

Research Article

Effect of temperature on the life cycle of *Trilocho varians* (Lepidoptera: Bombycidae) in Pakistan

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Abstract

Ficus benjamina is known as weeping fig, planted along roadsides in Pakistan to increase the aesthetic value of the country. It is native to tropical and sub-tropical regions of the world. In 2019, plants were infested by leaf eating caterpillar, identified as *Trilocho varians*. The larvae of the pest were caused up to 100% defoliation of *F. benjamina*. The aim of the recent study was to determine the life cycle of *T. varians* under two different environmental temperatures i.e. $26^{\circ}\text{C} \pm 1.0$ controlled and uncontrolled $33^{\circ}\text{C} \pm 2.0$. The recent study was obtained that there was significant difference in the time taken for eggs, larval and pupal period of *T. varians* between high and low environmental temperatures. The life cycle of the test insect, *T. varians* was increased at low temperature and reduced in high temperature. The results showed that the fecundity of female ranged from 164 to 275 and 130-190 under controlled and uncontrolled conditions respectively. *T. varians* has complete metamorphosis and five larval stages. The last instar transferred into dark reddish colour prior to adult formation. The longevity of females and males was 10.0 ± 0.43 and 5.4 ± 0.35 days, respectively. Pupa of the pest was obtect. Our present study results were effective for future management of *T. varians* in Pakistan.

Keywords: Bombycid moth; Climatic conditions; Life history; Ornamental plants; Pakistan

Introduction

Ficus benjamina commonly known as weeping fig is ornamental plant belong to family Moraceae. It is grown in tropical and sub-tropical regions of the world [1]. The plants can grow well in high temperature areas and it is grown to enhance the beauty of country and for landscaping purpose. These plants are planted alongside the roads to enhance the aesthetic value of many countries including Pakistan. It has medicinal

value, used for the treatment of allergy and many other infections [2]. It has been reported that plant has anti-fungal and anti-tumor properties [3, 4]. It is also used to remove the pollution and very toxic chemical like carbon monoxide and formaldehyde [5]. Several insect pests including mealybug and whitefly are cause damage to *ficus species* like *Ficus benjamina* and *Ficus microcarpa* [6-8]. Among these pests, *Trilocho varians* known as leaf eating caterpillar is major one

and cause 100% defoliation [9]. *T. varians* is distributed in Pakistan, Philippines, Haryana, India, Tamil Nadu and Karnataka [1, 8, 10-13]. *Ficus religiosa*, *Ficus infectoria*, *Ficus elastica* and *Ficus benghalensis* are also infested [10, 14, 15]. The early instars of the pest feed on leaves, roots and twigs of the plants [16]. The leaves of the plants look sieve like or appear transparent. The severe attack of pest can kill the plants and reduce the aesthetic value of plants [1].

There was still no study carried out to check the effect of climatic conditions on the life history of *T. varians* in Pakistan. Weather parameters like temperature and humidity change remain uniform throughout the year but change during rainy days in the study area. Hence, present study was carried out to determine the life cycle of *T. varians* under two environmental conditions viz., 26°C and 32°C (control and non-control respectively). The environmental conditions like temperature effect the developmental time of insect pests like *T. varians*.

The purpose of the recent study was to determine the life cycle of *T. varians* under two different environmental conditions i.e. controlled and un-controlled conditions.

Materials and methods

Study area

A study was carried out in MNS-University of Agriculture Multan (30.2° N and 71.4° E) 123-meter-high above sea level from January 2019 to June 2019.

Sampling site

Immature stages such as eggs, larvae and pupae of insect were collected with the help of forceps from infested *ficus* plants surrounded in the University.

Rearing and life cycle of *Trilocho varians*

The collected live insect stages were kept into transparent plastic jars and brought to Ecology Laboratory for rearing purpose. For rearing purpose, 10 plastic containers of 2L were purchased from nearby market and 10 larvae were placed in each container with

natural diet, leaves of *F. benjamina*. Other stages such as pupae and eggs of pest were kept into separate plastic containers. Larvae were fed with *ficus* plants leaves until they reached at pupal stage. After adult emergence, a pair of moths was placed into jar for collection of eggs and mating purposes. After mating eggs, leaves were examined for eggs. After eggs lying, eggs were placed into separate containers for larvae collection. Pest was reared under two different temperature i.e. controlled (26°C ± 1.0) and uncontrolled (33°C ± 2.0). When the eggs hatched out, larvae were released placed into containers and *F. benjamina* leaves were placed. On daily basis new leaves were provided for food and data regarding to eggs, larvae, pupa and adults recorded. Data was removed, if any stages like larvae or adults died during the study. Total of 15 and 9 specimens under controlled and uncontrolled condition respectively were successfully reared.

Statistical analysis

Data recorded regarding to developmental period of *T. varians* between controlled and uncontrolled conditions were analyzed by using Mann-Whitney test.

Results and discussion

Life cycle of *T. varians* reared at 26°C and 33°C temperatures

T. varians was passes through different stages like eggs, larval stages (1st, 2nd, 3rd and 4th), pupae and adults. All these stages were studied in the current experiment.

Egg

During the study, it was observed that 215 ± 32.87 eggs deposited by adult female in rows on the walls of containers while dorsal surface of the leaves in field conditions. The colour of eggs was change during the developmental time. Newly laid eggs were light yellow. Before hatching, colour of eggs were change from yellow to black. Shape of eggs was round flat, rounded at base and yellow in colour. The eggs were hatch within

six days (Mean \pm SE, 6.14 ± 0.47) and become larvae under controlled condition (Fig. 1). In the present study, eggs hatchability was recorded 95.50%. Under

uncontrolled conditions ($33^{\circ}\text{C} \pm 2.0$), eggs hatchability took less time (Mean \pm SE, 5.00 ± 0.76) for hatching than the controlled temperature.



Figure 1. Egg mass of *T. varians* on *F. benjamina* leaf

The significant differences in the time taken between the two temperatures, controlled and uncontrolled conditions for eggs to hatch were ($N = 36$, $U = 70.00$, $p = 0.006$, $r = 0.50$), larvae period ($U = 14$, $N = 36$, $p < 0.003$, $r = 0.70$) and pupation period ($N = 36$, $U = 62$, $p < 0.05$, $r = 0.55$).

Larva

Body of larvae was cylindrical with five and three pairs of abdominal and thoracic legs respectively. There was a caudal horn on each larva with length of 0.50mm. The dorsal and lateral sides of first instar larva were white and dark green respectively. The head of *T. varians* was black. Caudal horn on second instar larva was twice long than first instar larva. White powder was present on the whole body of second instar larva. Second

instar larva was less moveable than the first instar. The length of caudal horn was longer in third and fourth while reduced in fifth instars. Newly emerged larvae were brown and after 24 hours change into greyish white till last instars. Last instars were resembled with the branches of *ficus* plants and difficult to find them.

There were 5th larval stages and duration of each stages 1st, 2nd, 3rd, 4th and 5th of *T. varians*, last for 2.50 ± 0.14 , 3.27 ± 0.28 , 4.10 ± 0.12 , 4.95 ± 0.15 and 6.99 ± 0.25 days respectively. Before changing into pupae, larval stages were lasted about 19.5 days (Mean \pm SE, 17.70 ± 2.50). Under uncontrolled conditions ($33^{\circ}\text{C} \pm 2.0$), larval stage was lasted for 11 days (Mean \pm SE, 8.94 ± 2.99) before changed into pupa (Fig. 2).



Figure 2. *T. varians* larva feeding on *F. benjamina* leaf

Pupa

Mature larva was covered itself into silken thread with boat shaped cocoon. During the whole study, colour of cocoon was change from white, bright yellow, light yellow and pinkish. Pupa of *T. varians* was obctect. Prior to emerging in adults, pupae took about five

to six days (Mean \pm SE, 6.70 ± 0.60). The period of life cycle become shorter due to high temperature under controlled conditions. The pupal period took four and a half days (mean \pm SE, 3.00 ± 1.93) prior changed to adult (Fig.3).



Figure 3. *T. varians* pupa in silk cocoon

Adult

In the recent study, it was observed that male was short lived as compared to female. Body parts such as head, thorax and abdomen of *T. varians* were dark reddish brown in colour. Mean longevity of both male and female was 6.6 ± 0.01 and 12.00 ± 0.10 days respectively. The outer margins of forewings and hind wings of adult were pale reddish brown and greyish reddish brown in colour respectively (Fig. 4).

There was no significant different in developmental period of both male and female under both conditions (Controlled:

Male; 27.80 ± 3.12 days; female; 29.09 ± 1.54 days; $N = 22$, $U = 29.5$, $p = 0.18$, $r = 0.32$; and Uncontrolled; Male; 23.00 ± 0.99 days; female; 22.67 ± 2.25 days; $N = 18$, $U = 26.5$, $p = 0.94$, $r = 0.05$). The recent study was conducted to determine the effect of temperature i.e. controlled and uncontrolled on life cycle of *T. varians* in Pakistan. During the study, it was observed that at high temperature developmental period was shorter from egg to adult while longer under low temperature. Our findings were similar to the earlier studies [9].



Figure 4. Adult of *T. varians*

At an earlier stage, low temperature affected the *T. varians* development. Similar findings had been observed by other researchers [14, 17, 18]. In recent study, it was observed that developmental period also affected through monsoon season. The similar results about effect of monsoon season on developmental period of pest had been performed by other researchers [9]. During monsoon season (October-March), developmental period of pest was longer while shorter in dry season (April-September). The population of *T.*

variens was at peak point in October to March and infestation rate also maximum during these months. In these months (October-March), developmental period was longer, larvae took more time to change into pupae, fed maximum plants and cause 100% defoliation.

There was a long caudal horn on 8th abdominal segment of early instars of *T. varians*. Same disruption had been described by other workers [3]. Pupation was taken placed into silken cocoon. Similar

observations had been observed by earlier studies [12]. The developmental periods from eggs to larva, larva to pupa and pupa to adults under uncontrolled as well as controlled conditions were similar to earlier studies [9, 16, 19].

Conclusion

The environmental conditions such as temperature was affected the life period of insect pests especially *T. varians*. The developmental time of pest was changed with variations in climate. This was the first study regarding life cycle of *T. varians* under two different temperatures in Pakistan. This study will be proved to be helpful for future pest control in Pakistan.

Authors' contributions

Conceived and designed the experiments: UN Ullah, Performed the experiments: M Ramzan, Analyzed the data: N Iqbal & Z Rasheed, Contributed materials/ analysis/ tools: S Saba, H Ghaffar & S Saeed, Wrote the paper: M Ramzan.

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