

## BIOLOGY OF TOMATO LEAF MINER, *TUTA ABSOLUTA* (MEYRICK) (LEPIDOPTERA : GELECHIIDAE) UNDER LABORATORY CONDITION

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**ABSTRACT :** The study on biology of tomato leaf miner, *Tuta absoluta* (Meyrick) was carried out during 2015-16. All the experimental studies were conducted in the controlled conditions (28°C Temp and 70% RH) at the Main Agriculture Research Station, Raichur, Karnataka. The results revealed that, egg, first, second, third and fourth larval period was  $4.08 \pm 0.55$ ,  $3.48 \pm 0.64$ ,  $1.78 \pm 0.40$ ,  $1.90 \pm 0.44$  and  $3.43 \pm 0.58$  days respectively with total larval period of  $10.59 \pm 2.06$  days. The pre-oviposition and oviposition period found to be  $1.33 \pm 0.33$  and  $11.55 \pm 0.92$  days, respectively. The fecundity varied from  $165.05 \pm 6.22$  eggs per female. The longevity of adult male was  $7.50 \pm 1.20$  days and female  $15.01 \pm 1.47$  days. The male and female of *T. absoluta* occupied  $29.76 \pm 3.92$  and  $37.30 \pm 4.88$  days, respectively to complete total life cycle.

**Key words :** *Tuta absoluta*, biology, incubation, fecundity and longevity.

### INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is the edible, often red berry type fruit which belongs to the nightshade family solanaceae. Tomato is a self pollinated crop which is originated in Central and South America having chromosome number,  $2n = 24$ . Tomato is one of the most popular and nutritious fruit vegetable, widely grown around the world and second ranked after potato. It is a perennial in its habitat and grown as an annual in temperate climates. In India, tomato is cultivated over an area of 8.82 lakh ha with a production of 187.35 lakh mt and the average productivity is 20.7 t/ha. Andhra Pradesh, Odisha, Madhya Pradesh, Karnataka, West Bengal, Maharashtra, Chhattisgarh and Gujarat are the major tomato growing states in India. Karnataka has an area of 0.61 lakh ha with a production of 20.68 lakh mt and productivity of 33.90 t/ha (Anonymous, 2014). Though, the potential yield of tomato is around 50 to 80 t/ha but the major bottleneck to achieve the potential yield is may be due to both biotic and abiotic factors. Among the biotic factors, insect pests and diseases are major with significant deleterious effects on crop growth and yield. The potential insect species attack on tomato are fruit borer, *Helicoverpa armigera* (Hubner), serpentine leaf miner, *Liriomyza trifolii* (Burgess), aphids, *Myzus persicae* (Sulzer) or *Aphis gossypii* (Glover), mites, *Tetranychus* spp., thrips, *Thrips tabaci* (Lindeman), armyworm, *Spodoptera litura* (Fabricius), mealybugs, *Maconellicoccus* sp. and whitefly, *Bemisia tabaci*

(Gennadius). Thrips and whitefly apart from the direct damage they cause huge crop loss due to their ability to carry the virus diseases (vector) viz., tospovirus (thrips) and leaf curl virus (whitefly). The major diseases caused by bacteria are bacterial canker, *Clavibacter michiganensis* (Smith), bacterial wilt, *Ralstonia solanacearum* (Ralston), bacterial stem rot and fruit rot, *Erwinia carotovora carotovora* (Jones). The fungal diseases noticed are anthracnose, *Colletotrichum gloeosporioides* (Penz.), fusarium wilt, *Fusarium oxysporum* f. sp. *lycopersici* (Saccardo), pythium damping-off, *Pythium aphanidermatum* (Edson) and verticillium wilt, *Verticillium dahliae* (Klebahn). Apart from bacterial and fungal diseases nematodes also cause heavy crop loss.

In recent years, a new invasive pest encountered is tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) inflicting severe loss for tomato production in many countries either in open field or greenhouses. It is one of the most devastating pests of tomato crop (EPPO, 2010). This pest was recorded first time in many parts of South America (Garica and Espul, 1982) and later it rapidly invaded to European countries and spread through the Mediterranean basin (Desneux *et al*, 2010). The tomato leafminer, invaded Egypt in 2009 and by 2011, it reached the North part of Sudan (Tamerak, 2011; Gaffar, 2012). In India, occurrence of this invasive pest was observed for the first time infesting tomato crop in Pune, Maharashtra. The adult female moth tends to lay

eggs on tender foliage, stem, flower buds, calyx and young fruits. The tiny larvae mines into the young foliage and later small blotches are visible and if the crop is affected severely, then the foliage appears burnt. On fruits, the larvae makes small pin holes and later secondary invasions of pathogen takes place, which leads to the deterioration of quality of tomato in market. The noticeable loss is around 90 per cent during severe infestation. It is observed that presence of this pest in Kolar and Bengaluru districts of Karnataka. Similarly, the occurrence of this pest in severe form was noticed in tomato growing areas of Raichur. The current report of *T. absoluta* from India is alarming because of this pest, as it is oligophagous and can attack several suitable solanaceous host plants.

### MATERIALS AND METHODS

Initially tomato leafminer, *T. absoluta* were collected from tomato field and transferred to tomato seedlings maintained in greenhouse and reared for two generations, which served as stock culture and used for further studies.

The seeds of tomato hybrid, Mahyco-401 were sown in pots and maintained in greenhouse condition. Twenty pots containing single seedling were taken for biology study, each pot was kept separately in insect proof cage having a size of 60 × 50 × 50 cm, which provided with tomato plant pots (young seedlings) for oviposition. Ten per cent honey solution along with yeast was provided as an adult food. The tomato pots were replaced daily for egg laying. Later entire seedling was observed with the help of 40X magnification binocular microscope for the presence of eggs. At regular interval biological parameters like preoviposition, oviposition, fecundity and developmental period were recorded. Similarly morphometric studies were undertaken on a separate culture maintained to obtain all stages *viz.*, eggs, larva, pupa and adults. After each moult different larval instars were collected in alcohol (70%) for morphometric parameters *viz.*, length and breadth of each stages of instars (egg, larva, pupa and adults) were measured with help of Progress software.

### RESULTS AND DISCUSSION

Adult tomato leafminer, *T. absoluta* lay eggs on under surface of the leaf, leaf neck, sepals and stem, which are oval in shape and creamy white in colour later, turn to yellow and finally black before hatching. The female was laid 165.05 ± 6.22 eggs in her life span. The length of egg was measured 0.35 ± 0.02 mm in length and 0.22 ± 0.01 mm in breadth (Table 1). The incubation of egg lasted for 4.08 ± 0.55 days (Table 2). Similarly, Erdogan and Babaroglu (2014) observed an incubation period of 4.1 days at 25°C. Erdogan and Babaroglu (2014) reported

**Table 1 :** Morphometry of different stages of tomato leafminer, *T. absoluta*.

Stages of insects		Length (mm)* Mean±SD	Breadth (mm)* Mean±SD	Head Capsule (mm)* Mean±SD
Egg		0.35 ± 0.02	0.22 ± 0.01	-
<b>Larval stages</b>				
First instar		1.36 ± 0.02	0.23 ± 0.01	0.15 ± 0.01
Second instar		2.33 ± 0.02	0.25 ± 0.02	0.23 ± 0.02
Third instar		3.86 ± 0.02	0.55 ± 0.04	0.36 ± 0.02
Fourth instar		7.84 ± 0.38	1.10 ± 0.05	0.59 ± 0.03
Pupa	Male	4.17 ± 0.32	1.15 ± 0.35	-
	Female	4.65 ± 0.16	1.28 ± 0.06	-
<b>Adult wing expansion</b>				
Fore wing	Male	4.03 ± 0.13	0.84 ± 0.02	-
Hind Wing	Male	3.14 ± 0.05	0.62 ± 0.03	-
Fore wing	Female	4.31 ± 0.02	0.95 ± 0.02	-
Hind Wing	Female	3.09 ± 0.02	0.77 ± 0.01	-
Body length	Male	3.20 ± 0.32	2.15 ± 0.21	-
	Female	4.38 ± 0.12	1.24 ± 0.31	-

SD-Standard Deviation, \*Means of 20 observations.

**Table 2 :** Biological parameters of tomato leaf miner, *Tuta absoluta*.

Biological parameters	Duration (days) Mean±SD*	
Egg incubation period	4.08 ± 0.55	
First instar	3.48 ± 0.64	
Second instar	1.78 ± 0.40	
Third instar	1.90 ± 0.44	
Fourth instar	3.43 ± 0.58	
Total larval duration	10.59 ± 2.06	
Pupa*	7.62 ± 1.07	
Total Development Period	22.29 ± 3.68	
Mating Time (in hours)	4.67 ± 0.47 (hrs)	
Pre oviposition	1.33 ± 0.33	
Oviposition	11.55 ± 0.92	
Post oviposition	2.13 ± 0.22	
Adult Longevity	Male	7.50 ± 1.20
	Female	15.01 ± 1.47
<b>Total Life Cycle</b>		
Male	29.76 ± 3.92	
Female	37.30 ± 4.88	
Fecundity (No. of eggs/female)	165.05 ± 6.22	

SD-Standard Deviation, \*Means of 20 observations.

that the mean fecundity of *T. absoluta* was 141.6 eggs on tomato.

After hatching the first instar larva was creamy yellow, then they feed and become greenish in colour and the dorsal region turned to reddish when they were close to pupate. The length of first instar larva measured on an average  $1.36 \pm 0.02$  mm in length and  $0.23 \pm 0.01$  mm in breadth with head capsule measuring  $0.15 \pm 0.01$  mm. The duration of first instar required  $3.48 \pm 0.64$  days to complete its development. The second instar larva measured on an average  $2.33 \pm 0.02$  mm in length and  $0.25 \pm 0.02$  mm in breadth with head capsule measuring  $0.23 \pm 0.02$  mm. The width of the head capsule for second instar larva was  $0.23 \pm 0.02$  mm and it required 1.78  $\pm$  0.40 days to complete its development. The width of the head capsule for third instar larva was  $0.36 \pm 0.02$  mm and it required  $1.90 \pm 0.44$  days to complete its development. The width of the head capsule for fourth instar larva was  $0.59 \pm 0.03$  mm and it required  $3.43 \pm 0.58$  days to complete its development. The pupal period occupied  $7.62 \pm 1.07$  days (Tables 1 & 2). Torres *et al* (2001) stated the period of larval instar of *T. absoluta* was 12 and 16 days at 27°C and found that period of pupae of *T. absoluta* was 7-9 days. Barrientes *et al* (1998) reported that average development time of *T. absoluta* was 23.8 days at 27.1°C. Cuthberston (2011) reported that the development from egg to adult took 35 days at 25°C. The longevity of male moths varied with  $7.50 \pm 1.20$  days, while that of female  $15.01 \pm 1.47$  days. The male and female of *T. absoluta* occupied  $29.76 \pm 3.92$  and  $37.30 \pm 4.88$  days, respectively to complete total life cycle. The pre-oviposition period of  $1.33 \pm 0.33$  days was recorded. The egg laying was started on 1.5 days after emergence with  $11.55 \pm 0.92$  days of oviposition period and effective period of egg laying on 2.5 days after emergence and declined thereafter. The post oviposition period of  $2.13 \pm 0.22$  days was recorded (Table 2). Erdogan and Babaroglu (2014) reported the oviposition period of tomato leaf miner was 7.88 days on tomato at 25-26°C. Estay (2000) and Torres *et al* (2001) found

that the adult of *T. absoluta* lifespan ranged between 10-15 days for females and 6-7 days for males.

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