A new report of fruit fly infestation on fruits of Madhuca indica in central India

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Abstract
This paper focuses on the identification of fruit fly insect infesting the fruit of Madhuca indica. The different site under Jabalpur region was selected and collection of fruit was made. Rearing of collected larva from fruit of mahua was conducted. Data and photographs of different stages of insect larva of mahua was noted and captured respectively. It was found that the large incidence was caused by M. indica fruit fly i.e. Bactrocera zonata and it was recorded as a new pest in Jabalpur region of central India in 2020 at Tropical Forest Research Institute Jabalpur, District Jabalpur.

Keywords: fruit fly, Madhuca indica, Bactrocera zonata

Introduction
The peach fruit fly, Bactrocera zonata (Saunders) is one of the most harmful species of Tephritidae. It is a polyphagous species attacking more than 40 species of fruit crops and has also been recorded from wild host plants. Bactrocera zonata is well adapted to hot climates. The genus Bactrocera includes about 500 species, mostly in Asia, the Pacific and Australasian Regions. These genera belong to the family Tephritidae (Trypetidae or Trupaneidae in some older literature), a group of about 4000 known species, an estimated 80% of which have larvae that develop in the seed bearing organs (flowers or fruit) of higher plants, and are therefore known as fruit flies. The genus Bactrocera is considered a serious threat of fruit crops because of the wide host range of its species and the invasive power of some species within the genus. The Bactrocera zonata was a serious pest of fruits causing severe losses to the fruit production and their quality (Khan et al. 2017) [8]. The fruit fly incidence was positively correlated with maximum and minimum temperature, and when the temperatures fall within the optimum range, the population was at its peak (Stanley et al. 2015) [6]. The temperature has significant role in determining the climatic suitability for B. zonata in reproduction (Choudhary et al. 2019) [5]. During faunistic surveys in Chhattisgarh conducted by the Zoological Survey of India, 7 species of fruit flies were collected out of which 3 species were reported for the first time from the state while dealing with the collection of 7 fruit flies (Haldar et al., 2015) [12]. Choudhary et al. (2019) [5] conducted an experiment on Bactrocera zonata (Saunders) and studied the temperature based growth potential at ecologically relevant constant temperatures (15, 20, 25, 30 and 35 °C; relative humidity of 60 ± 10% and a photoperiod of 12:12 h.L:D) and simulated growth potential parameters that were validated with fluctuating temperatures life cycle data under laboratory conditions on artificial diet. Satarkar et al. (2009) [13] studied the spatial distribution of Bactrocera fruit flies in the Goa region (west coast of India) using several dispersion parameters between April 2006 and March 2008 in three ecological zones, viz. coastal, midland and upland. He concluded that the population of all the fruit fly species attracted to methyl eugenol-baited traps, viz. Bactrocera dorsalis, Bactrocera caryae, Bactrocera zonata, Bactrocera affinis and Bactrocera correcta, was following the negative binomial distribution pattern and was highly aggregated or clumped. Bactrocera zonata was recorded as a new pest in central India in 2020 At Tropical Forest Research Institute Jabalpur, District Jabalpur. The attack of B. zonata was first time reported on the fruit of Madhuca indica in Jabalpur region of Central India.

Detection and identification symptoms
The collection of fruits of Madhuca indica was carried out randomly in sunny days.
Identification and Observation of fruit-fly larva and adult was carried out as per Kumar et al. (2020) with some modification. Attacked fruits usually show signs of oviposition punctures. Fruits with high sugar content, such as peaches, exude a sugary liquid, which usually solidifies adjacent to the oviposition site.

**Host and damages known to attack**
Mahua, guava, mango, banana, apple, pineapple, peach, jamun, grapes, custard apple included some vegetables etc. larvae infest inside the fruit pulp of inset making it unfit for the consumption.

**Distribution**
Occurs in China, India, Myanmar, Nepal, Pakistan, Sri Lanka, Egypt and Thailand.

**Classification**
Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Order: Diptera
Family: Tephritidae
Genus: Bactrocera
Species: Zonata

**Synonymy**
B. cucurbitae, B. dorsalis, B. zonata, B. correcta, B. tryoni, B. oleae

**Methods and Materials**
**Collection site**
Collection of Mahua fruit was started from mid-May to June end. The present study was performed in accordance to Kumar and Bhowate et al. (2020) at Tropical Forest Research Institute Jabalpur campus & nearby places.

**Table 1:** Distribution of *Madhuca indica* fruit-fly larva in different location under Jabalpur region

| S. No. | Date of collection | Site details | GPS coordinates | Habitat type | Percentage of infestation |
|--------|-------------------|--------------|-----------------|--------------|--------------------------|
| 1      | 13.06.2020        | BOTANICAL GARDEN, TFRI | N23-05’57.02 E079-58’59.49 Elevation-1371 ft. | Forest area | 20% |
| 2      | 14.06.2020        | BARHA, BARGI NAGAR, JABALPUR | N 23⸰01’35.4 E 079⸰59’31.1 Elevation-1401ft. | Forest area | 40% |
| 3      | 16.06.2020        | NEAR SCIENTIST HOSTEL, TFRI | N 23⸰05’45.83 E 079⸰59’14.71 Elevation-1404 ft. | Grass area | 70% |
| 4      | 17.06.2020        | NEAR SCHOLAR HOSTEL, TFRI | N 23-05’45.83 E 079-59’14.71 Elevation-1404 ft. | Grass area | 65% |
| 5      | 18.06.2020        | SILVICULTURE NURSERY, TFRI | N 23-05’57.02 E 079-58’59.49 Elevation-1371 ft. | Forest area | 32.5% |

**Formula of incidence**
Percentage incidence of *M. indica* fruitfly larva = (No. of infested fruit)/(Total no. of observed fruits) × 100

**Fig 1:** Percentage infestation in different sites by *B. zonata*

**Rearing of Mahua fruit-fly - *B. zonata* (Saunders)**

**Larvae collection**
Larvae of *B. zonata* were obtained from infested *Madhuca indica* fruits that were collected from different location under tropical forest research institute, Jabalpur (M.P) of central India. Emerged larvae were reared for two generations on Mahua fruits in the laboratory for adaptation.

**Larval rearing**
Rearing of larvae of *B. zonata* was carried out in Insect chamber in the Department of entomology forest protection division (TFRI, JABALPUR). The room was provided with heat and fluorescent light systems. Rearing conditions was adjusted to 25 ± 2 °C, 65 – 75% RH and a photoperiod of 14:10 (L: D).

**Handling pupae**
Collecting pupae was done for 4 days after pupation. Pupae were held in the adult rearing jar until emergence. Number of pupae recovered and percentage of pupal recovery was noted based in the initial numbers of eggs put on the diet.

**Adult rearing**
Collected pupae from infested Mahua fruits were placed inside plastic jar. Jars were covered with muslin cloth for ventilation. Emerged adult flies were provided with a 1:10(volume: volume) solution of honey and water thrice in a week. Fresh Mahua fruits were put inside the jar to stimulate flies to lay eggs. Deposited eggs were collected by using Camel hair brush. Eggs were collected until adults reach up to 30 days from the beginning of egg laying.
Fig 2: Mahua fruit

Fig 3: Fruit infestation by B. zonata

Fig 4: Larval feeding inside fruit

Fig 5: Measurement of larva of B. zonata

Fig 6: Size of larva

Fig 7: Pupation stage of B. zonata

Fig 8: Adult rearing vessel of B. zonata

Results and Discussion

Nature of infestation

It was observed that the fruit of *Madhuca indica* was infected by the larvae of *Bactrocera zonata*. The adult female fruit fly of *B. zonata* lays there eggs on the surface of the fruit through their ovipositor. After hatching off eggs the larva penetrate inside the fruit and start feeding on the fruit pulp.

Taxonomic description

*Bactrocera zonata* is a brightly colored little fly, predominately black with lateral yellow stripes, approximately 5.8 mm in length. It has two black transverse bands on its face and predominately black scutum with two yellow lateral stripes (vittae). Yellow costal band on the wing is interrupted and expanded at apex into a brown spot. Abdomen yellow-to orange-yellow with a black “T” mark on dorsal surface. Larvae (maggots) are white to creamy white, legless with cylindrical bodies narrowed at the anterior end. Due to large infestation seen on the fruits of many species of Mahua, *B. zonata* (Dipteran- tephritidis) is also known as Mahua fruit fly.
Life cycle

Eggs
Elongated, elliptical, whitish, 1.0-1.2mm long, somewhat round at posterior end, slightly pointed anteriorly.

Larvae
Cylindrical, whitish yellow color 1.0-7mm long anteriorly pointed and posteriorly round in shape.

Pupae
Barrel-shaped, 11 segments, yellowish or yellowish brown, 4.2-5.8 mm long, 2.3-2.5 mm wide, anterior end with two anterior spiracles, posterior end rounded, posterior spiracles occupy the same position as in larva.

Adult
It is a yellowish brown colored little fly, having yellow colored triangle band at the posterior end of thorax, wings transparent marked with brown spot at the apex, male is slightly smaller than female.

Fig 9: Adult of Bactrocera zonata

Fig 10: Mouth part of B. zonata
Conclusion
The present study is the first effort in exploring the identity of Madhuca indica fruit fly in Jabalpur region of central India in 2020 at tropical forest research institute Jabalpur, district Jabalpur, Madhya Pradesh. During the study different sites were selected and fruits were collected. The data showed that large infestation of fruit fly was seen in the area of silviculture nursery at Jabalpur. The species identified is Bactrocera zonata a fruit fly causing severe damage to fruits of Madhuca indica the condition can be normalized by adopting the good agronomic and pest management practices.

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