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, Trilocha varians (Walker, 1855).

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

This pest is distributed in Pakistan (Ramzan et al., 2019), Philippines (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 71.40 longitude E and 30.20 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).

| Biological parameters | Mean ± SD* | Range (days) |
|-----------------------|------------|--------------|
| Incubation period     | 6.0 ± 1.436| 3-9          |
| 1st instar            | 2.90 ± 0.324| 2-4          |
| 2nd instar            | 3.30 ± 0.456| 3-5          |
| 3rd instar            | 3.51 ± 0.345| 3-4          |
| 4th instar            | 4.99 ± 0.435| 4-5          |
| 5th 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.

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  | Mean ± SD | Range | Mean ± SD | Range | Mean ± SD | Range |
|--------|----|-----------|-------|-----------|-------|-----------|-------|
| 1      | 35 | 0.31±0.10 | 0.32-0.38 | 0.30±0.02 | 0.30-0.50 | 2.03±0.46 | 1.21-2.30 |
| 2      | 35 | 0.37±0.09 | 0.47-0.83 | 0.40±0.04 | 0.39-0.50 | 4.04±0.50 | 2.01-4.01 |
| 3      | 35 | 0.97±0.10 | 0.87-1.71 | 0.90±0.04 | 0.89-1.50 | 8.52±1.44 | 5.53-10.10 |
| 4      | 35 | 1.69±0.49 | 1.44-1.94 | 1.59±0.31 | 1.50-1.60 | 13.14±3.21 | 10.01-15.02 |
| 5      | 35 | 2.10±0.10 | 2.10-2.37 | 2.10±0.10 | 2.01-2.21 | 23.02±4.77 | 12.10-27.02 |

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 day 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 potion/ segment in each instar larvae which reduced in later in stars like 5th. There was difficult to locate final instars of *T. varians* due to their resemblance with young branches of *F. benjamina* (Figure 3).

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).

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

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

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

|              | Male Pupa            | Female Pupa           |
|--------------|----------------------|-----------------------|
| Mean ± SD    | 7.91±0.65            | 9.90±1.00             |
| Range        | 6.50-9.00            | 8.00-11.00            |
| Width        | 2.87±0.17            | 3.10-4.00             |
| Length       | 9.69±1.02            | 10.60±0.73            |
| Range        | 8.00-12.10           | 8.51-12.00            |

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

|              | Male                | Female               |
|--------------|---------------------|----------------------|
| Mean ± SD    | 6.0 ± 1.171         | 11.4 ± 1.70          |
| Range        | 5-7 (days)          | 7-13 (days)          |
Table 6: Dimensions (mm) of adult males and female.

|       | Antennal length | Body length | Hindwings | Forewing |
|-------|-----------------|-------------|-----------|----------|
|       | Mean ± SD       |             | Width     | 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 | 8.00-11.00 | 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. carica, F. nitida, F. religiosa, F. elastica, Artocarpus communis, A. heterophyllus 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 increase 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 others 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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