



Research Article

Biological and Morphological Parameters of *Trilocho varians* (Lepidoptera: Bombycidae) in Pakistan

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MR wrote the manuscript and collected the data. UNU planned the study while MA and HR critically reviewed the manuscript.

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Ornamental plant, Weeping fig, Leaf eating caterpillar, Bombycidae, Biological studies

Abstract | The biology and morphology of *Trilocho varians* was studied on *Ficus benjamina* (L.) under the laboratory conditions. The results on different biological and morphological parameters showed that the fecundity of female ranged from 160 to 281 which increased its survival rate. *Trilocho varians* has five larval instars. The last instar changed its colour to dark reddish and look like branches of host plants. The male and female mean longevity was 6.0 ± 1.171 and 11.4 ± 1.70 days. Pale reddish brown lines were present on the dorsal side of female forewings. Female forewings were broader than male wings with dark reddish brown thorax, head and abdomen. Adult hind wings were grayish with reddish brown outer margins. The biological and morphological information of *Trilocho varians* described in current paper will lead to proper management practices during peak reproductive period of insect to avoid pest outbreak.

Novelty Statement | *Trilocho varians* is emerging pest of ornamental plants especially *Ficus* species that not only planted to increase the aesthetic value of country but also use as fruits and medicine. There is need to control this destructive pest of ornamental plants in Pakistan to minimize the losses. The biology and morphology informations are very important before adopted any strategy against this pest. For this purposes, the current study was conducted and this is first study on this pest in Pakistan.

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Introduction

Ficus benjamina (Rosales: Bombycidae) (Zolotuhin and Witt, 2009), commonly known as weeping figs having medicinal value (Kumar *et al.*, 2012) and used for the removal of gaseous formaldehyde from indoors (Kim *et al.*, 2008). It is planted alongside the road as ornamental plant and native to tropical and subtropical regions of the world. During the study, it was found to be infested by many insect pests such as mealy bug, whitefly (Walton and Pringle, 2004; Avery *et al.*, 2011) and a lepidopteran caterpillar, *Trilocho varians* (Walker, 1855).

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Among these, *T. varians* is major issue for moraceae family plant like *F. benjamina*.

This pest is distributed in Pakistan (Ramzan *et al.*, 2019), Philipines (Navasero *et al.*, 2013), India (Singh and Brar, 2016; Kedar *et al.*, 2014; Udayagiri, 1988; Rajavel and Shanthi, 2007), Nepal, Thailand, Malaysia (Basari *et al.*, 2019), southern China and Taiwan. The infestation of *T. varians* larvae was caused 100% defoliation even kills the whole plants of *F. benjamina* which ultimately reduced the aesthetic value of country (Pakistan). Larvae of *T. varians* are attack on the all plant parts such as leaves, branches, twigs and leaves look like transparent. These are also feed on other host plants like *F. infectoria*, *F. religiosa*, *F. benghalensis* and *F. elastica* (Kedar *et al.*, 2014).

Before this study, no such type of study has conducted on this pest in Pakistan. For this purpose, this study is conducted to check the biological and morphological parameters of *T. varians* under laboratory conditions in Pakistan.

Materials and Methods

Study area

The present study was conducted at Institute of Plant Protection, MNS-University of Agriculture Multan. The study area is located at 71.4° longitude E and 30.2° latitude N with arid and semi-arid areas. There are four seasons in Pakistan: dry, cool winter from December-February; dry, hot spring from March-May and summer monsoon season with high rain from June-November. June and January are the hottest (35 °C) and coldest (13 °C) months of Pakistan.

Insect collection

The immature stages such as eggs and larvae were collected from *F. benjamina* plants planted along the boundary walls of MNS-University of Agriculture, Multan during 2019.

Leaf collection and culture maintenance

Different collected stages were brought to Rearing laboratory at University for rearing purpose. The plastic containers were purchased from nearby market and each stage of pest kept into separate container. The new and fresh *F. benjamina* leaves were cut with the help of secateurs and placed into containers containing *T. varians* larvae.

On daily basis, old leaves food was changed and provided new leaves for larvae feeding. Newly hatched larvae were kept into separate petri dishes which purchased from nearby market. The larvae were converted into pupae and converted into adults. The one pairs of adults were placed into rearing cage for egg lying purposes and a napliner placed inside the cage for collection of eggs. Number of eggs was counted on daily basis and recorded the number of days from egg lying to hatching. On daily basis, eggs were collected early in the morning and individual egg placed into separate petri dishes. For this purpose, 50 petri dishes were used and one larva placed in each petri dish to record the developmental period and hatching time. Culture of *T. varians* was maintained at 26±2°C, 65±5% temperature and relative humidity (RH), respectively with 14:10 photoperiod.

Results and Discussion

Different developmental parameters like biological and morphological were recorded during the study period. The study revealed that female adult was long lived as

compared to male adult. The male and female mean longevity was 6.0 ± 1.171 and 11.4 ± 1.70 days (Table 5). Pale reddish brown lines were present on the dorsal side of female forewings (Figure 1). Female forewings were broader than male wings with dark reddish brown thorax, head and abdomen. Adult hind wings were grayish with reddish brown outer margins. The clear difference was observed between both sexes on the basis of wing venation (Table 6).

Table 1. Biological parameters of *Trilochoa varians* on *Ficus benjamina* (L.).

Biological parameters	Mean ± SD*	Range (days)
Incubation period	6.0 ± 1.436	3-9
1 st instar	2.90 ± 0.324	2-4
2 nd instar	3.30 ± 0.456	3-5
3 rd instar	3.51 ± 0.345	3-4
4 th instar	4.99 ± 0.435	4-5
5 th instar	6.10 ± 0.635	5-7
Pupal period	12.07±2.432	11-17
No. of eggs per female (Fecundity)	210.7±32.59	160-281

Note: *Mean value of 15 replicates ± SE.



Figure 1: Adult of *Trilochoa varians*.

During the whole study, female was mated only once in her whole life period and died within 7-13 days. The study resulted that mating was taken place within half an hour of adult emergence and continued for several hours. During the study, it was also observed that female laid 210.7 ± 32.59 eggs on the upper surface of leaves in rows (Figure 2) under natural conditions while on the surface of container walls.

The newly laid eggs were look like candy (flat) and pink in shape and colour while before hatching changed

Table 2: Head capsule width, length and body length of different larval instars.

Instar	n	Larval Head capsule length (mm)		Head capsule width (mm)		Body length	
		Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD	Range
1	35	0.31 \pm 0.10	0.32-0.38	0.30 \pm 0.02	0.30-0.50	2.03 \pm 0.46	1.21-2.30
2	35	0.37 \pm 0.09	0.47-0.83	0.40 \pm 0.04	0.39-0.50	4.04 \pm 0.50	2.01-4.01
3	35	0.97 \pm 0.10	0.87-1.71	0.90 \pm 0.04	0.89-1.50	8.52 \pm 1.44	5.53-10.10
4	35	1.69 \pm 0.49	1.44-1.94	1.59 \pm 0.31	1.50-1.60	13.14 \pm 3.21	10.01-15.02
5	35	2.10 \pm 0.10	2.10-2.37	2.10 \pm 0.10	2.01-2.21	23.02 \pm 4.77	12.10-27.02

into blackish brown. After hatching, eggs were changed into whitish or golden colour. The incubation period of eggs was 6.0 ± 1.436 and hatched within 6-8 days. During the study, five larval instars of *T. varians* were recorded. The duration period of 1st, 2nd, 3rd, 4th and 5th larval instars was 2.90 ± 0.324 , 3.30 ± 0.456 , 3.51 ± 0.345 , 4.99 ± 0.435 and 6.10 ± 0.635 days, respectively (Table 1).

**Figure 2: Eggs of *Trilocho varians* on *Ficus* leaf.**

The mouth and abdomen of newly hatched larvae were blackish brown and two light green dots present on the dorsal side of mouth. The lateral side of neonate larvae was black and the dorsal side of whole body covered with white hairs which removed after one days of hatching. The colour of 1st instar larvae was remained grayish white till to fourth instar. A short and narrow long horn was present on eighth abdominal portion/ segment in each instar larvae which reduced in later instars like 5th. There was difficult to locate final instars of *T. varians* due to their resemblance with young branches of *F. benjamina* (Figure 3).

**Figure 3: Larva of *Trilocho varians*.**

The current study resulted that 12-16 days were the total duration of larval instars. The length and width of

head capsule, length and body length of different larval instars was described in detail (Table 2). Larvae spun on the leaves and the pupation took place in boat-shaped silken cocoon. The colour of new pupated larvae was whitish yellow and changed into blackish brown prior to adult conversion (Figure 4).

**Figure 4: Pupae of *Trilocho varians*.**

The length of male and female cocoon was 9.69 ± 1.02 and 10.60 ± 0.73 days, respectively. The width of male and female cocoon was 4.90 ± 0.53 and 5.67 ± 0.62 days, respectively (Table 3) while 7.91 ± 0.65 and 9.90 ± 1.00 was the length of male and female pupae (Table 4). The weight of dead moth and pupa was recorded $0.008g$ and $0.006g$.

Table 3: Length, width of male and female cocoon of *T. varians*.

	Male cocoon		Female cocoon	
	Mean \pm SD	Range	Mean \pm SD	SD Range
Length	9.69 ± 1.02	8.00-12.10	10.60 ± 0.73	8.51-12.00
Width	4.90 ± 0.53	4.00-5.60	5.67 ± 0.62	3.61-7.60

Table 4: Length and width of Male and female pupa.

	Male Pupa		Female Pupa	
	Length	Width	Length	Width
Mean \pm SD	7.91 ± 0.65	2.87 ± 0.17	9.90 ± 1.00	11.60 ± 0.85
Range	6.50-9.00	2.50-3.20	8.00-11.00	3.10-4.00

Table 5: Longevity of male and female of *Trilocho varians*.

Male	6.0 ± 1.171	5-7 (days)
Female	11.4 ± 1.70	7-13 (days)

Table 6: Dimensions (mm) of adult males and female.

			Hindwings		Forewing	
	Antennal length	Body length	Width	length	length	Width
Female						
Mean± SD	2.12 ± 0.23	11.01± 0.80	8.77± 0.61	4.99± 0.67	9.99± 0.89	5.76 ± 0.48
Range	2.30-3.10	9.01-10.00	8.01-9.40	4.10- 6.30	9.00-10.52	4.80-6.51
Male						
Mean± SD	3.27 ± 0.54	8.89 ± 0.90	7.25 ± 0.56	4.98 ± 0.64	8.10±0.74	16.99± 1.66
Range	2.60-3.58	7.70-9.99	6.80-8.00	3.60-5.54	8.00-11.0	12.99-19.01

The biological and morphological parameters on the present pest that belongs to order, Lepidoptera and Bombycidae family were studied under laboratory conditions. The maximum pest infestation was observed from October to December months. It was observed that later instars (4th and 5th) caused 90-100 % defoliation in weeping fig, *F. benjamina*. Our findings are in line with the findings of earlier researchers (Singh and Brar, 2016; Ramzan *et al.*, 2019) they reported 100% defoliation. The eggs of the pest were yellow in colour and our observations are similar to others scientists (Daimon *et al.* 2012; Ramzan *et al.*, 2019). Singh and Brar (2016) had reported that eggs hatched within 3-8 days which is similar to our observations.

During the study, it was observed that *T. varians* attack on other *Ficus* species such as *F. infectoria*, *F. religiosa*, *F. benghalensis* and *F. elastica*. Our observations are in agreement with the findings of Kedar *et al.* (2014) they had reported the similar hosts (*F. elastica*, *F. benghalensis* and *F. infectoria*). Arya (2020) had concluded that *Ficus benjamina*, *F. benghalensis*, *F. infectoria*, *F. caraica*, *F. nitida*, *F. religiosa*, *F. elastic*, *Artocarpus communis*, *A. heterpphyllus* and *A. kamansi*, are natural host plants of *T. varians* larvae. This pest is needed to control this emerging pest by using different biological fauna (parasitoids and predators). The present study findings are in line with many researchers study findings (Rajavel and Shanthi, 2007; Udayagiri, 1988).

During the study, many other insect pests such as whitefly, mealy bug and scale were also observed that attack on the *F. benjamina*. Among all these pests, the maximum infestation of *T. varians* was observed and whole plant died during severe attack of this emerging pest.

The environmental factors are also affecting the life cycle of insect pests such as *T. varians*. A study was conducted to determine the effect of temperature on the biological parameters of *T. varians* under controlled and uncontrolled conditions in various regions of the world including Pakistan (Ramzan *et al.*, 2019). The study revealed that life cycle of pest was increased during low temperature (Navasero and Navasero, 2014) while reduced

during high environmental conditions (temperature) (Ramzan *et al.*, 2019; Basari *et al.*, 2019). The life period of *T. varians* was increased during monsoon season (October-March) because these months are favorable for larval feeding and host availability. In these months, larvae feed vigorously and developmental period was prolonged. The similar findings have been observed by many other workers (Lu *et al.*, 2016; Sibly *et al.*, 2016).

Conclusions and Recommendations

The study provides basic information about the biology and morphology of *T. varians*. The results of current study are important for future management of *T. varians* population especially in Pakistan.

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Conflict of interest

The authors have declared no conflict of interest.

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