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# Biology of *Trioza jambolanae* Craw. on infected *Syzygium jambos* (L.) Alston leaves from Kota District, Rajasthan

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**Abstract:** ***In this process of gall formation, cell proliferation, differentiation and hypertrophy occur which convert the inner-gall chamber. The results of present study revealed that, the galls of Trioza jambolanae on the leaves of Syzygium jambos generally occur as isolated epiphyllous pustules, with usually one and rarely two nymphal chambers. On the adaxial side of the leaf, they are expressed as linear swellings with a narrow slit-like ostiole, while along the abaxial side gall appears like spiral venation. The insect completes its life cycle in 40-42 days. Morphometric evaluation showed that in the process of life cycle insect stage converted from spherical egg to long Nymph and finally in winged male and female adults***.

**Keywords:** Gall formation, Hypertrophy, Epiphyllous, Pustules, Life cycle, Morphometric

## 1. Introduction

Plant galls are abnormal plant cells, tissues or organs formed as a result of stimulation by various parasites ranging from fungi and bacteria to insects and mites (Harris et al. 2003). Generally three stages are involved in gall formation, which include initiation, growth and maturation. Initiation occurs after oviposition by the adult wasp on the meristematic tissue; the host normally responds with necrosis of cells beneath the egg and the cells below this begin to proliferate and finally surround the egg, which results into a gall. In this process cell proliferation, differentiation and hypertrophy occur which convert the inner-gall chamber lined with inner-gall tissue and the outer gall which is composed of cortical parenchyma. The growth stage consists mainly of cell expansion, leading to gall growth and inner-chamber growth. The larva grazes on the inner-gall tissue throughout development and as the larva increases in size, the cell layers of inner-gall tissue decrease.

Therefore, for the management of cecidozoan, it is of utmost importance to have basic knowledge about the life cycle of the psyllid (*Trioza jambolanae* Crawford) on *Syzygium jambos* (L.) Alston. Meager information is available on this aspect. Keeping this in view the present investigation was carried out to determine life cycle of the psyllid.

## 2. Material and Methods

### 2.1. Pot Experiments:

To study the life cycle stages of *Trioza jambolanae* Crawford on *Syzygium jambos* (L.) Alston from egg to adult stage pot experiments were set.

**a) Raising of plants for experiment purpose-**
One year old 30 potted plants were brought from the nursery, kept and maintained in college garden for experimental purpose.

**b) Inoculation-**
Mature adult male and female from the naturally growing infected trees were collected and directly dusted on the leaves of potted plants and immediately the host plant twigs were enclosed in muslin bags and bags were tied with threads to ensure contact of the psyllid with the host leaves in the months of June and July because optimum temperature and humidity conditions were available for the insect infection during this time period.
For the study of developmental stages of the insect, observations were taken after every day and changes in insect stages were noted.

**c) Staining of Insect stages-**
To observe all the stages of the insect, galled tissues galled leaf sections were stained with 0.5% Eosin. Tissue with different insect stages and were observed under Stereo-binocular microscope with attached photographic system and photographs were taken.

### 2.2 Laboratory Practices

**a) Mean longevity of developmental stages-**
For the evaluation of the mean longevity (in days and hours) of each developmental stage from egg to adult, galls on potted plants which were enclosed in muslin bags were examined every day and mean value of longevity of each stage was find out by studying 10 galls.

**b) Morphometric evaluation-**
Length and Breadth of eggs, nymphs and adults were measured in millimeter with a caliberated ocular micrometer after their extraction from the galls. Mean length and breadth of each developmental stage were calculated by measuring 10 samples of each stage.

**c) Mass evaluation-**
Mean egg mass, mass of each nymphal stage and adult (in milligram) were obtained by collectively weighing of 10 samples of each developmental stage in electric balance (0.001 g. sensitivity). Galls of every developmental stage, after the removals of insect

material were individually weighed, and mean mass of 10 samples was calculated.

## 3. Observations

**Biology**

The pathogen responsible for the occurrence of galling on *Syzygium jambos* (L.) Alston was *Trioza jambolanae* Crawford a member of the family Triozidae or Psyllid. The infected portion was studied under stereo binocular microscope. It was observed that the life cycle of the insect consisted of seven stages viz. Egg, Nymphal instar- I, II, III, IV, V and Adult. Each developmental stage continued for different time period (Table-1, Plate-1).

### 3.1. Mean longevity of each developmental stage (Fig.1)

**a. Egg**

During life cycle study it was noted that the female *Trioza* oviposits eggs through the marginal sutures of young Jamun leaves by partially inserting them into leaf tissue with the help of ovipositor. The eggs layed were approximately 20-30 in number. Eggs were ovoid in shape and creamish yellow in colour. Egg stage continued from 2 days 8 hours to 3 days 5 hours. (Table-1).

**b. Nymphal-I instar**

After 2 to 4 days egg hatched and converted into Nymphal-I instar, which had a lifespan of 3 days and 5 hours to 4 days.

**c. Nymphal-II instar**

Nymphal-I instar moulted into Nymphal-II instar after 10 days and remained for 5 days and 8 hours to 6 days and 6 hours. It was the longest stage of the insect inside the gall.

**d. Nymphal-III instar**

After 15-16 days moulting process occured and Nymphal-II instar converted into Nymphal-III instar, which have a lifespan of 3 days to 3 days 6 hours.

**e. Nymphal-IV instar**

Nymphal-III instar entered into moulting process and converted into Nymphal-IV instar after 19-20 days of egg laying. This stage remained for 3 days 4 hours to 3 days 9 hours.

**f. Nymphal-V instar**

After 20-24 days of egg laying Nymphal-V instar stage appeared which stayed for only 1 day 2 hours to 2 days 3 hours. It was the shortest life span stage of the insect after the egg stage.

**g. Adult**

Nymphal-V instar converted into adult male or female after 27-28 days of egg laying on the leaf. This stage continued for 10-12 days. Hence insect completed its life cycle in 38-40 days. Adult males and females at emergence were pale brown with black terminal antennal segments but during maturation progressive changes in colour were observed and finally mature *Trioza* adults were deep brown in colour.

### 3.2. Morphometric evaluation (Fig. 2)

Table-2 represents the morphometric data of the developmental stages of the insect, which indicated average length, breadth and mass of all the stages of Psyllid and gall mass at different developmental stages.

Average length and breadth of each egg was 0.04 and 0.02 mm respectively whereas Average mass was 0.001 mg. Nymphal-I instar had 0.20 mm average length and 0.16 mm breadth with 0.004 mg average mass. Nymphal-II instar possessed 0.35 mm average length and 0.28 mm average breadth with 0.007 mg of average mass. Nymphal-III instar had 0.56 mm length and 0.46 mm breadth having 0.014 mg average mass.

Nymphal-IV instar had 0.83 mm length and 0.79 mm breadth with 0.018 mg mass. V-instar possessed 1.70 mm length and 1.4 mm breadth with an average mass of 0.031 mg. Adult male and female showed different size. Adult male were 2.16 mm in length and 1.8 mm in breadth with an average mass of 0.43 mg, whereas adult female was 1.98 mm in length and 1.5 mm in breadth with an average mass of 0.37 mg.

**Table 1:** Mean longevity of developmental stages of *Trioza jambolanae* Crawford (on *Syzygium jambos* (L.) Alston) (Results are mean of 10 replicates)

| S. No. | Developmental Stage | Days & hours |
|---|---|---|
| **1.** | Egg | 2 days 8 hr. to 3days 5 hr. |
| **2.** | Nymphal-I instar | 3 days 5 hr. to 4 days |
| **3.** | Nymphal-II instar | 5days 8 hr. to 6 days 6 hr. |
| **4.** | Nymphal-III instar | 3 days to 3 days 6 hr. |
| **5.** | Nymphal-IV instar | 3 days 4 hr. to 3 days 9 hr. |
| **6.** | Nymphal-V instar | 1 day 2 hr. to 2 day 3 hr. |
| **7.** | Adult | 10 day to 12 day |

**Table 2:** Morphometric data of the developmental stages of *Trioza jambolanae* Crawford (on *Syzygium jambos* (L.) Alston) (Results are mean of 10 replicates)

| S. No. | Life Cycle stages | Length (mm)±S.E. | Breadth (mm) ±S.E. | Avg. Mass (mg) ±S.E. |
|---|---|---|---|---|
| 1. | Egg | 0.04 ± 0.062 | 0.02 ± 1.902 | 0.001 ± 0.212 |
| 2. | I | 0.20 ± 1.009 | 0.16 ± 0.567 | 0.004 ± 1.921 |
| 3. | II | 0.35 ± 0.845 | 0.28 ± 2.102 | 0.007 ± 0.637 |
| 4. | III | 0.56 ± 0.328 | 0.46 ± 0.856 | 0.014 ± 0.311 |
| 5. | IV | 0.83 ±1.043 | 0.79 ± 1.091 | 0.018 ± 0.722 |
| 6. | V | 1.70 ±0.994 | 1.4 ± 0.657 | 0.031 ± 0.856 |
| 7. | Adult male | 2.16 ± 0.342 | 1.8 ± 2.943 | 0.43 ± 1.986 |
| 8. | Adult female | 1.98 ± 1.213 | 1.5 ± 0.534 | 0.37 ± 0.348 |

**Table 3:** Fresh mass (mg.) of developing gall at different stages (Results are mean value of 10 replicates)

| *S. No.* | *Gall age in days* | *Syzygium jabos* |
|---|---|---|
| **1.** | 10 | 0.046 ± 1.092 |
| **2.** | 20 | 0.185 ± 0.783 |
| **3.** | 30 | 0.211 ± 0.453 |

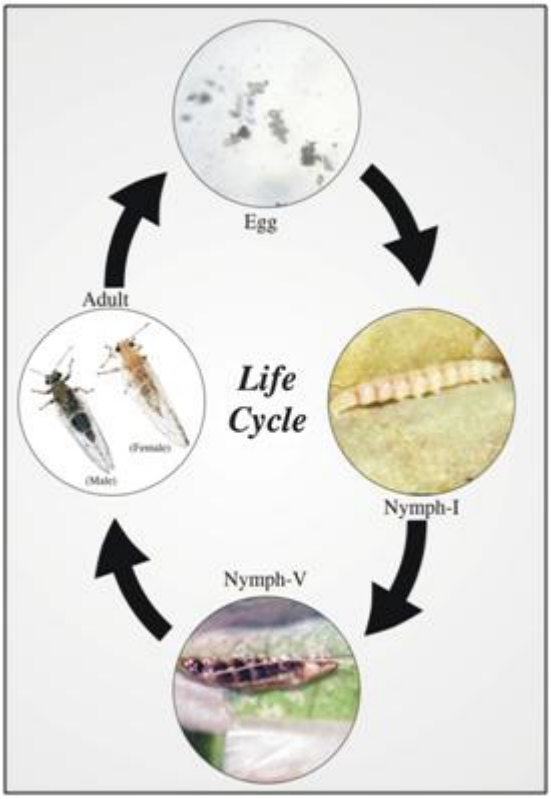


**Plate 1:** Showing Biology of *Trioza jambolanae* Crawford on *Syzygium jambos* (L.) Alston

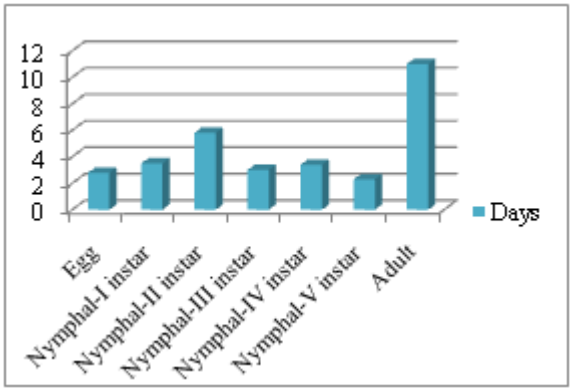


**Figure 5:** Presentation of Mean longevity of all Developmental Stages of *Trioza jambolanae* Craw. (from *Syzygium jambos* (L.) Alston)

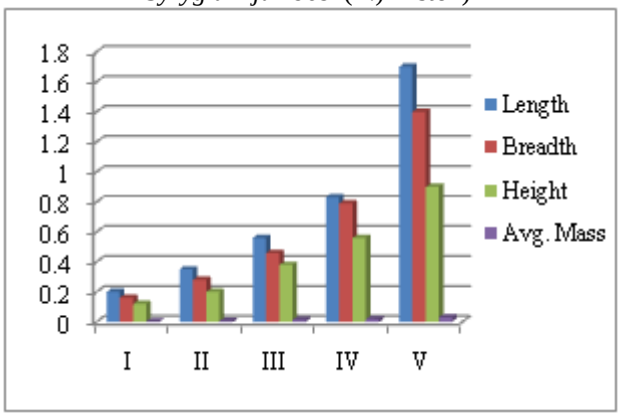


**Figure 6:** Presentation of Morphometric data of the Nyphal Instars of the *Trioza jabolanae* Craw. (from *Syzygium jambos* (L.) Alston)

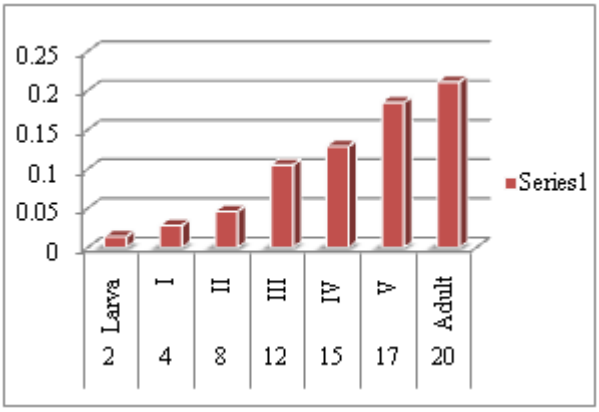


**Figure 7:** Presentation of Mean fresh mass of developing galls on *Syzygium jambos* (L.) Alston

### 3.3. Gall Mass (Fig.3)

When the adult *Trioza jambolanae* Crawford female oviposited the egg in the leaf tissue, it induced gall formation. After inoculation of egg into the fresh plant material, development of gall started within the leaf tissue and gradually the healthy leaf converted into a gall. With different stages of life cycle, gall structure, size and mass also changed. The average (10 galls) gall mass was calculated at 10 days interval after the infection of the leaf with the insect (Table-3). 10 days old galled tissue had an average 0.046 mg of gall mass, and in 20 days old gall it was 0.185 mg. The gall mass of 30 days old galls was calculated to be of 0.211 mg. After 28-30 days when adult male and female matured gall dehisced and the adult escaped from the gall, through an ostiole on the leaf surface.

## 4. Result and Discussion

### 4.1. Biology of *Trioza jambolanae* Craw. on *Syzygium jambos* (L.) Alston

The results of present study revealed that, the galls of *Trioza jambolanae Crawford* on the leaves of *Syzygium jambos* (L.) Alston generally occur as isolated epiphyllous pustules, with usually one and rarely two nymphal chambers. On the adaxial side of the leaf, they are expressed as linear swellings with a narrow slit-like ostiole, while along the abaxial side gall appears like spiral venation.

Nymphal II instar has longest longetivity and Nymphal V instar has smallest longetivity inside the gall. Morphometric evaluation showed that in the process of life cycle insect stage converted from spherical egg to long Nymph and finally in winged male and female adults. Eggs are smallest in size as they are 0.02 × 0.04 mm with 0.001 mg of average mass. Size of Nymphal instars varies from 0.20 × 0.16 mm to 1.4 × 1.70 mm with an average mass from 0.004 mg to 0.031 mg. Adult male and female are different in size as size of male was 1.8 × 2.16 mm and size of female was 1.5 × 1.98 mm. Weight of both is also different; male is 0.43 mg and female is of 0.37 mg. Results of 10 mean replicates showed that mass of gall also varies from gall initiation to gall maturation.10 days old gall have 0.046 mg of weight and 30 days dehisced gall have 0.211 mg of weight. It

indicates that as the developmental stage of insect proceeds mass of gall also increases.

*Trioza jambolanae* Crawford lay eggs in serial rows along the marginal sutures of leaves of *Syzygium jambos* (L.) Alston. Similar findings were given by Raman (1991) in *Trioza alacris* which attacks on *Syzygium cumini.* Young leaves of *Syzygium* show marked metaplastic changes after the oviposition of *T. jambolanae.* After the oviposition, the egg incline along the plant surface and instar I nymphs migrates towards stomatal apertures of leaves. The first nymphal instars of *T. jambolanae* insert their stylets through stomata of young host leaves and initiate galls by feeding on undifferentiated mesophyll parenchyma. Similar behavior of other gall-inducing psylloids in terms of preferring tender leaves and generating complex galls was observed by Lewis and Walton (1964), Taylor (1987), Raman (1987, 1991).

The majority of gall-inducing insects stimulate the host-plant tissue to develop into galls through their feeding action, whereas species of Hymenoptera trigger gall development via oviposition. Even vascular tissues may be modified by gall induction, ensuring a supply of nutrients and water for the inducing insect (Meyer and Irrigation vasculaire dans les galles, Bull. Soc. Bot. Fr. Mem 1969). These insects, through feeding or oviposition, cause differentiation of a special nutritive tissue that is rich in sugars, proteins, and lipids, as well as a range hydrolyzing enzymes (Raman 2003; Raman and Ananthakrishnan. 1983).

Gall inducing insects are generally host specific. Shorthouse and Rohfritsch (1992), Raman (1994) concluded that a large number of them are so specific to their host plant genera as to be considered efficient indicators of plant taxa. *Trioza jambolanae* Crawford is known from the leaf galls of *Syzygium jambos* (L.) Alston. The galls induce enlarged, nutritive cells which covers the eggs and other developmental stages of the insect, and breaks down to allow the larva to graze on nutritive cells. Some species such as *Diaphorina truncata* Crawf. and *Psyllopsis fraxini* (Linn.) belonging to Psyllidae - a group that includes relatively few gall inducers - display a high level of fidelity to their respective host plants (Balakrishna and Raman 1992, Nguyen 1970 a, b).

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