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Fruit fly species diversity in selected fruit crops in Andhra Pradesh, India

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ABSTRACT: A study to document the diversity of fruit fly species infesting selected fruit crops *viz.,* mango, guava, custard apple and ber in Rayalaseema region of Andhra Pradesh was conducted at College of Horticulture, Anantharajupeta during 2023-24. Random collection of infested fruit samples through roving survey in potential crop growing areas of Annamayya, Ananthapuramu, Chittoor and Nandyal districts of Rayalaseema was done for rearing and further species identification. The study revealed that infestation of three major fruit fly species *viz*., *Bactrocera dorsalis*, *Bactrocera zonata* and *Bactrocera correcta* in these crops. In four districts, highly predominant species in all these crops is *B.dorsalis* with infestation percentage ranging from 45-64.7, followed by *B. correcta* (20.0-31.42%) and *B. zonata* (11.66-33.33%). In ber crop, it was found that, there is complete displacement of ber fruit fly, *Carpomyia vesuviana*, a monophagous species by genus *Bactrocera*. This displacement may be due to wide host range and adaptability of *B. dorsalis* complex in fruit crops. This is also a first report on ecological species displacement of Carpomiya vesuviana by Bactrocera dorsalis complex in ber crop from Andhra Pradesh.

Keywords: Fruit flies, species, mango, ber, custard apple, guava

INTRODUCTION

India's varied climate supports the growth of a wide range of fresh fruits and vegetables. It is the second largest fruit producer globally, following China. The country generates 11.21 MMT of fruits from an area of 7.05 Mha. Uttar Pradesh and Madhya Pradesh lead in guava and ber production with 983.59 t and 121.76 t, respectively while, Andhra Pradesh ranks fourth and fifth in ber and guava production, contributing 335.11 t and 59.30 t, respectively (NHB, 2022)

Mango, *Mangifera indica*, (Anacardiaceae) often called as the "King of Fruits," is a key fruit crop in India. Guava (*Psidium guajava*), also known as the "Apple of the Tropics" or "Poor man's apple," is another significant fruit. Custard apple (*Annona squamosa*) is an edible tropical and arid fruit also called "Sugar apple." Ber (*Zizyphus mauritiana*) is also an arid fruit with nutritional properties known as "Indian jujube, Red dates, Indian plum and Korean date". Despite high production levels, significant losses occur in these fruit crops due to several factors. Abiotic stresses like extreme temperatures (both hot and cold), water shortages, soil salinity, and heavy metal contamination contribute to various levels of yield losses. Additionally, insects pests as biotic factors also hinders the production.

Fruit fly infestations cause substantial yield losses in mango, guava, and ber, sometimes reaching up to 65-80% (Jena *et al.* 2022). Similarly, in custard apple losses can range from 25-50% if harvested at the mature ripe stage, with losses potentially increasing upto 80% during severe infestations (Math *et al.,* 2017).

Bactrocera dorsalis, a major fruit fly species attacks over 300 cultivated and wild fruit crops compared to the other species. It's damage levels range upto 80% in mango, 50% in guava and 58-70% in custard apple fruits (Choudhary *et al.,* 2017). *Bactrocera correcta* (Bezzi, 1916), another major species affecting over 70 types of fruits and melons across 35 plant families in tropical and subtropical areas. Key hosts include guava, mango, cashew, cherry, jujube, orange, banana, carambola, and wax apple. In Northern India, guava is heavily infested by fruit fly species, *B. zonata*, *B. dorsalis*, and *B. cucurbitae*. In contrast, *B. correcta* has emerged as a significant threat in South India, potentially causing up to 80% damage. (Jana and Idris (2020).

Ber, *Ziziphus mauritian* is a tropical fruit crop. The crop is being infested by several pests, which, include the fruit fly (*Carpomyia vesuviana* Costa), Meridarchis scyrodes Meyr, chafer beetle (*Holotrichia consanguinea* Blanch), and bark-eating caterpillars (*Indarbela tetraonis* Moore and *I. quadrinotata* Walker) (Karuppaiah *et al.,* 2015; Haldhar *et al.* (2016a). Among them fruit fly, *Carpomyia vesuviana* Costa, is the most severe threat to the ber trees. This fruit fly species was noted as monophagous pest specifically targets *Zizyphus species* in arid and semi-arid regions of Oriental Asia, including India, the Middle East, Temperate Asia, China, and Southern Europe (He *et al.,* 2010). Lakra (1998) reported

six species of fruit flies, *Corpomyia vesuviana* Costa, *Caprpmoyia zizyphae* Agarwal & Kapoor, *Bactrocera dorsalis* Hendel, *B. correcta* Bezzi, *B.zonata* Saunders and *Bactrocera spp*. on ber in India.

MATERIALS AND METHODS

The study was carried out at the College of Horticulture, Anantharajupeta, and the Horticultural Research Station, Ananthapuramu, Dr. YSR Horticultural University, located in Southern Agro climatic Zone of Andhra Pradesh, at an elevation of 162 MSL, 13.980° N latitude and 79.400° E longitude. The fruit collection for species diversity studies was done through roving survey method, which was carried out during 2023-24 across multiple farmer fields in the Ananthapuramu, Nandyal, Chittoor and Annamayya districts within the Rayalaseema region of Andhra Pradesh.

Fifty fly infested ber fruits (two seasons Nov 2023 and June 2024) and twenty mango, custard apple and guava fruits each were collected from each farmer's field. These fruits were brought to the laboratory at the COH, Anantharajupeta, where they were placed in plastic tubs containing 5-10 cm deep layer of sand, later these plastic tubs were placed in rearing cages (25 x 25 x 25 cm). Within 3-4 days, the mature maggots inside the fruits pupated in sand mixture. The newly formed pupae were then collected and transferred to plastic bottles (12 x 6 x 8 cm) with sand to allow adult fly emergence. Adult flies began to emerge within 8-9 days. Once the flies are emerged, they were fed by placing cotton swabs soaked in a 10% honey solution inside the bottles for two days, which facilitated the sclerotization and body coloration process. The reared flies were collected with a fine camel brush and were segregated based on their district of collection, killed and stored in 70% ethyl alcohol solution for further taxonomic studies.

RESULTS AND DISCUSSION

Fruit fly species identification was done using microscope (10x, 40x magnification), through the taxonomic keys given by Billah *et al.* (2009) and David and Ramani (2011). Further, samples collected from different districts were sent to NBAIR, Bengaluru for confirmation. From the study three species *viz., Bactrocera dorsalis*, *Bactrocera correcta* and *Bactrocera zonata* were identified and scientifically documented based on the following taxonomical and morphological characteristics of their head, thorax, wings and abdomen.

***Bactrocera dorsalis* (Hendel):** Adult fly is bigger than a housefly. Males measuring 5-6.5 mm in length, while females 5-6.7 mm.

Head: Head with reduced chaetotaxy, lacking ocellar and post cellar setae. First flagellomere was atleast three times longer than breadth. Face yellowish marked with a dark round spot in each antennal furrow.

Thorax: The scutum is mainly black, with the exception of lateral yellow vittae, and yellow postpronotal lobe and notopleurae. The scutellum, on the other hand, is entirely pale in color, although occasionally it may have a narrow black line across the base. Additionally, it possesses anterior supra-alar setae and prescutellar acrostichal setae.

Wings: Vein Sc abruptly bent forward at nearly $90^{0,}$ beyond this bend and ending at subcoastal break. Costal margin of the wing is with a distinct colored band from the end of vein Sc to just beyond the end of vein $R_{4+5.}$ Cross veins r-m and dm-cu without a complete covering of microtrichia.

Legs: All femora are fulvous, with the apices of the femora exhibiting a red-brown coloration.

Abdomen: All tergites are distinct and separate from each other. Tergite 5 is characterized by a pair of slightly depressed areas. In males, there is a row of setae called pectin on each side of tergite 3. Abdominal tergites 3 to 5 feature a prominent black 'T'-shaped mark, while the postpronotal lobes lack any setae.

***Bactrocera correcta* (Bezzi):** Often termed as the 'guava fruit fly', this adult fly is a vividly colored small insect, measuring approximately 5-5.5 millimeters in length.

Head: The face features a pair of elongated black spots arranged transversely, nearly meeting at the center to form a black band. The third antennal segment is notably three or more times longer than its width.

Thorax: The mesonotum is primarily black, yet the central part is adorned with gray pubescence, featuring three faint narrow black vittae. Adjacent to these, there are two broad lateral yellow post-sutural vittae. Notably, there is no medium vitta present. The scutellum is yellow in color, with a narrow black band at its base.

Wings: The fore wings are transparent, with a discontinuous or extremely narrow costal band extending from R_{2+3} to the apex, where it expands into a spot. There's a small oval dark brown spot across the apex of R_{4+5}. The subcoastal cell appears yellow, with a faint hint of yellow

along the costal margin at the apex of cell R_1. Additionally, there's a narrow brown spot at the lower apex of cell R_3 and the upper apex of cell R_5. The cubital cell faintly shows yellow, with no developed cubital streak.

Legs: Predominantly yellow, hind tibiae exhibit a notable keel-like protrusion on the posterior dorsal surface just before the apex.

Abdomen: The abdomen displays a reddish-brown coloration on the dorsal side, with black basal markings on terga 2 and 3, and a central black stripe extending from terga 3 to 5. Tergum 5 bears a pair of black oval spots, while tergum 3 features a pectinate structure. The sterna of both sexes are uniformly yellow.

***Bactrocera zonata* (Saunders):** The adult fly, approximately the size of a housefly, exhibits a predominantly red-brown hue and measures between 5 to 6 millimeters in length.

Head: Face reddish in color with big oval brownish black- facial spots in the antennal furrow.

Thorax: Thorax with reddish brown scutum and two parallel sided post sutural vittae which are yellow in color extending posteriorly to the level of intra-alar setae. Scutellum yellow colored with narrow black basal band with a pair of prescutellar bristles.

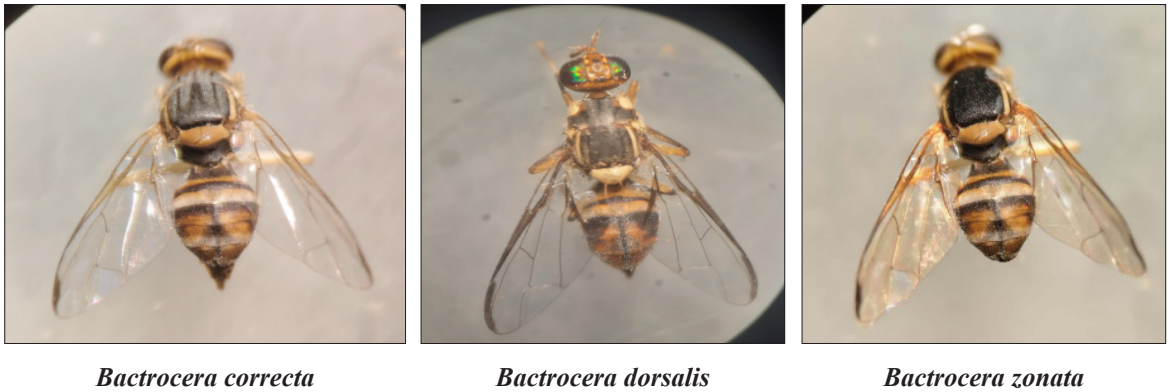
Wings: The fore wings exhibit a costal band, which may be either discontinuous or include an extremely narrow section distal to the apex R_{2+3} before expanding into a narrow isolated spot at the wing apex. A raised area is observed in the narrow basal part of the wing cell, lacking microtrichia. Notably, there is an absence of an "anal streak," characterized by the lack of a diagonal colored band across the base of the wing aligned with cell bcu.

Legs: All femora are fulvous, with the apices of the femora exhibiting a red-brown coloration.

Abdomen: Typically, there exists a pair of dark marks on tergite 3, with no medial dark line except for tergite 5. Males possess a pecten on tergum 3.

Table 1: Fruit fly species composition of various fruit crops in different districts of Rayalaseema region

Crop	District	Fruit fly species (%)		
		B. dorsalis	***B. correcta***	***B. zonata***
Mango	Annamayya	58.18	25.45	16.36
	Chittoor	64.70	23.52	11.76
Guava	Annamayya	45.0	21.67	33.33
	Chittoor	51.6	20.0	28.4
Custard apple	Ananthapuramu	56.25	22.91	20.83
	Nandyal	45.71	31.42	22.85
Ber	Ananthapuramu	57.69	26.92	15.39
	Nandyal	60.0	28.33	11.66



Bactrocera correcta ***Bactrocera dorsalis*** ***Bactrocera zonata***

Fig.1. Adult flies of different fruit fly species

***Bactrocera correcta* elongated black spots arranged transversely**

***Bactrocera dorsalis* with big dark round facial spots**

***Bactrocera zonata* with oval brownish-black facial spots**

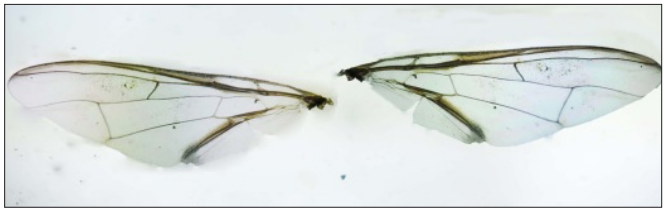
Fig.2. Head with facial spots in different fruit fly species

***Bactrocera correcta* with black basal markings on terga 2 and 3**

***Bactrocera dorsalis* with prominent black 'T'-shaped mark**

***Bactrocera zonata* with no medial dark line except for tergite 5**

Fig.3. Structure of abdomen in different fruit fly species



***Bactrocera dorsalis* with distinct colored band from end of vein Sc to end of vein R_{4+5}**

***Bactrocera zonata,* lacking microtrichia and absence of an anal streak.**

***Bactrocera correcta* with extremely narrow costal band, where it expands into a spot with microtrichia**

***Bactrocera correcta* hind tibia with keel like process**

Fig.4. Wing characters of different fruit fly species

CONCLUSION

Three fruit fly species are found, affecting fruits of mango, guava, ber, and custard apple crops in four Rayalaseema districts *viz*., Ananthapuramu, Chittoor, Nandyal, and Annamayya. These species differ in few taxonomic and morphological characters, presence of complete costal band on the R_{2+3} vein at the wing apex in *Bactrocera dorsalis;* smaller size, black in coloration, with transverse black facial spots forming a band across face and a distinctive keel-like structure on its hind tibiae in *Bactrocera correcta*. *Bactrocera zonata* is characterized by its discontinuous costal band on wings, with a pair of prescutellar bristles in thoracic region. Within the four districts, the most predominant species in all these crops is *B. dorsalis* with infestation percentage ranging from 45- 64.7, followed by *B. correcta* (20.0-31.42%) and *B. zonata* (11.66-33.33%). However, in ber there is no record of *Carpomyia vesuviana* in two seasons collections, though it is a monophagous pest of ber. The complete displacement of *Carpomyia vesuviana* by *Bactrocera dorsalis* complex in ber crop was found. This is also a first report on ecological species displacement of *Carpomyia vesuviana* by *Bactrocera dorsalis* complex in ber crop from Andhra Pradesh.

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