



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(5): 2407-2414

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Received: 25-07-2018

Accepted: 30-08-2018

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## Incidence of South American tomato leaf miner, *Tuta absoluta* (Meyrick) in Chittoor district of Andhra Pradesh, India

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### Abstract

Roving surveys were carried out on the incidence of *Tuta absoluta* (Meyrick) on tomato during *rabi* 2016-17 and 2017-18 in Chittoor district of Andhra Pradesh. The mean per cent *T. absoluta* infested plants, leaflets and fruits were ranged from 51.37 to 66.12, 24.99 to 34.25 and 25.00 to 36.12 per cent, respectively. The mean per cent infested plants, leaflets and fruits by *T. absoluta* were maximum in Kalikiri mandal (66.12%), (34.25%) and (32.65%), respectively while minimum in Kalakada mandal (51.37% infested plants), Madanapalli (24.99% infested leaflets), (25.00% infested fruits). The miridbug, *N. tenuis* was found predated on eggs and first instar larvae of *T. absoluta*. The mean number of adults and nymphs of *N. tenuis* per plant ranged from 1.04 to 1.45. Maximum predator population was recorded in Vayalpadu mandal (1.45) whereas minimum in Kalikiri mandal (1.04).

**Keywords:** South American tomato leaf miner, *Tuta absoluta*, tomato, *Nesidiocoris tenuis*

### Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most widely cultivated and consumed food crops among the vegetables in India. Tomato is rich in minerals, vitamins and antioxidants that are important to a well balanced diet. It is also an important dietary component because it contains high levels of lycopene, an antioxidant that reduces the risk associated with several cancers and neurodegenerative diseases. It is used as a salad, paste, peeled tomatoes, diced products, juice, sauces and soups. In India, it is cultivated in an area of 808.54 thousand ha with a production of 19696.92 thousand MT and productivity of 24.36 tonnes ha<sup>-1</sup> whereas in Andhra Pradesh, it is cultivated in an area of 55.50 thousand ha with a production of 2100.95 thousand MT and productivity of 37.86 tonnes ha<sup>-1</sup> during 2016-17 ([www.indiastat.com](http://www.indiastat.com))<sup>[20]</sup>. The major tomato producing states in India are Andhra Pradesh, Karnataka, Orissa, Maharashtra, Madhya Pradesh, West Bengal, Bihar, Gujarat, Uttar Pradesh, Himachal Pradesh, Chhattisgarh, Tamil Nadu, Telangana and Jharkhand. In Andhra Pradesh, the major tomato producing districts are Chittoor, Kadapa, Ananthapuramu, Kurnool, Prakasam and Visakhapatnam.

Tomato production has been fluctuating due to many biotic and abiotic constraints. Prominent among the biotic constraints are pests and diseases which reduce yields and the quality of marketable fruits. The major insect pest complex of tomato includes fruit borer, *Helicoverpa armigera* (Hubner), tobacco caterpillar, *Spodoptera litura* (Fabricius), serpentine leaf miner, *Liriomyza trifolii* (Burgess), whitefly, *Bemisia tabaci* (Gennadius), aphids, *Aphis gossypii* (Glover), mealybugs, *Phenacoccus solenopsis* (Tinsley) and mites, *Tetranychus urticae* (Koch) (Assaf *et al.*, 2013). Recently, South American tomato leaf miner or pinworm, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), is emerging as major pest and causing extensive damage up to cent per cent yield loss in India particularly under South Indian field conditions. It has been reported from different parts of India throughout the year though the incidence level varies (Nitin *et al.*, 2017)<sup>[11]</sup>.

*T. absoluta* is an invasive species commonly known as South American tomato leaf miner, South American tomato pinworm, South American tomato moth and tomato borer. It is considered as one of the most devastating tomato pests in the countries it has invaded so far. The pest is native to Peru in South America; it has spread to Argentina, Bolivia, Brazil, Chile, Columbia, Ecuador, Paraguay, Uruguay and Venezuela. Since the first detection in Spain in

this pest is spreading rapidly across Southern Europe and North Africa to whole of the Mediterranean countries (Desneux *et al.*, 2010) <sup>[5]</sup>. In Asia, it is distributed in Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen, India (Shasank *et al.*, 2015) <sup>[6]</sup>, Bangladesh (Hossain *et al.*, 2016) <sup>[7]</sup> and Nepal (Bajracharya *et al.*, 2016) <sup>[2]</sup>.

In India, *T. absoluta* was first reported during October, 2014 infesting tomato fields in Pune, Ahmednagar, Dhule, Jalgaon, Nashik and Satara districts of Maharashtra (Shashank *et al.*, 2015) <sup>[16]</sup>. Subsequently pest was recorded from Karnataka (Sridhar *et al.*, 2014) <sup>[18]</sup>, (Kalleshwaraswamy *et al.*, 2015) <sup>[8]</sup> and Ballal *et al.*, 2016) <sup>[4]</sup>, Tamil Nadu (Shanmugam *et al.*, 2016) <sup>[14]</sup>, Andhra Pradesh and Telangana (Anitha *et al.*, 2015) <sup>[1]</sup>, New Delhi (Shashank *et al.*, 2016) <sup>[14]</sup>, Gujarat (Ballal *et al.*, 2016) <sup>[4]</sup>, Madhya Pradesh (Swathi *et al.*, 2017) <sup>[19]</sup>, Punjab (Sandeep *et al.*, 2017) <sup>[12]</sup>, Meghalaya (Sankarganesh *et al.*, 2017) <sup>[13]</sup> and Himachal Pradesh (Sharma and Gavkare, 2017) <sup>[15]</sup> causing severe damage to tomato in invaded areas in India. In Kerala it was first reported on brinjal in 2015 (Kumar *et al.*, 2017) <sup>[19]</sup>.

*T. absoluta* attacks the tomato crop from seedling to harvesting stage. Tomato plants are damaged by feeding on leaves, stems, flower buds and both green and ripe fruits by the invasion of secondary pathogens which enters through the wounds caused by the pest (Shasank *et al.*, 2015) <sup>[16]</sup>. In early infestation, newly emerged neonates penetrate the leaf into the mesophyll layer and feed between the lower and upper surfaces of the leaf to form small and transparent mines. As a result of continuous feeding by the larvae, the irregular mines combine together and eventually form galleries. The mines were filled with black coloured fecal pellets and over time the mined areas turns brown and dryup. In fruits, the larvae tunnel inside and leave only a pin hole visible from outside and make mines just below the surface. *T. absoluta* infestation causes 50 to 100 per cent losses under greenhouse and open field conditions. When plants from heavily infested are shaken, adult moths found flying near to ground surface (EPPO, 2005) <sup>[6]</sup>. In Chittoor district of Andhra Pradesh, the incidence of this pest on tomato was recorded during *rabi* 2016-17 and 2017-18.

## 2. Materials and Methods

### 2.1 Locations and method of survey

Chittoor district occupies first place in tomato cultivation in Andhra Pradesh with an area of 16320 hectares and production of 13000 million tonnes during 2015-16. Based on the tomato area and production, Chittoor district was selected for the survey. Roving surveys were carried out in Chittoor district to record the incidence of tomato leaf miner at fortnight intervals during *rabi* 2016-17 and 2017-18. In Chittoor district, five largest tomato growing mandals i.e Piler, Kalikiri, Vayalpadu, Kalakada and Madanapalli were selected, in each mandal two villages and in each village one field was selected to document the incidence of tomato leaf miner. The incidence was recorded at different stages of crop growth i.e., vegetative stage, flowering stage, fruiting stage and harvesting stage.

### 2.2 Collection of data

In each tomato field observations made on 25 plants. The number of plants infested and total number of plants per 2 m<sup>2</sup> was recorded in five randomly selected sampling units. On each plant three fully opened single compound leaves (top,

middle and bottom) were selected. On each single compound leaf data on number of leaflets infested with *T. absoluta* and the total number of leaflets of compound leaf were recorded. Similarly, on each plant, number of fruits damaged by *T. absoluta* and total number of fruits were recorded. The number of *Nesidiocoris tenuis* (Reuter) (Hemiptera: Miridae) per plant was also recorded. The infestation of *T. absoluta* on leaves and fruits was identified by observing the blotch like mines and pinhead sized holes, respectively. Standard sampling procedure adopted for the leaf miner was followed as per the manual of tomato pest surveillance (NICRA, 2012) <sup>[10]</sup> for assessing the intensity of *T. absoluta* damage. Per cent infested plants, per cent infestation on leaflets and per cent damage on fruits were calculated by using following formulae.

$$\text{Per cent infested plants} = \frac{\text{Total number of plants infested}}{\text{Total number of plants observed}} \times 100$$

$$\text{Per cent infestation on leaflets} = \frac{\text{Total number of leaflets infested}}{\text{Total number of leaflets observed}} \times 100$$

$$\text{Per cent damage on fruits} = \frac{\text{Total number of fruits damaged}}{\text{Total number of fruits observed}} \times 100$$

## 3. Results and Discussion

Roving surveys were conducted at fortnight intervals on the incidence of South American tomato leaf miner, *T. absoluta* on tomato in Chittoor district of Andhra Pradesh during *rabi* 2016-17 and 2017-18. The population of predator, *Nesidiocoris tenuis* (Reuter) on *T. absoluta* was also recorded. The survey results are presented hereunder (Tables 1 to 5).

### 3.1 Incidence of *T. absoluta* on tomato in Chittoor district of Andhra Pradesh

#### 3.1.1 Incidence of *T. absoluta* on tomato in Chittoor district during *rabi* 2016-17

Results of the surveys presented in the Table 1 and data revealed that, the infestation of *T. absoluta* was observed throughout *rabi* 2016-17 in Chittoor district except few locations. The per cent infested plants, per cent infested leaflets and per cent damaged fruits by *T. absoluta* were ranged from zero to 92.00, zero to 72.57 and 8.92 to 56.87 per cent, respectively. The per cent infested plants was high in Yellampalli and Reddivaripalli with 92 per cent followed by Regallu, Parapatla and Vempalli with 88 per cent, Pachipala Vari Palli, Mellacheruvu, Ankemvaripalli, Challavaripalli, Kothapalli, Pyarampalli, Balaiahgaripalli and Eguvamadigapalli with 84 per cent while infestation was not found at Gandlapalli, Gyarampalli, Ethamanuvaddipalli and Penchupadu villages. The per cent infested leaflets was high in Yellampalli (72.57%) followed by Parapatla (63.36%), Pyarampalli (63.11%) and Reddivaripalli (58.88%). The per cent damaged fruits was high at Reddivaripalli (60.04%) followed by Regallu (52.48%), Gangapuram (52.11%) and Marripadu (50.66%) while per cent infested fruits were low in Mudiyaivaripalli (8.92%) followed by Munga Makula Palli (17.20%), Krishnapuram (24.44%) and Kotakadapalli (27.42%).

The mean per cent *T. absoluta* infested plants was maximum in Kalikiri mandal (77.75%) followed by Piler (70.25%), Madanapalli (65.75%), Vayalpadu (65.0%) and Kalakada (59.50%). The mean per cent infested leaflets was maximum in Kalikiri (45.66%) followed by Madanapalli (34.07%),

Vayalpadu (33.87%), Piler (30.84%) and Kalakada (30.68%). The mean per cent damaged fruits was maximum in Vayalpadu (50.09%) followed by Piler (39.93%), Kalikiri

(38.89%), Madanapalli (35.13%) and Kalakada (32.89%) (Table 2).

**Table 1:** Survey on the incidence of South American tomato leaf miner, *T. absoluta* and number of *N. tenuis* adults and nymphs per plant on tomato in Chittoor district of Andhra Pradesh during *rabi* 2016-17

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>Nesidiocoris tenuis</i> / plant*
Piler	M.V. Palli	Oct I FN	Vegetative	Sweakar-448	68.00	28.76	-	1.24
	Talapula	Oct I FN	Nearing end of Harvesting	US-440	80.00	22.37	47.96	1.40
	Adavipalli	Oct II FN	Fruiting	Sweakar-448	64.00	18.51	19.08	1.08
	Balamvaripalli	Oct II FN	Vegetative	Utham-4140	52.00	24.53	-	2.88
	Sivaramapuram	Nov I FN	Vegetative	Sweakar-448	76.00	36.53	-	1.76
	Nagari	Nov I FN	Vegetative	Unknown	60.00	35.20	-	2.08
	Jandla	Nov II FN	Vegetative, Flowering	Sweakar-448	72.00	22.10	-	1.00
	Yerraguntapalli	Nov II FN	Flowering	Sweakar-448	68.00	20.21	-	0.93
	Pachipalavaripalli	Dec I FN	Mid Harvesting	Sweakar-448	84.00	39.11	49.80	1.24
	Mudupulavemula	Dec I FN	Flowering	Prabha	56.00	35.23	-	0.80
	Kuraparthivaripalli	Dec II FN	Vegetative, Flowering	Sweakar-448	68.00	25.92	-	1.92
	Bandakindapalli	Dec II FN	Nearing end of Harvesting	Sweakar-448	80.00	38.37	44.72	0.92
	Kammappalli	Jan I FN	Flowering	Unknown	56.00	20.16	-	1.80
	Veeramreddy Garipalli	Jan I FN	Mid Harvesting	US-440	68.00	29.92	31.87	1.44
	Mellacheruvu	Jan II FN	Flowering, Fruiting	Sweakar-448	84.00	40.32	33.60	2.16
	Regallu	Jan II FN	Harvesting	Sweakar-448	88.00	56.32	52.48	1.52
Mean					70.25	30.84	39.93	1.51

#### Continued 1

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Kalikiri	Kuravapalli	Oct I FN	Vegetative	US-440	76.00	23.42	-	0.64
	Pottekulavaripalli	Oct I FN	Vegetative	Sweakar-448	72.00	23.61	-	0.84
	Ankemvaripalli	Oct II FN	Nearing end of Harvesting	Sweakar-448	84.00	56.96	41.18	0.88
	Nagripalli	Oct II FN	Vegetative Flowering	Unknown	72.00	31.42	-	1.64
	Yellampalli	Nov I FN	Flowering	Sweakar-448	92.00	72.57	-	1.40
	Palem	Nov I FN	Mid Harvesting	Sweakar-448	76.00	42.37	39.44	1.28
	Addavaripalli	Nov II FN	Mid Harvesting	Sweakar-448	80.00	52.96	36.80	-
	Pasalavandlapalli	Nov II FN	Vegetative Flowering	Sweakar-448	76.00	51.36	-	1.20
	Rajuvaripalli	Dec I FN	Vegetative	Unknown	64.00	38.66	-	2.80
	Besthapalli	Dec I FN	Flowering Fruiting	Sweakar-448	80.00	53.03	32.86	1.64
	Challavaripalli	Dec II FN	Mid Harvesting	Sweakar-448	84.00	55.55	44.21	1.40
	Cheruvumundarapalli	Dec II FN	Vegetative	Prabha	68.00	25.60	-	-
	Thummalapeta	Jan I FN	Vegetative	Sweakar-448	76.00	40.53	-	1.12
	Tekalakona	Jan I FN	Vegetative Flowering	Sweakar-448	72.00	43.20	-	1.52
	Kothapalli	Jan II FN	Vegetative	Sweakar-448	84.00	56.00	-	1.28
	Parapatla	Jan II FN	Vegetative Flowering	Sweakar-448	88.00	63.36	-	1.84
Mean					77.75	45.66	38.89	1.21

#### Continued 1

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Vayalpadu	Vitalam	Oct I FN	Nearing end of Harvesting	Prabha	80.00	48.14	39.50	1.24
	Gandaboyanapalli	Oct I FN	Vegetative	Sweakar-448	64.00	16.19	-	1.78
	Chinthaparthi	Oct II FN	Vegetative	Sweakar-448	44.00	25.60	-	1.60
	Manchuru	Oct II FN	Vegetative, Flowering	US-440	60.00	25.90	-	1.88
	Tatiguntapalli	Nov I FN	Flowering	Sweakar-448	76.00	34.66	-	1.52
	Murevandlapalli	Nov I FN	Vegetative, Flowering	Sweakar-448	72.00	26.28	-	1.92
	Ayyavaripalli	Nov II FN	Flowering	Unknown	68.00	45.76	-	1.80
	Jarravaripalli	Nov II FN	Vegetative, Flowering	Sweakar-448	56.00	28.80	-	2.20
	Pyarampalli	Dec I FN	Harvesting	Sweakar-448	84.00	63.11	56.87	1.12
	Gandlapalli	Dec I FN	Vegetative	Sweakar-448	-	-	-	3.36
	Marripadu	Dec II FN	Mid Harvesting	Sweakar-448	76.00	32.00	50.66	1.58
	Sakirevupalli	Dec II FN	Vegetative	US-440	48.00	22.93	-	1.56

	Itlamvaripalli	Jan I FN	Harvesting	Sweakar-448	80.00	38.40	43.42	1.52
	Vaddipalli	Jan I FN	Flowering	Unknown	68.00	27.20	-	2.48
	Chinthalaripalli	Jan II FN	Vegetative	Sweakar-448	72.00	48.10	-	2.04
	Reddivaripalli	Jan II FN	Nearing end of Harvesting	Sweakar-448	92.00	58.88	60.04	1.22
Mean					65.00	33.87	50.09	1.80

**Continued 1**

Mandal	Village	Month	Stage of the Crop	Variety/Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Kalakada	Kona	Oct I FN	Harvesting	Sweakar-448	68.00	20.44	34.19	1.00
	Mudiyamvaripalli	Oct I FN	Flowering, Fruiting	Unknown	60.00	19.42	8.92	0.92
	Yerrakotapalli	Oct II FN	Vegetative	Sweakar-448	68.00	44.80	-	1.48
	Devalapalli	Oct II FN	Flowering	Prabha	64.00	29.14	-	1.08
	Balaiahgaripalli	Nov I FN	Mid Harvesting	Sweakar-448	84.00	45.03	41.82	0.48
	Kadirayacheruvu	Nov I FN	Vegetative, Flowering	Sweakar-448	52.00	23.61	-	0.96
	Batavaripalli	Nov II FN	Flowering	Sweakar-448	72.00	48.16	-	1.68
	Gudibanda	Nov II FN	Vegetative	Unknown	68.00	32.61	-	2.48
	Gyarampalli	Dec I FN	Vegetative	Sweakar-448	-	-	-	2.24
	Nadimicherla	Dec I FN	Vegetative	Sweakar-448	56.00	37.06	-	1.96
	Ethamanuvaddipalli	Dec II FN	Vegetative, Flowering	Sweakar-448	-	-	-	2.60
	Kotakadapalli	Dec II FN	Harvesting	US-440	64.00	30.72	27.42	0.92
	Kusuvripalli	Jan I FN	Vegetative	Unknown	76.00	30.40	-	2.52
	Gadi	Jan I FN	Vegetative	Sweakar-448	68.00	29.14	-	2.40
	Gangapuram	Jan II FN	Mid Harvesting	Shakti	72.00	45.03	52.11	1.12
	Madinenipalem	Jan II FN	Vegetative	Sweakar-448	80.00	55.38	-	0.72
Mean					59.50	30.68	32.89	1.53

**Continued 1**

Mandal	Village	Month	Stage of the Crop	Variety/Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Madanapalli	Valasapalli	Oct I FN	Vegetative	US-440	68.00	21.86	-	1.32
	Kotavaripalli	Oct I FN	Vegetative	Sweakar-448	64.00	18.13	-	1.56
	Jangalapalli	Oct II FN	Vegetative	Unknown	76.00	41.86	-	1.24
	Vempalli	Oct II FN	Harvesting	Sweakar-448	88.00	57.18	48.37	0.84
	Beripalli	Nov I FN	Vegetative	Sweakar-448	68.00	37.60	-	0.92
	Mungamakulapalli	Nov I FN	Flowering Fruiting	US-440	60.00	23.61	17.20	1.64
	Boggilivaripalli	Nov II FN	Vegetative	US-440	64.00	38.76	-	2.60
	Egumamadigapalli	Nov II FN	Mid Harvesting	Sweakar-448	84.00	52.96	50.54	1.32
	Jannevaripalli	Dec I FN	Flowering	Sweakar-448	68.00	36.88	-	2.08
	Krishnapuram	Dec I FN	Flowering Fruiting	US-440	60.00	33.03	24.44	1.56
	Malepadu	Dec II FN	Vegetative Flowering	Sweakar-448	64.00	38.40	-	2.24
	Molakaladinne	Dec II FN	Vegetative Flowering	Unknown	60.00	28.80	-	1.96
	Kothapalli	Jan I FN	Vegetative Flowering	Sweakar-448	72.00	32.00	-	2.08
	Penchupadu	Jan I FN	Vegetative	US-440	-	-	-	1.92
	Chinnatippasamudram	Jan II FN	Vegetative	Sweakar-448	76.00	36.19	-	1.84
	Karakampalli	Jan II FN	Vegetative	Sweakar-448	80.00	48.00	-	1.04
Mean					65.75	34.07	35.13	1.63

\*Average number of 25 tomato plants, FN- Fort Night

**Table 2:** Mean per cent infested plants, leaflets and fruits of tomato by *T. absoluta* and mean number of *N. tenuis* adults and nymphs per plant on tomato in Chittoor district of Andhra Pradesh during *rabi* 2016-17

Mandal	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> /Plant*
Piler	70.25	30.84	39.93	1.51
Kalikiri	77.75	45.66	38.89	1.21
Vayalpadu	65.00	33.87	50.09	1.80
Kalakada	59.50	30.68	32.89	1.53
Madanapalli	65.75	34.07	35.13	1.63

\*Average number of 25 tomato plants

**3.1.1.2 Incidence of *T. absoluta* on tomato in Chittoor district during *rabi* 2017-18**

During *rabi* 2017-18, the per cent infested plants, per cent infested leaflets and per cent damaged fruits by *T. absoluta*

were ranged from 0.00 to 88.00, 0.00 to 40.96 and 9.28 to 38.40 per cent, respectively. The per cent infested plants was high at Boyapalli (88%) followed by Nagari (84%), Annangivaripalli, Yellampalli, Ayyavaripalli and Diguvaipalem with 80 per cent. No infestation was recorded at

Munellapalli, Pothugaripalli, Kollabyu and Malepadu. The per cent infested leaflets was high at Nagari (44.32%) followed by Reddivaripalli (40.96%), Diguvapalem (36.28%) and Annangivaripalli (35.84%). The per cent damaged fruits was high at Gajjalavaripalli (38.40%) followed by Boyapalli (37.55%), Nagari (35.46%) and Nawabpeta (30.36%) while low at Nadimicherla (9.28%) followed by Vempalli (10.63%), Penchupadu (13.86%) and Bandakindapalli (14.96%) (Table 3).

The mean per cent *T. absoluta* infested plants was maximum

in farmers fields of Kalikiri mandal (54.50%) followed by Piler (52.0%), Vayalpadu (49.87%), Kalakada (43.25%) and Madanapalli (39.75%). The mean per cent infested leaflets was maximum in Kalikiri mandal (22.85%) followed by Piler (21.80%), Vayalpadu (20.63%), Kalakada (19.44%) and Madanapalli (15.92%). The mean per cent damaged fruits was highest in Kalikiri mandal (26.37%) followed by Piler (23.91%), Vayalpadu (22.16%), Kalakada (20.14%) and Madanapalli (14.87%) (Table 4).

**Table 3:** Survey on the incidence of South American tomato leaf miner, *T. absoluta* and number of *N. tenuis* adults and nymphs per plant on tomato in Chittoor district of Andhra Pradesh during rabi 2017-18

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Piler	Regallu	Oct I FN	Vegetative	Sweakar-448	72.00	30.25	0.00	0.48
	Pachipalavaripalli	Oct I FN	Vegetative	Unknown	52.00	20.15	0.00	0.56
	Nagari	Oct II FN	Mid Harvesting	Sweakar-448	84.00	44.32	35.46	0.00
	M.V.Palli	Oct II FN	Vegetative	Sweakar-448	20.00	9.23	0.00	1.12
	Bandakindapalli	Nov I FN	Harvesting	Prabha	48.00	20.36	14.96	0.00
	Veeramreddy Garipalli	Nov I FN	Flowering	Sweakar-448	72.00	28.40	0.00	0.40
	Agraharam	Nov II FN	Mid Harvesting	US-440	76.00	28.44	18.28	1.72
	Bodumalluvaripalli	Nov II FN	Vegetative	Sweakar-448	56.00	16.61	0.00	2.24
	Talapula	Dec I FN	Flowering	Shakthi	16.00	3.84	0.00	0.64
	Abbireddigaripalli	Dec I FN	Vegetative	Sweakar-448	32.00	11.07	0.00	1.40
	Vepulabyu	Dec II FN	Vegetative	Sweakar-448	36.00	12.36	0.00	1.96
	Kavalipalli	Dec II FN	Flowering	SR-101	28.00	4.57	0.00	1.32
	Boyapalli	Jan I FN	Nearing end of Harvesting	Sweakar-448	60.00	28.34	20.75	0.84
	Kuraparthivaripalli	Jan I FN	Vegetative	Prabha	48.00	23.84	0.00	0.64
	Jalalsahabgaripalli	Jan II FN	Flowering	Sweakar-448	52.00	31.20	0.00	1.76
	Annangivaripalli	Jan II FN	Harvesting	Sweakar-448	80.00	35.84	30.11	1.04
Mean					52.00	21.80	23.91	1.00

### Continued 3

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Kalikiri	Thummalapeta	Oct I FN	Flowering	Sweakar-448	64.00	28.52	0.00	0.00
	Ankemvaripalli	Oct I FN	Vegetative	SR-101	40.00	15.60	0.00	0.08
	Yellampalli	Oct II FN	Vegetative	Sweakar-448	80.00	34.40	0.00	1.96
	Kuravapalli	Oct II FN	Vegetative	SR-101	24.00	3.07	0.00	0.00
	Boyapalli	Nov I FN	Mid Harvesting	Sweakar-448	88.00	33.44	37.55	0.00
	Cheruvumundarapalli	Nov I FN	Vegetative	SR-101	64.00	21.53	0.00	0.00
	Pottekulavaripalli	Nov II FN	Vegetative Flowering	SR-101	48.00	24.96	0.00	1.08
	Reddivaripalli	Nov II FN	Mid Harvesting	Sweakar-448	68.00	40.96	21.94	0.72
	Nagiripalli	Dec I FN	Harvesting	Unknown	52.00	21.52	18.06	0.44
	Pathegada	Dec I FN	Vegetative	Sweakar-448	24.00	9.84	0.00	1.24
	Marrikuntapalli	Dec II FN	Harvesting	Sweakar-448	48.00	19.52	15.92	1.20
	Munellapalli	Dec II FN	Vegetative	Shakthi	0.00	0.00	0.00	0.72
	Tekalakona	Jan I FN	Flowering	Sweakar-448	72.00	29.14	0.00	1.84
	Moorevandlapalli	Jan I FN	Vegetative	SR-101	56.00	19.62	0.00	1.64
	Parapatla	Jan II FN	Vegetative	SR-101	68.00	29.07	0.00	2.24
	Gajjalavaripalli	Jan II FN	Nearing end of Harvesting	Sweakar-448	76.00	34.56	38.40	0.76
Mean					54.50	22.85	26.37	0.87

### Continued 3

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Vayalpadu	Ayyavaripalli	Oct I FN	Mid Harvesting	Sweakar-448	80.00	32.56	26.79	1.60
	Gandlapalli	Oct I FN	Vegetative	Sweakar-448	20.00	12.30	0.00	0.00
	Reddivaripalli	Oct II FN	Vegetative	Shakthi	60.00	21.80	0.00	0.88
	Vaddipalli	Oct II FN	Flowering	Unknown	52.00	19.92	0.00	0.00
	Itlamvaripalli	Nov I FN	Vegetative	Sweakar-448	48.00	12.76	0.00	1.28
	Vayalpadu	Nov I FN	Flowering	SR-101	52.00	12.16	0.00	1.24

	Jarravaripalli	Nov II FN	Vegetative	SR-101	72.00	33.23	0.00	0.76
	Vitalam	Nov II FN	Flowering Fruiting	Sweakar-448	64.00	24.38	15.09	2.60
	Chinthalavaripalli	Dec I FN	Mid Harvesting	SR-101	32.00	21.12	19.20	1.12
	Gandaboyanapalli	Dec I FN	Vegetative	Sweakar-448	24.00	14.76	0.00	1.30
	Manchuru	Dec II FN	Vegetative	Sweakar-448	40.00	18.46	0.00	1.68
	Sakirevupalli	Dec II FN	Vegetative	SR-101	24.00	11.07	0.00	1.40
	Budivedu	Jan I FN	Harvesting	Sweakar-448	56.00	19.12	25.97	0.76
	Chinthaparthi	Jan I FN	Vegetative	SR-101	52.00	20.00	0.00	1.48
	Jamallapalli	Jan II FN	Nearing end of Harvesting	Sweakar-448	68.00	27.77	27.20	0.00
	Kuraparthi	Jan II FN	Flowering Fruiting	Sweakar-448	54.00	28.80	18.75	1.80
Mean					49.87	20.63	22.16	1.11

Continued 3

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Kalakada	Pothugaripalli	Oct I FN	Fruiting	Sweakar-448	0.00	0.00	0.00	1.28
	Batavaripalli	Oct I FN	Fruiting	Unknown	32.00	17.61	22.31	1.84
	Kadirayacheruvu	Oct II FN	Vegetative	Sweakar-448	12.00	0.96	0.00	0.00
	Diguvapalem	Oct II FN	Vegetative	Sweakar-448	80.00	36.28	0.00	1.12
	Nadimicherla	Nov I FN	Harvesting	SR-101	48.00	19.44	9.28	1.00
	Balaiahgaripalli	Nov I FN	Flowering	SR-101	36.00	15.07	0.00	0.00
	Nawabpet	Nov II FN	Fruiting	SR-101	76.00	34.56	30.36	2.12
	Yerrakotapalli	Nov II FN	Vegetative	Sweakar-448	60.00	32.00	0.00	1.80
	Devalapalli	Dec I FN	Flowering	Sweakar-448	28.00	9.23	0.00	1.32
	Gangapuram	Dec I FN	Vegetative	SR-101	44.00	19.69	0.00	1.24
	Madinenipalem	Dec II FN	Flowering	Prabha	40.00	16.15	0.00	0.60
	Mudiyamvaripalli	Dec II FN	Mid Harvesting	Sweakar-448	48.00	19.20	16.23	0.76
	Ratiguntapalli	Jan I FN	Harvesting	Sweakar-448	56.00	26.88	18.66	0.88
	Gudibanda	Jan I FN	Vegetative Flowering	Sweakar-448	32.00	13.71	0.00	1.52
	Kothapalli	Jan II FN	Flowering Fruiting	Prabha	52.00	29.71	24.00	0.00
	Devapatla	Jan II FN	Flowering	Sweakar-448	48.00	20.57	0.00	2.52
Mean					43.25	19.44	20.14	1.12

Continued 3

Mandal	Village	Month	Stage of the Crop	Variety/ Hybrid	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Madanapalli	Kasiraopeta	Oct I FN	Flowering	Sweakar-448	44.00	17.42	0.00	0.92
	Chinnatippasamudram	Oct I FN	Mid Harvesting	Unknown	56.00	20.72	16.00	1.60
	Beripalli	Oct II FN	Vegetative	Sweakar-448	52.00	15.46	0.00	1.12
	Egumamadigapalli	Oct II FN	Vegetative	SR-101	40.00	16.22	0.00	0.00
	Penchupadu	Nov I FN	Fruiting	Sweakar-448	56.00	17.60	13.86	0.00
	Edigapalli	Nov I FN	Vegetative Flowering	SR-101	48.00	17.23	0.00	0.00
	Kollabyly	Nov II FN	Vegetative	Sweakar-448	0.00	0.00	0.00	1.24
	Valasapalli	Nov II FN	Flowering	Sweakar-448	72.00	35.92	0.00	1.16
	Vempalli	Dec I FN	Harvesting	SR-101	52.00	15.40	10.63	0.00
	Malepadu	Dec I FN	Vegetative	Unknown	0.00	0.00	0.00	0.96
	Ponnetipalem	Dec II FN	Flowering Fruiting	Sweakar-448	44.00	25.14	18.56	1.80
	Molakaladinne	Dec II FN	Vegetative	SR-101	36.00	12.00	0.00	2.32
	Kothavaripalli	Jan I FN	Flowering	Sweakar-448	24.00	11.42	0.00	0.56
	Tenegalavaripalli	Jan I FN	Vegetative	SR-101	52.00	20.40	0.00	1.68
	Krishnapuram	Jan II FN	Flowering	Prabha	20.00	7.61	0.00	1.44
	Boggilivaripalli	Jan II FN	Harvesting	Sweakar-448	40.00	22.22	15.31	2.40
Mean					39.75	15.92	14.87	1.07

\*Average number of 25 tomato plants, FN- Fort Night

**Table 4:** Mean per cent infested plants, leaflets and fruits of tomato by *T. absoluta* and mean number of *N. tenuis* adults and nymphs per plant on tomato in Chittoor district of Andhra Pradesh during rabi 2017-18

Mandal	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> /Plant*
Piler	52.00	21.80	23.91	1.00
Kalikiri	54.50	22.85	26.37	0.87
Vayalpadu	49.87	20.63	22.16	1.11
Kalakada	43.25	19.44	20.14	1.12
Madanapalli	39.75	15.92	14.87	1.07

\*Average number of 25 tomato plants



### 3.1.1.3 Incidence of *T. absoluta* on tomato in Chittoor district during *rabi* 2016-17 and 2017-18 (Pooled Data)

The data presented in the Table 5 revealed that the mean per cent *T. absoluta* infested plants, leaflets and fruits were ranged from 51.37 to 66.12, 24.99 to 34.25 and 25.00 to 36.12 per cent, respectively. The mean per cent infested plants, leaflets and fruits by *T. absoluta* were maximum in Kalikiri mandal (66.12%), (34.25%) and (32.65%), respectively while minimum in Kalakada (51.37% infested plants), Madanapalli (24.99% infested leaflets), (25.00% infested fruits).

**Table 5:** Overall mean per cent infested plants, leaflets and fruits of tomato by *T. absoluta* and mean number of *N. tenuis* adults and nymphs per plant in Chittoor district of Andhra Pradesh during *rabi* 2016-17 and 2017-18 (Pooled Data)

Mandal	Per cent infested plants*	Per cent infested leaflets*	Per cent damaged fruits*	Number of <i>N. tenuis</i> / Plant*
Piler	61.12	26.32	31.92	1.25
Kalikiri	66.12	34.25	32.63	1.04
Vayalpadu	57.43	27.25	36.12	1.45
Kalakada	51.37	25.06	26.51	1.32
Madanapalli	52.75	24.99	25.00	1.35

\*Average number of 25 tomato plants

Based on the observations of both the seasons, it was concluded that, *T. absoluta* has adapted well to the climatic and cultural conditions existing in Chittoor district of Andhra Pradesh and its high damaging potential makes a key limiting factor for tomato production. The incidence was observed from seedling to harvesting stage. The larvae were mined into the leaves, apical buds, flowers and they bored into the stems, green and ripened fruits. Typical damage symptoms of *T. absoluta* on leaves are blotch mines that are visible from both upper and lower leaf surfaces. In case of severe infestation, tomato plants become dead and drying of entire field was observed. *T. absoluta* damaged fruits had more than one pinhead size holes near to calyx. Fruit rot was also observed due to entering of secondary pathogens through pinhead size holes of damaged fruits. The incidence of *T. absoluta* was low during *rabi* 2017-18 compared to 2016-17. This could be due to differences in weather factors. The variation in the incidence of *T. absoluta* on tomato in different fields might be difference in the stages of the crop growth, variety, usage of the fertilizers, insecticides and fungicides etc.

The present results are in close agreement with the findings of Shasank *et al.* (2015) [16] who observed more than 50 per cent *T. absoluta* damage in localities viz., Pune, Ghargaon, Saphashrunji and Malegaon followed by 10-50 per cent damage in Shirpur and Satara in Maharashtra. The present results are supported by Sridhar *et al.* (2014) [18] reported the infestation of *T. absoluta* was 87 per cent on tomato during *rabi* 2014 in Bengaluru, Karnataka. Anitha *et al.* (2015) [4] also observed 14.4 to 97.90 per cent damage by *T. absoluta* on tomato at Vegetable Research Station, Rajendranagar, Telangana. Similar results were also reported by Kalleshwaraswamy *et al.* (2015) [8], Ballal *et al.* (2016) [4], Shanmugam *et al.* (2016) [14], Sharma and Gavkare (2017) [15] and Balaji *et al.* (2018) [3].

## 3.2 Predatory mirid bug, *Nesidiocoris tenuis* (Reuter) on tomato

### 3.2.1 Predatory mirid bug, *N. tenuis* adults and nymphs on tomato during *rabi* 2016-17

The number of adults and nymphs of *N. tenuis* per plant

ranged from 0.00 to 3.36 during *rabi* 2016-17. It was maximum in tomato fields located around Gandlapalli (3.36) followed by Balamvaripalli (2.88), Rajuvaripalli (2.80), Ethamanuvaddipalli and Boggilivaripalli (2.60). *N. tenuis* was not found in Addavaripalli and Cheruvumundarapalli (Table 1).

The mean number of *N. tenuis* per plant was maximum in Vayalpadu mandal (1.80) followed by Madanapalli (1.63), Kalakada (1.53), Piler (1.51) and Kalikiri (1.21) (Table 2).

### 3.2.2 Predatory mirid bug, *N. tenuis* on tomato during *rabi* 2017-18

During *rabi* 2017-18, the number of adults and nymphs of *N. tenuis* per plant ranged from up to 2.60. The population of *N. tenuis* was maximum in Vitalam village (2.60) followed by Devapatla (2.52), Molakaladinne (2.32), Bodumalluvaripalli and Parapatla (2.24) while it was not observed in Nagari, Bandakindapalli, Thummalapeta, Kuravapalli, Boyapalli, Cheruvumundarapalli, Gandlapalli, Vaddipalli, Jamallapalli, Kadirayacheruvu, Balaiahgaripalli, Kothapalli, Eguvamadigapalli, Penchupadu, Edigapalli and Vempalli (Table 3).

The mean number of *N. tenuis* per plant was maximum in tomato fields located around Kalakada mandal (1.12) followed by Vayalpadu (1.11) Madanapalli (1.07), Piler (1.0) and Kalikiri (0.87) (Table 4).

### 3.2.3 Predatory mirid bug, *N. tenuis* on tomato during *rabi* 2016-17 and 2017-18 (Pooled Data)

The observations on *N. tenuis* in both the seasons revealed the presence of mirid bug, *N. tenuis* in all major tomato growing mandals in Chittoor district except few locations. The mean number of *N. tenuis* per plant ranged from 1.04 to 1.45. The mean number of *N. tenuis* per plant was maximum in Vayalpadu (1.45) whereas minimum population were observed in Kalikiri (1.04) (Table 5).

Predatory mirid bug, *N. tenuis* was the predominant predator on eggs and early instar larvae of *T. absoluta*. Similar observations were recorded by Sridhar *et al.* (2014) [18], Anitha *et al.* (2015) [1] and Ballal *et al.* (2016) [18] who observed this mirid bug, *N. tenuis* as predator on eggs and early larval stages of *T. absoluta* under field conditions. Similarly, Sharma and Gavkare (2017) [15] also support the present finding *N. tenuis* as predator on early instars of *T. absoluta*.

## 4. Conclusions

The roving surveys on the incidence of *T. absoluta* in Chittoor district revealed that the damage of *T. absoluta* was found throughout the *rabi* season and observed from seedling to harvesting stage. The mean per cent infested plants, leaflets and fruits by *T. absoluta* were maximum at Kalikiri mandal (66.12%), (34.25%) and (32.65%), respectively while minimum at Kalakada (51.37%), Madanapalli (24.99%), (25.00%), respectively.

Predatory miridbug, *N. tenuis* was predating on eggs and first instar larvae of *T. absoluta*. The mean number of *N. tenuis* per plant was maximum at Vayalpadu (1.45) whereas minimum at Kalikiri (1.04).

## 5. References

1. Anitha KD, Anitha A, Anitha A, Lakshmi BKM, Vennila S, Rao NHP. New record of leaf miner, *Tuta absoluta* (Meyrick) in tomato. Insect Environment. 2015;

- 20(4):136-137.
2. Assaf LH, Hassan FR, Ismael HR, Saeed SA. Population density of tomato leaf miner *Tuta absoluta* Meyrick (Lepidoptera: Gelechiidae) under plastic houses conditions. Journal of Agriculture and Veterinary Sciences. 2013; 5(4):7-10.
3. Bajracharya ASR, Mainali RP, Bhat B, Bista S, Shashank PR, Meshram NM. The first record of South American tomato leaf miner, *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechiidae) in Nepal. Journal of Entomology and Zoology Studies. 2016; 4(4):1359-1363.
4. Balaji DR, Jeyarani, Ramaraju SK, Mohan S, Shanmugam PS. Occurrence of South American tomato pinworm, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae): An invasive pest in Tamil Nadu, India. Journal of Entomology and Zoology Studies. 2018; 6(2):657-662.
5. Ballal CR, Ankita G, Mohan M, Lalitha Y, Abraham V. The new invasive pest *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in India and its natural enemies along with evaluation of Trichogrammatids for its biological control. Current Science. 2016; 110:1-6.
6. Desneux N, Wajnberg E, Wyckhuys KAG, Burgio G, Arpaia S, Narvaez-Vasquez, *et al.* Biological invasion of European tomato crops by *Tuta absoluta*: ecology, geographical expansion and prospectus for biological control. Journal of Pest Science. 2010; 83:1-19.
7. EPPO. Datasheet of *Tuta absoluta*. OEPP/EPPO Bulletin. 2005; 35:434-435.
8. Hossain MS, Mian MY, Muniappan R. First record of *Tuta absoluta* (Lepidoptera: Gelechiidae) from Bangladesh. Journal of Agricultural and Urban Entomology. 2016; 32:101-105.
9. Kalleshwaraswamy MC, Murthy S, Viraktamath CA, Kumar NK. Occurrence of *Tuta absoluta* (Lepidoptera: Gelechiidae) in the Malnad and Hyderabad-Karnataka Regions of Karnataka, India. Florida Entomological Society. 2015; 98(3):970-971.
10. Kumar ST, Josephraj KA, Anitha N. First report of tomato pinworm, *Tuta absoluta* on egg plant, *Solanum melongena* L. from Kerala, India. Entomon. 2017; 42(4):335-338.
11. NICRA team of tomato pest surveillance. Manual for tomato pest surveillance. Jointly published by National Centre for Integrated Pest Management, New Delhi; Central Institute for Dryland Agriculture, Hyderabad; Indian Institute of Horticultural Research, Bengaluru and Indian Institute of Vegetable Research, Varanasi. 2012; 39.
12. Nitin KS, Sridhar V, Kumar KP, Chakravarthy AK. Seasonal incidence of South American tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on tomato ecosystem. International Journal of Pure Applied Biosciences. 2017; 5(1):521-525.
13. Sandeep KS, Sridhar V, Sharma A, Asokan R. Report on the occurrence of South American Tomato moth, *Tuta absoluta* (Meyrick) in Punjab, India as evident from trap catches and molecular diagnosis. Pest Management in Horticultural Ecosystems. 2017; 23(1):89-91.
14. Sankarganesh E, Firake DM, Sharma B, Verma VK, Behere GT. Invasion of the South American Tomato Pinworm, *Tuta absoluta*, in northeastern India: a new challenge and biosecurity concerns. Entomologia Generalis. 2017; 36(4):335-345.
15. Shanmugam PS, Ramaraju K, Indhumathi K. First record of South American tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in Tamil Nadu, India. Entomon. 2016; 41(1):61-66.
16. Sharma PL, Gavkare O. New distributional record of invasive pest *Tuta absoluta* (Meyrick) in North-Western Himalayan Region of India. National Academy Science Letter, Springer, 2017.
17. Shasank PR, Chandrasekhar K, Meshram NM, Sreedevi K. Occurrence of *Tuta absoluta* (Lepidoptera: Gelechiidae) an invasive pest in India. Indian Journal of Entomology. 2015; 77(4):323-329.
18. Shashank PR, Suroshe SS, Singh PK, Chandrashekar K, Nebapure SM, Meshram NM. Report of invasive tomato leaf miner, *Tuta absoluta* (Lepidoptera: Gelechiidae) from northern India. Indian Journal of Agricultural Sciences. 2016; 86(12):1635-1636.
19. Sridhar V, Chakravarthy AK, Asokan R, Vinesh LS, Rebijith KB, Vennila S. New record of the invasive South American tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in India. Pest Management in Horticultural Ecosystems. 2014. 20(2):148-154.
20. Swathi P, Swathi B, Das SB, Sridhar V, Giribabu O, Snehalatha *et al.* First report of South American tomato leaf miner, *Tuta absoluta* (Meyrick) from Madhya Pradesh, India. Pest Management in Horticultural Ecosystems. 2017; 23(1):92-93.
21. www.indiastat.com. State-wise area, production and productivity of tomato in India, 2016-17.