

DIVERSITY AND SPECIES COMPOSITION OF FRUIT FLIES IN MANGO FROM FOREST AREAS OF VALSAD DISTRICT IN SOUTH GUJARAT

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Abstract: Fruit flies are pests of quarantine importance and greatly impact agricultural, horticultural, or forest ecosystems which cause enormous damage to fruits and vegetables. A study was undertaken to know the diversity and species composition of mango fruit flies from forest areas of Valsad district in South Gujarat during 2023. Kaparada block in Valsad district was selected for this study which comes under heavy rainfall zone, sub-mountain, undulating topography, and more than 55 percent forest areas of the district. The fruit fly trap method was used wherein methyl eugenol-based “NAUROJI Stonehouse fruit fly trap” developed by Navsari Agricultural University, Navsari was used. Fruit flies trapped were collected at fortnightly intervals from May to July 2023. Results revealed that forest areas of Kaparada, Gujarat indicated the prevalence of two fruit fly species viz; *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders). *Bactrocera zonata* remained dominant and contributed 66.00 percent followed by *B. dorsalis* (34.00 %). Diversity indices showed that a higher diversity of fruit flies was recorded in Matuniya ($D=0.515$) followed by Chandvegan ($D=0.535$) and Mendha ($D=0.547$).

Keywords: Fruit flies, mango, forest, NAUROJI Stonehouse fruit fly trap, Diversity index, Species composition

INTRODUCTION

South Gujarat is the hub for fruits such as mango and sapota. Banana, papaya and many other fruits are cultivated on large scale. South Gujarat region has been declared as an agro-export zone with in respect two fruits, particularly, Kesar and Alphanso mangoes. Valsad district in South Gujarat is located at 20.7' to 21.5' North latitude and 72.74' to 73.00' East longitude and at elevation of 12 meters above mean sea level. Valsad district falls in South Gujarat Heavy Rainfall Zone- I which consist of two agro-ecological situation viz. I- comprise of Dharampur and Kaparada block (1650 sq.km., sub-mountain, undulating topography, more than 90 per cent forest, more than 90 per cent tribal population and II- comprise of Valsad, Pardi and Umargam block (927 sq.km., plain, mediam black soil, coastal region).

Fruit flies are pests of quarantine importance and have great impact on agricultural or horticultural or forest ecosystem which causes enormous damage to fruits and vegetables.

Out of nearly 4,400 species of fruit flies described so far and distributed throughout the world (Norrbon, 2004), 250 species are of economic importance and are distributed widely in temperate and sub-tropical regions of the world, with the greatest diversity of species occurring in the tropical regions (Norrbon *et al.*, 1998). More than 200 species of fruit flies have been reported from India, however, majority of them have no economic importance (Madhura and Verghese, 2003). The major economically important species of fruit flies are *Bactrocera dorsalis* (Hendel), *Bactrocera cucurbitae* Coquillett, *Bactrocera zonata* (Saunders) and *Bactrocera correcta* Bezzi. Among these, *B. dorsalis*, *B. zonata* and *B. correcta* infest mango and guava and *B. cucurbitae* infests cucurbitaceous vegetables (Nath and Bhushan, 2006).

Incidence of fruit flies is of regular occurrence in South Gujarat. Since area under mango and sapota is increasing, the intensity of this pest is also increasing. Moreover, every species react differently with the environment, it is very important to have its correct identity. Moreover, insects can use the vegetation surrounding the orchard as a refuge and may also transit from one environment to another; that is, the insects that predominate in the orchard can move to the surrounding area and vice versa. Thus, they can provide favourable conditions for community maintenance of insects. In South Gujarat research on different species of fruit flies has been carried out since long times from plain areas. But, the information regarding diversity and species composition of fruit flies from forest areas of South Gujarat particularly from forest areas of Valsad in South Gujarat is scanty. Hence the present work was carried out to know the diversity and species composition of fruit flies from forest areas of Valsad district.

MATERIALS AND METHODS

An extensive study was undertaken during 2023 in forest areas of Valsad district of Gujarat to study the species composition and diversity of fruit flies (Fig.1). The study was undertaken by utilizing the parafferomone for attracting and collecting the male fruit flies. Parafferomone used is the methyl eugenol that attracts the male fruit flies and that infests the mango fruits. The use of the methyl eugenol yields quick results. Methyl eugenol based NAUROJI stonehouse fruit fly trap generated by Navsari Agricultural University, Navsari, Gujarat was used for the purpose. Six villages in Kaparada block which is the major forest area in Valsad district were selected. From each village a mango orchard was selected and two traps were installed (1 trap per 10 trees) at each location. Fruit flies trapped were collected at fortnightly interval from May to July, 2023. During each visit after collection of

flies, each trap was cleaned. At each location, every collected fly was carefully transferred to a butter paper cover. The details of the location were then recorded in a field notebook along with the details of the various butter paper covers containing the flies. This data was used for labelling the specimens. From the total collection of trapped flies (two traps from each location), 100 fruit flies were randomly separated and kept in relaxing chamber (plastic container with moist sand) for two hours in order to avoid insect damage.

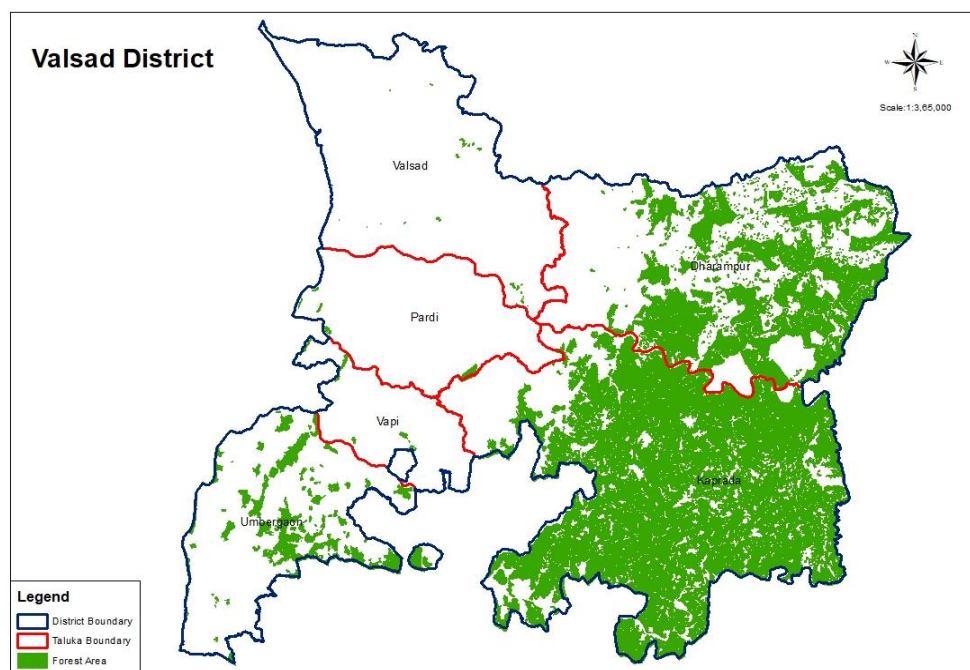


Fig. 1 Experimental area – Forests of Valsad district in South Gujarat

Identification of specimens: All the collected specimens were mounted on a stereomicroscope and identified at 10X magnification and sorted out individually using the keys and diagrams developed by David and Ramani (2011). Using this information, the number of specimens collected for each species encountered at each site was tabulated. The data was used for further analysis of diversity and species richness.

Further they also separated species wise for each location by using the identification keys. Based on this per cent species composition was worked out. Fruit flies were mounted on a stereomicroscope and identified at 10X magnification. The salient characters of fruit fly species as described by David and Ramani (2011) were utilized for identification of species. Using this information, the number of specimens collected for each species encountered at each site was tabulated. The data was used for further analysis of diversity and species richness.

Species richness: Species richness is a very simple and direct measure of diversity, which counts the number of species collected or available in any locality. Most qualitative data can be analysed by counting the number of species and this measure will be useful under such situations.

Diversity indices: Two diversity indices viz., Shannon-Weiner index (Shannon's index for simplicity) and Simpson index were worked out for measuring the diversity of the fruit fly species collected during the survey.

Shannon's index, H' was computed as $H' = -\sum P_i \ln P_i$

Where P_i = Proportion of individuals in the i th species and is given by $P_i = n_i/N$ where n_i = number of individuals of the i th species collected at the site and N is the total number of individuals of all species collected at that locality.

Simpson index was computed as

$$D = \sum \frac{n_i(n_i-1)}{N(N-1)}$$

n_i = number of individuals in the i th species N = Total number of individuals Values of D range from 0 to 1; increase in D value shows a decline in diversity. Therefore, reciprocal form of Simpson's index ($1/D$) is usually adopted and in the present study also the same was used as the index of diversity.

RESULTS AND DISCUSSION

The survey undertaken in the different places in Kaparada, Gujarat (Table 1) indicated the prevalence of two species of fruit fly viz; *Bactrocera dorsalis* (Hendel) and *Bactrocera zonata* (Saunders). *B. zonata* contributed for 66.00 per cent followed by *B. dorsalis* (34.00 per cent). Data indicated that *B. zonata* remained the dominant species by accounting for 66.00 per cent of the total flies (600); followed by *B. dorsalis* (34.00%) (Fig.2). Diversity indices and richness of fruit flies at each location was calculated (Table 2). Shannon index of diversity was maximum in Matuniya ($H' = 0.67$) followed by Chandvengan ($H' = 0.66$). Shannon index, which assumes all species are represented in a sample and that they were sampled randomly. Simpson index (D) was more in the Arnai ($D = 0.576$) which indicated the diversity of flies was minimum. Higher diversity of fruit flies were recorded in Matuniya ($D = 0.515$) followed by Chandvengan ($D = 0.535$) and Mendha ($D = 0.547$). Simpson index is a dominance index because it gives more weight to common or dominant species (Table 2).

Table1. Abundance and species composition of fruit flies based on trapped flies at different forest locations of Valsad District in Gujarat

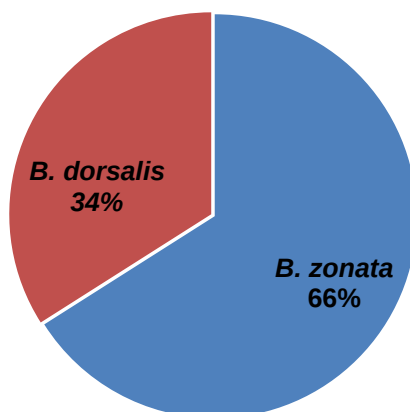
Sr. No.	Location (Village name)	Species abundance of fruit flies (Nos.)		Total no. of FF adults examined	Species composition of fruit flies (%)	
		<i>B. zonata</i>	<i>B. dorsalis</i>		<i>B. zonata</i>	<i>B. dorsalis</i>
1	Chandvengan	64	36	100	64.00	36.00
2	Veri Bhavada	68	32	100	68.00	32.00
3	Mendha	66	34	100	66.00	34.00
4	Arnai	70	30	100	70.00	30.00
5	Matuniya	60	40	100	60.00	40.00
6	Nandgam	68	32	100	68.00	32.00
				Average	66.00	34.00

FF: Fruit Flies**Table 2: Diversity indices of fruit flies from different forest locations of Valsad District in Gujarat**

Sr. No.	Location (Village name)	Shannon index (H')	Species Richness	Simpson index (D)	Simpson Reciprocal index (1/D)
1	Chandvengan	0.66	2	0.535	1.871
2	Veri Bhavada	0.62	2	0.560	1.784
3	Mendha	0.64	2	0.547	1.829
4	Arnai	0.61	2	0.576	1.737
5	Matuniya	0.67	2	0.515	1.941
6	Nandgam	0.62	2	0.560	1.784

All the species belonged to the genus *Bactrocera* under the subfamily Dacinae and tribe Dacini. All the species that were recorded have been previously reported in Gujarat. These findings are more or less corroborated with the reports of Bansode (2009) wherein he reported three species of fruit flies present in south Gujarat. Among them, *B. zonata* was pre-dominant (62.05 %) species of fruit fly followed by *B. dorsalis* (37.27 %) and *B. correcta* (< 1 %). Morde (2003) observed *B. caryae*, *B. dorsalis* and *B. zonata* in the methyl eugenol traps installed in Konkan area of Maharashtra. Kawashita (2004) reported catches of *B. correcta*, *B. dorsalis* and *B. zonata*. Satarkar (2006) in coastal region reported four species of fruit flies viz., *B. caryae*, *B. zonata*, *B. affinis* and *B. correcta* that were attracted to methyl eugenol in the guava orchard.

Fig. 2 Species diversity of fruit flies at different forest locations in Valsad District of Gujarat



The diversity of fruit trees in a natural forest increases the likelihood of occurrence of monophagous species of fruit flies (Aluja and Mangan, 2008) and therefore, increases the probability of a greater diversity of Tephritoidea in the ecosystem. Host plant availability and suitability as well as meteorological factors have proven to have an impact on fruit fly population dynamics and occurrence patterns (Aidoo *et al.*, 2014). Moreover, Virgilio *et al.* (2011) recorded significantly higher number of fruit flies in disturbed habitats than in pristine forest. The horticultural orchards in an agro-ecosystem provide suitable habitats for fruit flies to thrive while trading of agricultural products by humans contributes to the dispersal of tephritid pests (Malacrida *et al.*, 2007).

According to Chaudhary *et al.* (2012) three fruit flies species *B. zonata*, *B. dorsalis* and *B. diversa* were recorded in forest ecosystem of Jharkhand. *Bactrocera zonata* was recognized as the predominant species comprising 95.04, 93.12, 94.65 and 96.76 per cent of population in mango growing areas of Ranchi, Gumla, Lohardaga and Khunti, respectively. Minhobo *et al.* (2018) surveyed different fruit fly species at two locations in West Africa viz., the research station of Lataha (9°34' N and 5°37' W), where mango orchards and other fruit species are planted; the research station of Kamonon Diabaté, private structure (9°33' N and 5°40' W), containing wood, African locust and shea tree productions, making up a small natural forest of about 40 ha. They reported 10 different fruit fly species viz., *B. dorsalis*, *B. cucurbitae*, *Ceratitis anonae*, *C. breinii*, *C. capitata*, *C. cosyra*, *C. punctata*, *Dacus ciliatus*, *D. punctatifrons* and *Dacus spp.* Among these species, *B. dorsalis* was dominant. It was captured by 94.04% and 90.94%, respectively, in mango orchards and forest areas included wild fruits.

Lamba *et al.* (2021) studied the habitat selection by fruit flies in a tropical agroecosystem in Papua New Guinea and recorded the highest abundance of fruit flies in secondary forest followed by primary reserved forest and cocoa plantation, respectively. Vargas *et al.* (2019) concluded that the orchard surrounded by native forest had the highest species richness and Shannon diversity. The environment surrounding the guava orchard influences the richness, diversity, abundance and sex ratio of fruit flies, indicating that the native forest may provide more resources for the maintenance of these insects. The present findings are more or less similar with the earlier workers.



A-Installation of trap for study; B-Collection of trapped flies; C-Trapped fruit flies; D-*Bactrocera zonata* E- *B. dorsalis*

CONCLUSION

Species of fruit flies from forest areas of Valsad District of Gujarat in the mango orchard revealed two species of fruit flies that were attracted to methyl eugenol viz.; *Bactrocera dorsalis* and *B. zonata* (Saunders). Among them, *B. zonata* was found to be dominant species. Of the total species collected, 66.00 per cent belonged to the *B. zonata* and 34.00 per cent represented by *B. dorsalis*. Diversity indices showed that higher diversity of fruit flies were recorded in Matuniya ($D=0.515$) followed by Chandvegan ($D = 0.535$) and Mendha ($D = 0.547$).

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