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Reproductive Biology of *Dacus persicus* (Aak Fruit Fly): A Pest of *Calotropis gigantea* in Sri Lanka

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1 INTRODUCTION

Calotropis species are categorized under the family of Apocynaceae in the plant kingdom. *Calotropis* plants grow as a small tree or spread as a shrub. It is drought resistant, salt tolerant and prefers disturbed sandy soils (Kumar *et al*, 2013). These species are distributed throughout the tropical regions. They are native to Asia and Africa (Sigh *et al*, 2013). Three species are recorded namely: *C.procera*, *C.acia* and *C.gigantea* (Bebawi *et al*, 2015). *C.gigantea* and *C.procera* are more common and have wider distribution than *C.acia* (Bebawiet *al*, 2015).

They have similar botanical characteristics and similar pharmacological effects, (Kumar *et al*. 2013) and are widely used in ayurvedic medicine. Different plant parts of *C.procera* are used in treatment of bronchitis, asthma, leprosy, eczema, elephantiasis, baldness, hair loss, toothache, intermittent fevers, rheumatoid/joint swellings and paralysis (Quaziet *al*, 2013). *C. gigantea* used in order to cure various types of cutaneous diseases, tumors, intestinal worms, inflammations, intermittent fever, anorexia, asthma, bronchitis, paralysis, cough, swellings and dyspepsia (Sethi, 2014).

Dacusspp. (sub family Tephritidae) are recorded as one of the commonly found insects on *Calotropis* sp. (Dhileepan

2014). Only two species of fruit flies, *Dacuspersicus* and *Daculongistylus* are recorded as pests on *Calotropis* species (Dhileepan 2014). Both species are considered as monophagus species. *D.persicus*, commonly known as Aak fruit fly, is present in Sri Lanka. There is no known record of *D.longistylus* within the country (Dhileepn, 2014). Aak fruit fly larva is a major destructive seed predator in *Calotropis* species (Sharma and Amritphale 2008).The damage is directly focused on the reproductive output of the plant which severely reduces the propagation of the *Calotropis* species. Therefore, *D. persicus* act is a major pest of *Calotropis sp*; and the reproductive biology of *D.persicus* is important in order to minimize the pest attack for this valuable medicinal plant.

No studies have been conducted on *D.persicus* of *C. gigantea* in Sri Lanka. The present study aims to fill in the important gap regarding the reproductive biology of *Dacuspersicus* in Sri Lanka which could be used to develop pest management practices on *C.gigantea*.

2 METHODOLOGY

Eight locations of Southern province were selected for monthly sampling in order to study their reproductive biology of Aak fruitfly. The sites were Kalametiya (6° 6'



N; 80° 55' E), Medilla (6° 2' N; 80° 48' E), Tangalle (6° 1' N; 80° 47' E), Dadalla (6° 2' N; 80° 11' E), Thalpe (5° 59' N; 80° 16' E), Kamburugamuwa (05° 56' N; 80° 29' E), Habaraduwa (5° 59' N; 80° 18' E) and Palena (5° 56' N; 80° 29' E).

Male and females of *D.persicus* were collected from above selected sites, directly by hand picking and were placed in plastic vials. They were reared in the laboratory, Department of Zoology in University of Ruhuna to study mating behaviour, larval development and oviposition. Flies kept in captivity in transparent plastic boxes covered with wire- mesh material on top. They were fed with bee honey and sugar solution kept in a small petri-dish. Each pair of adult male and female flies was kept in separate transparent plastic boxes. Mating behaviour was recorded and each mating pair was observed for pre-mating, mating, post mating, pre- oviposition, oviposition behaviour and the time taken for each activity under laboratory conditions.

Calotropis fruits of different maturity stages were plucked from trees and also recently fallen fruits (148 in number) were collected from the ground. Fruits were dissected under laboratory conditions. The larval stages were extracted to determine the number of larval instars. Larval stages were placed in 70% alcohol. The maximum length of the head capsule of each larva was measured using a calibrated ocular micrometer in a binocular dissecting microscope.

In addition, *Calotropis* fruits (250 in number) were collected from selected sites and egg clusters were extracted from infected fruits. Number of egg clusters per fruit and eggs per cluster was recorded and maximum length and width of extracted eggs were measured. Extracted eggs, larval stages and pupae were reared under laboratory conditions at a temperature (27± 1 °C) to study the life cycle stages of the Aak fruit fly. The mortality was also recorded.

3 RESULTS

Observations of mating behaviour of fruit flies revealed that, flies mated at any time during the day. Before mating, male fruit fly showed a dancing behaviour to attract females. After several mounting attempts, prolonged copulation occurred. Mating time period of fruit fly pairs were observed and the mating time period was recorded as 53.80 (± 1.68) minutes. After mating, female ovipositor was greatly elongated. The length of ovipositor varies from 3 mm to 12 mm.

Gravid females aggregate on immature fruits in order to oviposit their eggs. Ovipositing by 2- 3 females within the same fruit was recorded. When a female fly finds a suitable spot, it bends its abdomen along the long axis of the body then moves the ovipositor into the fruit penetrating the outer cover of the fruit. The duration of oviposition was observed in ovipositing females recorded as 92.31 (± 2.62) minutes.

Eggs were observed on inner most layers of pericarp or sometimes on seeds. The eggs were laid in clusters. Only one cluster per fruit was recorded even though few females oviposited in same fruit. Average egg count of an egg clusters was calculated as 18.5 (± 0.847). Each cluster consists of pale whitish, delicate eggs arranged as a bunch of bananas. Sometimes 3-4 eggs were attached to each other and appeared as a separate bunch. The egg is elongated, slightly curved and tapering towards either end. One end of the egg is rounded while the other end is more pointed. Average maximum length of fruit fly eggs was recorded as 1.35 (±0.01) mm.

2-3 days, after oviposition eggs gave rise to first larval instar. Larvae just after hatching were transparent and head capsule was not clearly distinguishable. After 3-4 days it turned into brownish colour. The developing larvae were creamy white in colour with brownish



head capsule and mandibles. According to head capsule measurements, *Dacus persicus* consisted of three larval instars. The third larval instar metamorphoses into pupa stage. The cocoon is cylindrical in shape but rounded at both ends and dull creamy white in colour with horizontal ring like ridges.

Average percentage mortality of larvae is recorded as 21.24% while an average number of cocoons per fruit is 7.04 (\pm

1.13). The average maximum width is recorded as 0.29 (\pm 0.004) mm and average maximum length is 0.65 (\pm 0.006) mm. Average percentage mortality of cocoons per fruit is observed as 33.48%. The average number of newly developed fruit flies per fruit was 3.522 (\pm 0.772). Within 10- 15 minutes after hatching, they able to fly. Observation of 50 newly emerged adults showed a sex ratio as 1:1. Field studies, showed higher abundance of females.

Table 1: Summarized data of *D. persicus* reproductive biology in *C. gigantea*

Index	Sample size	Average / Percentage
Mating time period	20 fruit fly pairs	53.80 (\pm 1.68) minutes
Oviposition time period	13 female fruit flies	92.31(\pm 2.62) minutes
Post oviposition time period	08 female fruit flies	18.75 (\pm 2.98) minutes
Number of fruit fly eggs per egg cluster	31 egg clusters	18.5 (\pm 0.847)
Maximum length of fruit fly egg	66 fruit fly eggs	1.35 (\pm 0.01) mm.
Number of larvae per an infected fruit	44 fruits	11.91 (\pm 1.27)
Mortality percentage of larvae per fruit	22 fruits	21.24%
Number of cocoons per an infected fruit	22 fruits	7.04 (\pm 1.13)
Maximum length of a cocoon	60 cocoons	0.65 (\pm 0.006) mm
Maximum width of a cocoon	60 cocoons	0.29 (\pm 0.004) mm
Pupation time duration	18 cocoons	11.72 (\pm 0.26) days
Mortality percentage of cocoons per fruit	22 fruits	33.48%
Number of newly merged fruit flies per an infected fruit	22 fruits	3.522(\pm 0.772)

4 DISCUSSION

Reproductive behaviour studies revealed a tendency of Aak fruit flies to oviposit fruit fly on immature *Calotropis* fruits. This may be due to two major reasons. Immature fruits are easy to penetrate and ensure the placement of eggs in inner pericarp layer. On the other hand, immature fruits consisted of immature seeds which were suitable food source for newly emerged larvae with delicate, developing mouth parts. Sharma and Amritphale 2008 also have shown that female gravid fruit flies are highly attracted to soft fruit morph than hard fruit morph of *C. gigantea* due to high penetrability of oviposit in soft morph fruits than hard morph. Male fruit flies were associated with immature fruits, during oviposition period of females. It

might be due to easy accessibility to females for mating process as well as territory marking on suitable host fruits for facilitating females for oviposition (Aluja and Liedo 2013).

Observations on pre and post oviposition behaviours of *D.longistylus* by Parihar 1984, is closely related with *Dacus persicus* behaviour in present study. While it was observed that, 2-3 females oviposited within one fruit; dissected fruits however showed only one egg cluster. It might be due to pseudo-oviposition of female fruit flies. In contrast, findings by Parihar (1984), of *Daculongistylus* explained that a fruit contains 2- 4 clusters of eggs. Similarly *D.longistylus* egg is 1.00 mm in length



while in *Dacus persicus* the eggs are (1.35 mm). Morphology of fruit fly egg of both species is similar. Cocoon size of *D. longistylus* is 0.45 mm in length and 0.2mm in width while *Dacus persicus* of Sri Lanka 0.65 mm in length and 0.29 mm in width.

To control fruit flies, parasitoids have been introduced in different countries of the world (Wang et al. 2004). According to Wang *et al.* 2004, some species act as egg- larval parasitoids. Other species parasitize on pupae of fruit flies (Guillen *et al* 2002). In the present study, some cocoons were parasitized by an unidentified Dipteran. Parasitic fly laid eggs in cocoons. The parasitic fly cocoons are dull creamy white and elongated but smaller than cocoons of *Dacus persicus*.

The fruit flies reared in laboratory had a 1:1 sex ratio of female and male. In field observations, the female fruit fly abundance was higher than males. The observation of higher abundance in female fruit flies than male may occur due to long lifespan of female fruit flies.

The findings of the present study provide detailed information on *D.persicus* reproductive biology in Sri Lanka. This information is required for pest management practices of *D.persicus*, which acts as destructive pest of *C. gigantea*.

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