Biological Forum
an International Journal 17(6): 132-135(2025)
ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Survey the Infestation of Fruit Borer Complex and their Natural Enemies on Tomato in Semi Arid Region of Rajasthan

Neelam Kumari*, B.L. Jat, Suresh Choudhary and Heera Kumari
Department of Entomology, Sri Karan Narendra Agriculture University, Jobner (Rajasthan) India.

(Corresponding author: Neelam Kumari)*
(Received: 25 March 2025; Revised: 06 May 2025; Accepted: 02 June 2025; Published online: 26 June 2025)
(Published by Research Trend)

DOI: https://doi.org/10.65041/BiologicalForum.2025.17.6.19

ABSTRACT: A survey conducted during Kharif 2023 and 2024 across six tehsils of Jaipur district revealed significant spatial and temporal variation in the infestation of tomato pinworm (*Tuta absoluta*) and fruit borer (*Helicoverpa armigera*). Chomu and Sanganer consistently emerged as pest hotspots, while Dudu and Kishangarh Renwal recorded low infestation levels. In Chomu, *T. absoluta* infestation peaked at 23.5 mines and 2.7 larvae per five plants in 2023, and 20.5 mines and 2.4 larvae in 2024, with fruit damage of 18.84% and 15.52%, respectively. *H. armigera* infestation was highest in Sanganer, with larval counts of 4.3 and 4.1 per five plants, and fruit damage of 35.66% and 31.31% in 2023 and 2024, respectively. Natural enemies such as the mirid bug (*Nesidiocoris tenuis*) and spiders were observed across all tehsils, with *N. tenuis* most abundant in Chomu (2.5 per five plants) and spiders in Sanganer (3.8 per five plants).

Keywords: Survey, Tomato, Significant, Consistently.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is an important vegetable crop of the Solanaceae family, cultivated worldwide for its economic and nutritional value. India is the second-largest producer after China, with extensive cultivation for fresh consumption. Tomato is widely used to make soup, juice, ketchup, puree, paste, and powder, and is also known for its medicinal value-reportedly possessing antiseptic properties that help combat intestinal infections and purify blood (Willcox *et al*., 2003). Lycopene, a key carotenoid found in tomatoes, is known for its antioxidant and anticancer properties (Rao & Agarwal 1999).

Tomato is grown globally, both in open fields and greenhouses, particularly in countries like China, India, USA, Turkey, Egypt, Iran, Italy, Spain, Brazil, and Mexico. In India, it is cultivated on 853.99 thousand hectares with a production of 21323 thousand MT and productivity of 24.97 MT/ha (Anonymous, 2023). Major tomato-producing states include Andhra Pradesh, Odisha, Telangana, Madhya Pradesh, Karnataka, West Bengal, Chhattisgarh, Maharashtra, Bihar, Gujarat, and Rajasthan. In Rajasthan, tomato covers 20.47 thousand hectares, with an annual production of 260.75 thousand MT and productivity of 12.74 MT/ha (Anonymous, 2023).

However, tomato production is often limited by biotic and abiotic stresses, especially insect pests and diseases which significantly reduce yield and fruit quality. Among emerging pests, the South American tomato pinworm (*Tuta absoluta*) is causing serious concern, with damage reports of up to 80% yield loss, especially in South Indian conditions (Nitin *et al*., 2017; Biondi *et al.,* 2018). This pest was first reported in India in October 2014 in Maharashtra (Pune, Ahmednagar, Dhule, Jalgaon, Nashik, and Satara districts) (Shashank *et al*., 2015), and later detected in Udaipur, Rajasthan during 2018 - 2020 under field and protected cultivation. *T. absoluta* larvae cause direct damage by mining leaves, boring into stems, buds, and fruits, and can cause losses up to 80–100% without timely control measures (Desneux *et al.,* 2010). This pest poses a significant threat to both open-field and greenhouse tomato production systems. Additionally, the fruit borer *Helicoverpa armigera*, a highly polyphagous pest, feeds on foliage and bores into shoots and fruits, severely impacting yield and quality. The larvae damage developing fruits, making them unmarketable and leading to crop losses of up to 55% (Selvanarayanan, 2000; Sharma, 2005).

This study focuses on these major pest threats by conducting field surveys to evaluate pest populations, monitor seasonal dynamics, and explore integrated pest management (IPM) strategies suited to the agro-climatic conditions of Rajasthan (Kumar *et al*., 2019).

MATERIALS AND METHODS

The survey on fruit borer complex and their natural enemies on tomato crop was conducted at vegetative and fruiting stages in the Jaipur district of Rajasthan at different locations *i.e.* six tehsils (Chomu, Bassi, Sanganer, Dudu, Kishangarh Renwal and Jobner). From each tehsil two village and from each village five farmers were selected during two consecutive seasons, *Kharif*, 2023 and 2024.

Method of observations

For recording the observations, five plants were selected randomly from each farmer's field at different locations. The observations on fruit borer complex and their natural enemies were recorded as per following sub-heads.

1. Tomato pinworm, *Tuta absoluta* (Meyrick). During the survey the number of leaf mines, number of larvae and per cent fruit damage was recorded on five randomly selected plants at vegetative and fruiting stages. The number of mines were counted on two leaves each from top, middle and bottom of the plant (Sridhar *et al*., 2016) and the mean number of mines per five plant was calculated. The larval population was recorded per five plant basis and per cent fruit damage was calculated using the formula given by Kashyap and Verma (1987).

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

2. Tomato fruit borer, *Helicoverpa armigera* (Hubner). The larval population of fruit borer was recorded on five randomly selected plants and percent fruit damage was worked out as formula given by Kashyap and Verma (1987).

3. Natural enemies. The population of natural enemies *viz*., mirid bug, *Nesidiocoris tenuis* (Reuter) (both nymph and adult) and spiders were recorded on five randomly selected plants during both the year of study from each field at different location.

RESULT AND DISCUSSION

Tomato pinworm, *T. absoluta*

Vegetative stage of tomato crop: The data presented in Table 1 and 2 revealed that at the vegetative stage of tomato crop during *Kharif* 2023, the maximum number of mines (16.0 per five 5 plants) and larvae (1.8 per 5 plants) of *T. absoluta* were recorded in Chomu tehsil, followed by Sanganer (15.0 mines and 1.7 larvae) and Jobner (12.5 mines and 1.5 larvae). The minimum number of mines (5.5 per 5 plants) and larvae (0.9 per 5 plants) were observed in Dudu tehsil, followed by Kishangarh Renwal (7.5 mines and 1.2 larvae) and Bassi (10.0 mines and 1.3 larvae).

Likewise, during *Kharif* 2024, the maximum number of mines (14.5 per 5 plant) and larvae (1.5 per 5 plants) were recorded in Chomu tehsil, followed by Jobner (13.0 mines and 1.3 larvae) and Bassi (10.5 mines and 1.2 larvae). The minimum number of mines (4.5 per 5 plants) and larvae (0.7 per 5 plants) were observed in Dudu tehsil, followed by Kishangarh Renwal (5.5 mines and 0.9 larvae) and Sanganer (8.0 mines and 1.1 larvae).

Fruiting stage of tomato crop: The data in Table 1 and 2 showed that at the fruiting stage during *Kharif* 2023, the maximum number of mines (23.5 per 5 plants) and larvae (2.7 per 5 plants) were recorded in Chomu tehsil, followed by Sanganer (21.5 mines and 2.5 larvae) and Jobner (20.5 mines and 2.2 larvae). The minimum number of mines (14.0 per 5 plants) and larvae (1.4 per 5 plants) were observed in Dudu tehsil, followed by Kishangarh Renwal (16.5 mines and 1.7 larvae) and Bassi (18.5 mines and 2.0 larvae). The maximum percent fruit infestation due to tomato pinworm was also recorded in Chomu tehsil (18.84%), followed by Sanganer (16.22%) and Jobner (12.88%), while the minimum was in Dudu tehsil (4.81%), followed by Kishangarh Renwal (7.27%) and Bassi (9.88%).

Similarly during *Kharif* 2024, the maximum number of mines 20.5 per 5 plants) and larvae (2.4 per 5 plants) were also recorded in Chomu tehsil, followed by Jobner (19.5 mines and 2.2 larvae) and Bassi (18.5 mines and 2.0 larvae). The minimum number of mines (13.5 per 5 plants) and larvae (1.3 per 5 plants) were observed in Dudu tehsil, followed by Kishangarh Renwal (14.5 mines and 1.5 larvae) and Sanganer (17.0 mines and 1.7 larvae). The maximum percent fruit infestation due to tomato pinworm was recorded in Chomu tehsil (15.52%), followed by Jobner (14.62%) and Bassi (10.36), while the minimum was in Dudu tehsil (2.41%), followed by Kishangarh Renwal (5.65%) and Sanganer (8.53 %).

These results are corroborated by Choudhary (2024), who also identified Chomu as the most severely infested tehsil. Similarly, Sridhar *et al.* (2014) recorded up to 15 mines per plant and over 80% plant infestation in tomato fields of Karnataka. High levels of leaf and fruit damage have also been reported by Balaji *et al.* (2018); Kalleshwaraswamy *et al.* (2015) in Tamil Nadu and Karnataka, indicating widespread threat posed by this pest across different regions.

The present findings also align with Rashid *et al.* (2018) in Andhra Pradesh, Ramesh *et al.* (2023) in Maharashtra reported infestation levels with leaf mines ranging from 0.46 to 12.6 per plant and fruit damage from 10.56% to over 80%. In Nepal, Bajracharya *et al.* (2016); Adhikari *et al.* (2019) recorded *T. absoluta* infestation above 75% in certain districts, confirming its high destructive potential.

Tomato fruit borer, *H. armigera*

Vegetative stage of tomato crop: The data presented in Table 1 and 2 showed that during *Kharif* 2023, at the vegetative stage of the tomato crop the maximum number of larvae (2.0 per 5 plants) was recorded in Sanganer tehsil, followed by Chomu (1.8) and Jobner (1.7), while, the minimum was in Kishangarh Renwal (1.1), followed by Dudu (1.3) and Bassi (1.4).

Likewise during *Kharif* 2024, the maximum number of larvae (1.8 per 5 plants) were recorded in Sanganer tehsil, followed by Chomu (1.7) and Bassi (1.5) and the minimum was in Dudu (0.7), followed by Kishangarh Renwal (1.0) and Jobner (1.2).

Fruiting stage of tomato crop: At the fruiting stage during *Kharif* 2023, the maximum number of larvae (4.3 per 5 plants) was recorded in Sanganer tehsil, followed by Chomu (4.0) and Jobner (3.8), while, the minimum was in Kishangarh Renwal (3.0), followed by Dudu (3.2) and Bassi (3.5). The maximum percent fruit infestation due to tomato fruit borer was observed in Sanganer tehsil (35.66%), followed by Chomu (32.16%) and Jobner (29.51%), while, the minimum

was in Kishangarh Renwal (18.17%), followed by Dudu (21.95%) and Bassi (27.68%).

Similarly during *Kharif* 2024, the maximum number of larvae 4.1 per 5 plants) was recorded in Sanganer tehsil, followed by Chomu (3.7) and Bassi (3.6), while, the minimum was in Dudu tehsil (2.6), followed by Kishangarh Renwal (2.9) and Jobner (3.2). The maximum percent fruit infestation due to tomato fruit borer was also observed in Sanganer tehsil (31.31%), followed by Chomu (29.69%) and Bassi (25.81), while the minimum was in Dudu (15.83%), followed by Kishangarh Renwal (18.85%) and Jobner (22.91%).

Similar trends were observed by Wakil *et al.* (2010) in Pakistan, where infestation ranged from 14.5% to 32.6%. Lal and Lal (1996) reported 70–80% fruit damage in areas surrounding Delhi, even under heavy pesticide use, underscoring the limited efficacy of chemical control.

Natural enemies : The natural enemies *viz.*, mirid bug, *Nesidiocoris tenuis* (Reuter) and spiders were observed in all the tehsil surveyed during both the year on tomato crop.

Mirid bug: During *Kharif* 2023, the mean population of both adults and nymphs of mirid bug, *N. tenuis* per five plant of tomato were ranged from 1.6 to 2.5 being, maximum in Chomu tehsil (2.5) and minimum in Dudu tehsil (1.6). Similarly during *Kharif* 2024, the mean population of *N. tenuis* per five plant were ranged from 1.5 to 2.2, being, maximum in Chomu (2.2) and minimum in Kishangarh Renwal (1.5). In other tehsils *viz.*, Sanganer, Jobner, Bassi and Kishangarh Renwal the population of mirid bug was 2.2, 2.0, 1.9 and 1.8, respectively during *Kharif*, 2023. In the tehsils Jobner, Bassi, Sanganer and Dudu the population was 2.0, 1.9, 1.8 and 1.8, respectively during *Kharif*, 2024.

Spider: During *Kharif* 2023, the mean population of spiders per five plant were ranged from 2.9 to 3.8 being maximum in Sanganer tehsil (3.8) and minimum in Dudu (2.9). Similarly during *Kharif* 2024, the mean population of spiders per five plant were also ranged from 2.6 to 3.5, being maximum in Sanganer (3.5) and minimum in Jobner (2.6). In other tehsils *viz.*, Chomu, Jobner, Kishangarh Renwal and Bassi the population of spiders was 3.5, 3.4, 3.2 and 2.9, respectively during *Kharif*, 2023. In the tehsils Chomu, Kishangarh Renwal, Bassi, and Dudu the population was 3.4, 3.2, 3.0 and 2.9, respectively during *Kharif*, 2024.

These results agree with Rashid *et al.* (2018), who reported *N. tenuis* preying on *T. absoluta* eggs and early larvae, and Devaraj *et al.* (2018), who recorded beneficial predators in Karnataka tomato fields. The present work is similar to that of Patil *et al.* (2023) who recorded ten different species of spiders in tomato. The consistent presence of natural enemies suggests their potential role in pest regulation and highlights the importance of conserving these beneficial organisms in integrated pest management (IPM) strategies.

Table 1: Survey the infestation of fruit borer complex and their natural enemies on tomato crop in *Kharif*, 2023.

District	Tehsil	*Tuta absoluta*					*Helicoverpa armigera*			Natural enemies	
		Vegetative stage		Fruiting stage			Vegetative stage	Fruiting Stage			
		Leaf mines/ 5 plants	Larvae/ 5 plants	Leaf mines/ 5 plants	Larvae/ 5 plants	Fruit infestation (%)	Larvae/ 5 plants	Larvae/ 5 plants	Fruit infestation (%)	Mirid bug/ 5 plants	Spider/ 5 plants
Jaipur (Rajasthan)	1. Chomu	16.0	1.8	23.5	2.7	18.84	1.8	4.0	32.16	2.5	3.5
	2. Bassi	10.0	1.3	18.5	2.0	9.88	1.4	3.5	27.68	1.9	3.0
	3. Sanganer	15.0	1.7	21.5	2.5	16.22	2.0	4.3	35.66	2.2	3.8
	4. Dudu	5.5	0.9	14.0	1.4	4.81	1.3	3.2	21.95	1.6	2.9
	5. Kishangarh Renwal	7.5	1.2	16.5	1.7	7.27	1.1	3.0	18.17	1.8	3.2
	6. Jobner	12.5	1.5	20.5	2.2	12.88	1.7	3.8	29.51	2.0	3.4

Table 2: Survey the infestation of fruit borer complex and their natural enemies on tomato crop in *Kharif*, 2024.

District	Tehsil	*Tuta absoluta*					*Helicoverpa armigera*			Natural enemies	
		Vegetative stage		Fruiting stage			Vegetative stage	Fruiting stage			
		Leaf mines/ 5 plant	Larvae/ 5 plants	Leaf mines/ 5 plants	Larvae/ 5 plants	Fruit infestation (%)	Larvae/ 5 plants	Larvae/ 5 plants	Fruit infestation (%)	Mirid bug/ 5 plants	Spider/ 5 plants
Jaipur (Rajasthan)	1. Chomu	14.5	1.5	20.5	2.4	15.52	1.7	3.7	29.69	2.2	3.4
	2. Bassi	10.5	1.2	18.5	2.0	10.36	1.5	3.6	25.81	1.9	3.0
	3. Sanganer	8.0	1.1	17.0	1.7	8.53	1.8	4.1	31.31	1.8	3.5
	4. Dudu	4.5	0.7	13.5	1.3	2.41	0.7	2.6	15.83	1.8	2.9
	4. Kishangarh Renwal	5.5	0.9	14.5	1.5	5.65	1.0	2.9	18.85	1.5	3.2
	5. Jobner	13	1.3	19.5	2.2	14.62	1.2	3.2	22.91	2.0	2.6

CONCLUSIONS

The survey on the incidence of *T. absoluta* and *H. armigera* in Jaipur district revealed that the damage of *T. absoluta* and *H. armigera* was found throughout the *Kharif* season and showed that Chomu and Sanganer tehsil consistently emerged as major hotspots for pest

incidence, whereas Dudu and Kishangarh Renwal tehsil reported relatively lower levels of infestation.

FUTURE SCOPE

The future scope of this study includes developing targeted pest management strategies tailored to hotspot areas like Chomu and Sanganer, and promoting the conservation of natural enemies such as *Nesidiocoris tenuis* and spiders for sustainable pest control. Further research could also explore the ecological factors driving spatial and temporal pest variation.

Acknowledgements. The authors thank the Dean, S.K.N. College of Agriculture, Jobner for providing facilities and "Research Fellowship Scheme – 2023" for financial support.
Conflict of Interest. No.

REFERENCES

Adhikari, D., Subedi, R., Gautam, S., Pandit, D. P. and Sharma, D. R. (2019). Monitoring and management of tomato leaf miner, *Tuta absoluta* (Meyrick) in Kavrepalanchowk, Nepal. *The Journal of Agriculture and Environment, 20*, 1-9.

Anonymous (2023). Report "Directorate of Horticulture, Government of Rajasthan, pp.16.

Bajracharya, A. S. R., Ram Prasad Mainali R. P., Bhat B., Bista S., Shashank P.R. and Meshram N. M. (2016). The first record of South American tomato leaf miner, *Tuta absoluta* (Meyrick 1917) (Lepidoptera: Gelechiidae) in Nepal. *Journal of Entomology and Zoology Studies 4*, 1359-1363.

Balaji, D. R., Jeyarani, S., Ramaraju, K., Mohankumar, S. and Shanmugam, P. S. (2018). Occurrence of South American tomato pinworm, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae): An invasive pest in Tamil Nadu, *Indian Journal of Entomology and Zoology Studies, 6*, 657-662.

Biondi, A., Guedes, R. N. C., Wan, F. H. and Desneux, N. (2018). Ecology, worldwide spread, and management of the invasive South American tomato pinworm, *Tuta absoluta*. *Annual Review of Entomology*, *63*, 239–258.

Choudhary (2024). Management of tomato leaf miner, *Tuta absoluta* (Meyrick) through eco-friendly approaches. M.Sc. thesis submitted to Ja Sri Karan Narendra Agriculture University, Jobner, Jaipur, India.

Desneux, N., Wajnberg, E., Wyckhuys, K. A. G., Burgio, G., Arpaia, S. and Vasquez, N. C. A. (2010). Biological invasion of European tomato crops by *Tuta absoluta* (Meyrick), Ecology, geographical expansion and prospects for biological control. *Journal of Pest Science*, *83*, 1–19.

Devaraj, A. N., Prasad, K. and Reddy, N. A. (2018). Incidence of South American tomato leaf miner *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) and its natural enemies in southern Karnataka. *Indian Journal of Entomology, 80*, 1128- 1132.

Kalleshwaraswamy, M. C., Murthy, S., Viraktamath, C. A. and Kumar, N. K. (2015). Occurrence of *Tuta absoluta* (Lepidoptera : Gelechiidae) in the Malnad and Hyderabad-Karnataka Regions of Karnataka, India. *Florida Entomological Society*, *98*, 970-971.

Kashyap, R. K. and Verma, A. N. (1987). Factor imparting resistance to fruit damage by *Heliothis armigera* (Hubner) in some tomato phenotypes. *International Journal of Tropical Insect Science, 8*, 111-114.

Kumar, P., Bhardwaj, R. K. and Yadav, M. (2019). Integrated Pest Management: A Key for Sustainable Agriculture. *Journal of Plant Protection Research*, *59*, 331–337.

Lal, O. P. and Lal, S. K. (1996). Failure of control measures against *Heliothis armigera* (Hub.) infesting tomato in heavy pesticidal application areas in Delhi and Satalite towns in western Uttar Pradesh and Haryana (India). *Journal of Entomological Research, 20*, 355-364.

Nitin, K. S., Sridhar, V., Kumar, K. P. and Chakravarthy, A. K. (2017). Seasonal incidence of South American tomato moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) on tomato ecosystem. *International Journal of Pure Applied Biosciences, 5*, 521-525.

Patil, R. R., Gundannavar, K. P., Guruprasad, G. S. and Kulkarni, V. R. (2023). Documentation of different pests and their natural enemies on tomato. *Journal of Farm Sciences, 36*, 81-86.

Ramesh, K. B., Zanwar, P. R., Tukaram, N. A. and Kelageri, S. S. (2023). Survey and seasonal incidence studies for new invasive tomato leaf miner, *Tuta absoluta* (Meyrick). *Journal of Entomological Research, 47,* 393-398.

Rao, A. V. and Agarwal, S. (1999). Role of lycopene as antioxidant carotenoid in the prevention of chronic diseases: A review. *Nutrition Research*, *19*, 305–323.

Rasheed, V. A., Rao, S. R. K., Babu, T. R., Krishna, T. M., Reddy, B. V. B. and Naidu, G. M. (2018). Incidence of South American tomato leaf miner, *Tuta absoluta* (Meyrick) in Chittoor district of Andhra Pradesh, India. *Journal of Entomology and Zoology Studies, 6*, 2407-2414.

Selvanarayanan, V. (2000). Bio-ecology and management of tomato fruit borer, *Helicoverpa armigera* (Hubner). *Pest Management in Horticultural Ecosystems*, *6*, 50–55.

Sharma, H. C. (2005). *Helicoverpa armigera* management: Current status and future prospects. *Insect Science, 12*, 409–414.

Shashank, P. R., Chandrashekar, K., Naresh, M. M. and Sreedevi, K. (2015). Occurrence of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) an invasive pest from India. *Indian Journal of Entomology, 77*, 323-329.

Sridhar, V., Chakravarthy, A. K., Asokan, R., Vinesh, L. S., Rebijith, K. B. and Vennila, S. (2014). New record of the invasive South American tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in India. *Pest Management in Horticultural Ecosystem, 20*, 148-154.

Sridhar, V., Onkaranaik, S. and Nitin, K. S. (2016). Efficacy of new molecules of insecticides against South American moth, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). *Pest Management in Horticulture Ecosystem*, *2*, 137-145.

Wakil, W., Ghazanfar, M. U., Kwon, Y. J., Qayyum, M. A. and Nasir, F. (2010). Distribution of *Helicoverpa armigera* (Hub) (Lepidoptera: Noctuidae) in tomato fields and its relationship to weather factors. *Entomological Research*, *40*, 290-297.

Willcox, J. K., Catignani, G. L. and Lazarus, S. (2003). Tomatoes and cardiovascular health. *Critical Reviews in Food Science and Nutrition*, *43*, 1–18.

How to cite this article: Neelam Kumari, B.L. Jat, Suresh Choudhary and Heera Kumari (2025). Survey the Infestation of Fruit Borer Complex and their Natural Enemies on Tomato in Semi Arid Region of Rajasthan. *Biological Forum, 17*(6): 132-135.