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Studies on Comparative Biology of Fruit Fly *Bactrocera caryeae* (Kapoor) in *Garcinia* spp.

Raghunatha R.[1]*, Suvarna Patil [2], R B Hirekurubar[3], Aswathanarayana Reddy N[4], Javaregowda[5], C G Yadav[1] and Harshavardhan M[1]

[1]College of Horticulture, Munirabad, Koppal, 583233, (Karnataka), India

ABSTRACT

Kokum is an important underutilized crop native of the Western Ghats in India which is greatly affected by fruit flies which can cause significant damage to kokum fruits, impacting production and potentially affecting the livelihoods of farmers who rely on this crop. Hence, investigations were undertaken at the Department of Entomology, College of Horticulture, Sirsi, Uttara Kannada (Karnataka) during 2021 and 2022 to comprehend the biology of *Bactrocera caryeae* (Kapoor) on *Garcinia indica* and *Garcinia morella* under laboratory condition. The facts on comparative biology of *B. caryeae* on *G.indica* revealed the average egg period (1.57 and 1.65 d), larval period (11.15 and 11.47 d), pupal period (12.90 and 12.60 d), male longevity (19.90 and 18.85 d), female longevity (23.10 and 23.05 d), fecundity (183.50 and 182.3 eggs) and total life cycle (25.62 and 25.72 d) during 2021 and 2022. Similarly, in *G. morella* the average egg period (3.05 and 2.87 d), larval period (12.82 and 12.62 d), pupal period (11.85 and 11.85 d), male longevity (18.85 and 18.90 d), female longevity (21.65 and 21.25 d), fecundity (133.7 and 130.80 eggs) and total life cycle (27.72 and 27.35 d) during 2021 and 2022. The present study provided valuable insights into the comparative biology of *Bactrocera caryeae* on *Garcinia indica* and *Garcinia morella*, highlighting significant variations in developmental parameters and reproductive potential. These findings can aid in devising targeted management strategies to mitigate fruit fly infestation in kokum cultivation.

Keywords: *Bactrocera caryeae,* Comparative Biology, *Garcinia indica*, *Garcinia morella.*

INTRODUCTION

Garcinia indica Choisy, generally known as Kokum is an underappreciated crop that grows in the tropical evergreen rain forests of India's Western Ghats. It is also known as wild mangosteen, Goa butter tree, Brand, Anslil, Amsol (Konkani and Marathi), Murugalu (Kannada), and Punarpuli (Malayalam), is the most lucrative of the species known to exist in India (Nayak *et al*, 2010). *G. indica* is incredibly popular as a spicy and medicinally valuable colorant. Roadsides, backyard wastelands, valleys, streams, and riverbanks are all home to kokum trees. (Karnik and Raorane, 2001). This crop is considered an underutilized and neglected crop but crucial to the means of support of millions of poor farmers across the globe. The total area in Karnataka is about 1200 ha with a yield of 8000 to 10000 t of dried rind per year (Ramachandran, 2014 and Laxminarayan, 2019). *Garcinia* spp. is rarely attacked by insect pests that seriously harm them. Among these, the Konkan region of Maharashtra was discovered to be infested by fruit fly *B. dorsalis.*

Tephritid fruit flies are major key pests in the world with the larval stages feeding on an array of fruits and vegetables. The fruit fly *B. dorsalis* (Hendel), first reported in Taiwan, is one of the most destructive pests of vegetable and fruits across globe, causing vast monetary losses (Wei *et al,* 2017) and is a serious pest on a wide range of crops in the Indian subcontinent. It is endemic to Southeast Asia, also been introduced to numerous regions of the world and became threats to the wide range of cultivated and wild fruits (Drew and Raghu, 2002). *B. dorsalis* is reported to cause 100.0, 87.0, 78.0 and 61.0% fruit damage in rainy season on guava, mango, peach and pear respectively (Sharma *et*

Corresponding Author's Email - raghunatha.raj@gmail.com
1College of Horticulture, Munirabad, Koppal, 583233, (Karnataka), India
2Regional Horticulture Research and Extension Center, Dharwad, Kumbapur, 580001, (Karnataka), India
3Horticulture Research and Extension Center, Hidkal Dam, 591107, (Karnataka), India
4Horticulture Research and Extension Center, Kolar, 563138, (Karnataka), India
5Department of Forest Biology and Tree Improvement, College of Forestry, UAS, Dharwad, 580005, (Karnataka), India

al, 2011). Numerous species complexes are existing in this family Tephritidae of which fruit fly, *Bactrocera dorsalis* (Hendel) species complex is of boundless importance. *Bactrocera caryeae* (Kapoor) is a member of this complex. Seven species of the complex are considered to be of economic importance with a wide host range and *B. caryeae* is one of them (Clarke *et al,* 2005). Therefore, the current investigation was carried out to study the comparative biology of *B. caryeae* (Kappor) on *G. indica* and *G. morella* under laboratory condition.

MATERIALS AND METHODS

Maintenance of culture of *Bactrocera caryeae* (Kapoor)

The initial culture of *B. caryeae* was raised by collecting infested fruits of Kokum from the orchards of various places in and around Sirsi, Uttara Kannada, during peak fruiting season in 2021 and 2022. The infested fruits were kept in a rearing cage on a thick layer of sieved moist sand (5 cm) to obtain the pupae. When full-grown maggots entered the sand for pupation, decayed fruits removed from the cages. Sand in the cages sieved after every 4-5 d to collect the pupae. Thereafter pupae were transferred in a clean plastic bottle individually. The bottles were covered with lids to prevent the escape of flies. Later banana fruits were used for maintaining the cultures of fruit flies, because of the *Garcinia* fruits are seasonal and its unavailability around the year. Hence it was used to maintain the fruit fly population. Adults were fed on mixture of milk powder, yeast and honey solution, later these flies were maintained up to 3-4 generations in the laboratory. The flies that emerged were utilized for further studies on life history (Jayanthi and Verghese, 2002).

Experimental details

Investigation was undertaken in the Department of Entomology, College of Horticulture, Sirsi, Uttara Kannada (Karnataka) during fruiting season 2021 and 2022in the laboratory condition with three replications to comprehend the biology of *Bactrocera caryeae* (Kapoor) on *Garcinia indica* and *Garcinia morella*. A pair of male and female were obtained from parental pure culture, and fully ripened healthy fruits of *Garcinia indica* and *Garcinia Morella* fruits were provided individually for oviposition in the rearing cages. The *Garcinia* fruits were replaced after observing the oviposition puncture. The fruits punctured due to egg laying were cut open with a fine razor blade and eggs laid if any were confirmed using a magnifying lens. The fruits having eggs were smoothly transferred in a separate petri dish and observed twice a day for their hatching. When eggs hatched out, the neonate maggots were gently transferred on a fresh fruit slice of *G. indica* and *G. morella* fruits, they were kept in a petri dish for further rearing. The food (fruit slices) as well as petri dishes were reformed every day to avoid microbial development on fruit slices. The maggots were reared following this methodology until they were fully grown and transferred along with a petri dish in a cage filled with a layer of 5 cm moist sand. Each petri dish was inspected and recorded the fecundity, incubation period, maggot period, pupal period, adult longevity, and total developmental period.

RESULTS AND DISCUSSION

Incubation period

The mean incubation period of 1.61 and 2.96 d was recorded in *G. indica* and *G. morella* respectively. The result indicated that the lower incubation period of *B. caryeae* was recorded in *G. indica* fruits followed by *G. morella*. Kalia (1992) reported impact of host varieties on egg period was 3.25, 3.00, 2.25 and 2.00 d, respectively on Dashehari, Amrapali, Mallika and Bangalora. Ashoka and Javaregowda (2019) reported that mean incubation period was significantly lowest on Alphonso (1.5 d) followed by Benishan fruits (1.6 d) than all other mango genotypes.

Larval (maggot) period

The data indicated that, the average larval period of 11.31 and 12.73 was recorded in *G. indica* and *G. morella* respectively. Thus, the study indicated that larva could complete its larval period earlier when fed on *G. indica* compared to *G. morella.* Kalia (1992) reported that studies on varietal differences revealed that the maggot period of *B. dorsalis* was 6.50, 6.00, 6.00 and 7.75 d, respectively on variety Dashehari, Amrapali, Mallika and Bangalora. Kalia and Srivastava (1992) also reported that the maggot period was 9.25, 9.00, 8.50 and 6.0 d on fruits of four, three, two and one week before maturity of Amrapali variety. However, it was 9.50, 9.0, 8.25 and 6.0 d on variety Mallika. Ashoka and Javaregowda (2019) reported the mean maggot period were significantly lowest on Benishan fruits (7.8 d) than all other mango genotypes

Pupal period

The mean pupal period 11.85 and12.75 d was recorded in *G. indica* and *G. morella* respectively. The present study can be comparable with the result of

Table 1: Comparative biology of *B. caryeae* in *G. indica* and *G. morella.*

Stage	*G. indica*		Pooled mean	*G. morella*		Pooled mean
	2021	2022		2021	2022	
	Mean ± SE (Days)	Mean ± SE (Days)	Mean ± SE (Days)	Mean ± SE (Days)	Mean ± SE (Days)	Mean ± SE (Days)
Incubation period	1.57 ± 0.11	1.65 ± 0.16	1.61 ± 0.12	3.05 ± 0.16	2.87 ± 0.17	2.96 ± 0.16
Maggot period	11.15 ± 0.27	11.47 ± 0.15	11.31 ± 0.18	12.82 ± 0.29	12.62 ± 0.27	12.73 ± 0.26
Pupal period	12.90 ± 0.23	12.60 ± 0.24	12.75 ± 0.20	11.85 ± 0.33	11.85 ± 0.24	11.85 ± 0.26
Male longevity	19.90 ± 0.38	18.85 ± 0.21	19.38 ± 0.21	18.85 ± 0.20	18.90 ± 0.19	18.88 ± 0.16
Female longevity	23.10 ± 0.53	23.05 ± 0.24	23.08 ± 0.30	21.65 ± 0.39	21.25 ± 0.40	21.45 ± 0.38
Total developmental period	25.62 ± 0.25	25.72 ± 0.34	25.68 ± 0.22	27.72 ± 0.58	27.35 ± 0.53	27.54 ± 0.52
Fecundity (No.)	183.50 ± 1.64	182.3 ± 1.22	182.90 ±1.29	133.7 ± 0.97	130.8 ± 0.92	132.25 ± 0.90

Kalia (1992) when *B. dorsalis* was reared on different varieties of mango, the shortest period was noted on Mallika (7.5 d) followed by Amrapali (8.0 d), Bangalora (8.75 d) and Dashehari (9.0 d). Kalia and Srivastava (1992) reported the pupal period as 8 to 10.50 d on Amrapali and 7.50 to 10.75 d on Malika. Jiji *et al* (2006) also reported that pupal period of *B. dorsalis* was 10.50 and12.75 d on variety Neelum and Bangalora respectively. Ashoka and Javaregowda (2019) also reported that the mean pupal period of *B. dorsalis* was maximum on Dasheri (12.6 d) followed by Neelum (12.3 d) which was at par with each other

Fecundity

The egg laying capacity of gravid female with pooled mean of 182.90 and 132.25 eggs/female was recorded in *G. indica* and *G. morella* respectively. It is clear from the studies that the greater number of eggs were laid in *G. indica* fruit compared to the *G. morella* fruits. Thus, the higher fecundity in *G. indica* fruit indicated the preference of particular fruits. The total sugars were considered to be an essential component in insect nutrition and play a vital role in host selection by phytophagous insects. The *G. indica* fruits has low rind thickness and high T.S.S. compare to *G. morella.* Narayanan and Batra (1960) recorded on an average 50 eggs of *D. dorsalis*, but under favorable conditions they observed 150-200 eggs per female in a period of one month. Ashoka and Javaregowda (2019) reported highest fecundity were recorded on Benishan and Alphonso with 189.5 eggs and 187.4 eggs which were significantly more than other genotypes.

Adult longevity

The mean male longevity of 18.85 and 18.88 d was recorded in *G. indica* and *G. Morella* respectively. The mean female longevity of 23.10 and 21.45 d was recorded in *G. indica* and *G. morella* respectively. Thus, the study indicated that the *B. caryeae* females lived longer than male. The male and female could live longer when reared on *G. indica* compared to *G. morella*. The variations in adult longevity might be due to differences in nutritional ingredients present in the food. Jiji *et al* (2006) reported adult longevity of *B. dorsalis* in the variety Neelum and Bangalora was 16.50 and 20.30 d respectively. Ashoka and Javaregowda (2019) reported the maximum male adult longevity (20.6 d) was observed on Benishan tailed by the Alphonso (20.1 d).

Total developmental period

It is evident from the data, the average life cycle of 25.68 and 27.54 d was documented in *G. indica* and *G. morella* respectively. It is clear from the studies that, the shorter period taken to complete the whole life cycle of *B. caryeae* on *G. indica* revealed the preference by the pest. The present studies were confined with the life cycle of *B. dorsalis* took lesser duration on mango variety Mallika (15.75 d) followed by Amrapali (17.00 d), Bangalora (18.50 d) and Dashehari (18.75 d) (Kalia, 1992). Ashoka and Javaregowda (2019) reported the total progressive period from hatching of maggot to emergence of adults from pupa was significantly longer on Dasheri (27.5 d) followed by Neelum (26.0 d).

CONCLUSION

In conclusion, biology of *B. caryeae* (Kapoor) is important to know the feeding preference of *Garcinia* spp. based on the rate of fecundity on different *Garcinia spp.* that support to make efficient strategies to control this economic pest. Based on the resistant/susceptible category of *Garcinia* spp. can be used in the breeding programme which helps to propagate *Garcinia* spp. in the field.

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