim to understand its possible expansion in different agro-climatic zones under predicted climate change. Though *T. absoluta* was able to develop between 15 and 35°C, temperature around 25-30°C was more suitable. Survival and fecundity was highest at 25°C and lowest at 35°C. Developmental threshold for different developmental stages of the pest varied from 6.2 to 9.5°C, while the thermal constant required by the insect to complete the development from egg to adult emergence was 500 degree-days. Population growth parameters were also influenced significantly by the rearing temperature. Intrinsic rate of increase, net reproductive rate and finite rate of increase was higher at 25 and 30°C as compared to other temperature regimes. The study concludes that *T. absoluta* can be a serious pest of tomato in mid-hills of north-western Himalayan region and the southern plains of India where temperature fluctuates between 15-35°C. Furthermore, the developmental threshold values indicate that the pest can develop and survive at temperatures as low as 6-9°C without entering the diapause as long as the food is available.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: MUTHUGOUNDER MOHAN

CO - AUTHOR: Kesavan Subaharan, Shiek Salman, Narasa Reddy, Omprakash Navik, R. Rangeshwaran, N. Bakthavatsalam,

THEME NAME: IOBC *Tuta absoluta* Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: MUTHUGOUNDER MOHAN

EMAIL: mohan.nbaii@gmail.com

ADDRESS: India

TITLE: Tomato pinworm, *Tuta absoluta* (Meyrick): Biology, host range, population build-up and biocontrol options for its management

DESCRIPTION: *Tuta absoluta* (Meyrick 1917), a lepidopteran leafminer also called a pin borer, belongs to the family Gelichiidae. It is considered one of the most devastating tomato pests in the countries it has invaded so far. Under unmanaged condition, the larvae of *Tuta absoluta* can cause 100% yield reduction on tomato crops. Its presence was first noticed in India in 2014. Now it is reported from almost all the tomato-growing regions of the country with damage ranging from negligible to cent percent. Laboratory feeding assays and field survey indicated that the preferred host plant is tomato followed by *Solanum tuberosum*, *S. nigrum* and *S. melangina* among others. Heavy population buildup of *T. absoluta* in Karnataka (Raichur, Kolar and Malur) and Tamil Nadu (Hosur and Krishnagiri) occurred (328.4 to 783.6 adults / pheromone trap per week) during winter months. The damage on tomato fruits during November to February varied between 23.1 to 80.3 percent. In the neglected and unsprayed tomato fields, there was a significant population of natural enemies of *T. absoluta* such as *Nesiochoris tenuis*, reduvid bugs and *Trichogramma acheae*. Screening for effective indigenous *Bacillus thuringiensis* isolates against the second instar larvae indicated that *Bacillus thuringiensis* based formulations will have the potential to check the population of *T. absoluta*.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: Padavala Swathi

CO - AUTHOR: Sridhar Vaddi, R Asokan, Onkara S Naik, H. Gadad, K S Nitin,

THEME NAME: IOBC Tuta absoluta Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: Sridhar Vaddi

EMAIL: vaddi_sridhar@rediffmail.com

ADDRESS: India

TITLE: Efficacy of Integrated Pest Management tools evaluated against *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on Tomato in India

V. Sridhar, P. Swathi, R. Asokan, S. Onkara Naik, H. Gadad and K. S. Nitin
Division of Entomology and Nematology,
ICAR-Indian Institute of Horticultural Research, Bengaluru – 560 089
Email: vaddi_sridhar@rediffmail.com
Mobile: 9449631795

DESCRIPTION: South American tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is an invasive pest on tomato and other solanaceous crops. In general, 20 to 30% yield loss is caused by this pest and may result in 100% damage, if timely management interventions are not followed. IPM has been one of the classical strategies developed and adopted by plant protectionists to combat the insect pests and reduce the losses caused by them. The IPM strategy aims at using all the available options, their integration at ground level to achieve the desired economic and ecological benefits while reducing the losses caused by the pests. Various tools of IPM against *T. absoluta* were evaluated including entomopathogens (*Bacillus thuringiensis*, *Metarhizium anisopliae*, *Beauveria bassiana* and *Nomuraea rileyi*), egg parasitoids (*Trichogramma chilonis*, *T. pretiosum* *T. bactrae*), light traps, pheromone traps, few insecticides and the results are discussed in this paper. Among the egg parasitoids and synthetic chemicals, *T. pretiosum* and spinetoram 12 SC@ 1.25ml/l were very effective. Efficacy of various components for the management of *T. absoluta* are discussed in this paper.

Key words: *Tuta absoluta*, IPM, entomopathogens, pheromone traps



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: Lalit Sah

CO - AUTHOR: Mukti Devkota, Kiran Bhusal, Luke A. Colavito, George Norton, Edwin George Rajotte, and R. Muniappan,

THEME NAME: IOBC *Tuta absoluta* Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: Lalit Sah

EMAIL: lpsah@ideglobal.org

ADDRESS: Nepal

TITLE: Evaluation of Different Management Options against South American Tomato Leafminer, *Tuta absoluta* in Nepal

DESCRIPTION : The farming of tomatoes has become a profitable business in Nepal. However, production has been limited by several biotic and abiotic factors. At present, the invasive South American tomato leafminer, *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) has become an important economical pest for both open and polyhouse tomato growers of Nepal. The farmers are adopting various management options based on their knowledge; however, most of the management options are ineffective and require better management technologies. Chemical pesticides have failed to control this pest because of development of insecticide resistance. The IPM Innovation Lab/International Development Enterprises (iDE) Nepal in collaboration with experts from the Government of Nepal, and a team of scientists from the U.S, have been instrumental in identifying, testing and developing new IPM solutions for managing this pest. We present the results of the approaches used to manage this pest. The trial on efficacy of pest exclusion nets was successful in reducing 90% pest population, 89% less leaf damage and 91% less fruit damage with a promising 23.58 more mt/ha yield as compared to open cultivation. Similarly, the results on effectiveness of colored traps with lures showed that the white colored delta traps attracted more moths followed by green, yellow and orange delta traps, respectively. Traps placed at ground level caught more moths followed by traps placed at 1ft, 2ft, 3ft and above 3ft height. iDE is utilizing a public-private partnership approach to develop smallholder commercial pockets and last mile supply chains to reach farmers with the IPM technologies.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: Ashok Hadapad

CO - AUTHOR:

THEME NAME: IOBC Tuta absoluta Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: Ashok Hadapad

EMAIL: ahadapad@barc.gov.in

ADDRESS: India

TITLE: Distribution and genetic diversity of tomato leaf miner, *Tuta absoluta* population in India in relation to Sterile Insect Technique application

DESCRIPTION: Tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is a very invasive and serious pest of tomato. It has become a major pest on tomato crops in open and protected conditions in the world. *Tuta* infestation has been observed recently in different states of India and causes 90-100% damage. Due to its invasion capacity, adaptability and high reproduction potential, this pest is being considered as a suitable candidate for Sterile Insect Technique (SIT). To develop SIT for *Tuta*, it is essential to understand the actual distribution, genetic diversity, mass rearing feasibility, optimizing sub-sterility dose and compatibility with other control strategies. Hence, we collected tomato leaf miner samples from different districts of ten states of India and samples were further used for genetic diversity studies. We observed high levels of infestation from Karnataka, Maharashtra, Tamil Nadu and Andhra Pradesh. In particular, Yadgir and Kalburgi districts of Karnataka showed >90% of tomato fruit damage and complete damage of leaves (blotch). Around 30-60% tomato fruit damage and 40-80% leaf mining was observed in most of the surveyed locations. So far, no infestation and/or adults were trapped from West Bengal and Bihar states during the present survey. Results of mass rearing protocols, radiation dose optimization and genetic diversity studies will be presented. In addition, the importance of the tomato leaf miner in tomato cultivation and integration of the SIT with biocontrol agents for the management of *T. absoluta* will be also be discussed.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

Evaluation Warning: The document was created with Spire.Doc for .NET.

AUTHOR NAME: Abhijin Adiga

CO - AUTHOR:

THEME NAME: IOBC Tuta absoluta Working Group Workshop

PRESENTATION TYPE: Oral

PRESENTER NAME: Abhijin Adiga

EMAIL: abhijin@gmail.com

ADDRESS: USA

TITLE: Multi-pathway models to understand the spread and impact of *Tuta absoluta*

DESCRIPTION: Movement of humans and their goods is widely accepted as the primary driver of invasive species invasions. However, mainstream approaches tend to focus more on the biological and ecological factors than on human-assisted pathways of spread. Modeling the latter remains a challenge owing to its complex nature, unavailability of quality data and lack of systematic modeling methods. Using network science and computational epidemiology, we have developed robust hybrid models to study the role of natural and anthropogenic drivers of invasive species spread, with application to *T. absoluta*. This talk will present our recent efforts in this direction demonstrating the role of this new modeling approach in analyzing spread, the role of tomato trade, effect of climate change and economic impact.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

AUTHOR NAME: Kesavan Subaharan

CO-AUTHOR: M Eswarmoorthy, R. Senthoorraja, TM. Subramanya, TM. Vinay, N. Bakthavatsalam, M. Mohan

THEME NAME: Biological Control Compatible Approaches

PRESENTATION TYPE: Poster

PRESENTER NAME: Kesavan Subaharan

EMAIL: mohan.nbaii@gmail.com

ADDRESS: India

TITLE: Controlled release matrix for delivery of South American tomato moth, *Tuta absoluta* (Meyrick) (Gelechiidae: Lepidoptera) pheromone

DESCRIPTION:

The South American tomato moth, *Tuta absoluta* (Meyrick) (Gelechiidae: Lepidoptera) is a key pest of tomato, *Solanum lycopersicum* in tomato growing countries across the globe. The female sex pheromone of *T. absoluta* comprises of (3E, 8Z, 11Z)-3, 8, 11-tetradecatrien-1-yl acetate and (3E, 8Z)-3, 8-tetradecadien-1-yl acetate (9:1). Pheromone loaded in rubber septa dispensers are being used @ 30 per ha for trapping the adult males. It has a high release rate of pheromone and warrants frequent replacement. This adds to the cost of the labour and chemistry. Nanoporous materials are a novel carrier/dispenser for the volatile signaling molecules with controlled spatiotemporal release rates. Dispensers made of mesoporous sieves with ordered pore channels was developed for loading the *T. absoluta* pheromone. Characterization by Field Scanning Electron Microscopy (FESEM) and X-ray Diffraction (XRD) confirmed the ordered structure of the pores on the matrix. Pheromone when loaded in nanomatrix showed delayed dissipation as compared to pheromone alone when assayed by Thermal gravity analysis (TGA). Fourier transform infrared (FT-IR) measurements confirmed the presence of pheromone in the nanomatrix. Entrapped pheromone in the nanomatrix revealed controlled release of pheromone as compared to release from rubber septa. The physiological response in olfactory receptor neurons of the male moths to the pheromone released from nanomatrix was ascertained. Field test of pheromone loaded in nanomatrix captured more moths than unbaited traps. On longevity of pheromone lures, the commercial lure containing 3 mg pheromone was exhausted in 20 - 30 days, whilst pheromone loaded into nanomatrix was effective for 45 - 60 days.



FIRST INTERNATIONAL CONFERENCE ON BIOLOGICAL CONTROL

APPROACHES & APPLICATION

27 - 29 SEPTEMBER, 2018

BENGALURU, INDIA

AUTHOR NAME: Sridhar Vaddi

CO - AUTHOR: R Asokan, Onkara S Naik, K S Nitin, H Gadad, P Swathi,

THEME NAME: Biological Control of Invasive Pests and Weeds

PRESENTATION TYPE: Poster

PRESENTER NAME: Sridhar Vaddi

EMAIL: vsridhar@ihr.res.in

ADDRESS: India

TITLE: Evaluation of Biological Control options for the management of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on Tomato

DESCRIPTION: The South American tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is an invasive pest on tomato and other solanaceous vegetables; it was first reported in India in 2014 and since then has spread rapidly to different states. In general, 20% to 30% yield loss is caused by this pest and may result in 100% damage, if timely management interventions are not followed. Entomopathogens like *Bacillus thuringiensis*, *Nomuraea rileyi*, *Beauveria bassiana* and *Metarhizium anisopliae* and egg parasitoids (*Trichogramma chilonis*, *T. pretiosum* *T. bactrae*) are eco-friendly and effective options both under polyhouse and open field conditions. The Mirid bug, *Nesidiocoris tenuis* is a good predator on eggs and first instars of *T. absoluta*. These biological control options have been evaluated at ICAR-Indian Institute of Horticultural Research, Bengaluru against *T. absoluta*. Four entomopathogens viz., Bt (1 ml/l) and *N. rileyi*, *B. bassiana* and *M. anisopliae* @ 1 x 10⁸ cfu/ml were evaluated and three egg parasitoids viz., *T. pretiosum*, *T. bactrae*, *T. chilonis* evaluated in separate trials. Egg parasitoids were released at weekly intervals @ 50,000/ha for five weeks. The observations on *T. absoluta* live mines were recorded on 3, 7 and 10 day intervals in each of the treatments. Various entomopathogens have resulted in 70-81% reduction in live larvae of *T. absoluta* on tomato. Among the egg parasitoids evaluated, *T. pretiosum* was found to be promising (25-55 % damage reduction). Botanical based Azadirachtin 5% EC at 2 ml/L was effective against *T. absoluta* resulting in 69.87 % reduction in live mines of *T. absoluta* and was relatively safe to the natural enemies also. Feeding potential of *Nesidiocoris tenuis* on *T. absoluta* eggs was assessed under laboratory conditions and revealed I, II, III and IV instars of *N. tenuis* can feed up to 27, 33, 47 and 38 (eggs/day), respectively, whereas adults fed up to 27 eggs/day. Being a newly invaded pest attacking major vegetable crops like tomato, these biological control options should be integrated with the other IPM practices for effective management of the pest. Potential of these biological control options as a part of IPM of *T. absoluta* is discussed in this paper.

Keywords : *Tuta absoluta*, *Trichogramma*, entomopathogens, *Nesidiocoris*
