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## Diversity of fruit flies in different agro-climatic zones of Karnataka

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### Abstract

The present study was conducted to study the diversity of fruit flies in different agro-climatic zones of Karnataka. The collection of fruit flies was carried out during April to June 2014. Results revealed that methyl eugenol attracted four species of fruit flies viz., *Bactrocera dorsalis* Hendel, *Bactrocera correcta* Bezzi, *Bactrocera zonata* Saunders and *Bactrocera affinis* Hardy. In total 71.66 per cent belonged to the *B. dorsalis*, 23.70 and 4.50 per cent represented by *B. correcta* and *B. zonata* respectively. *B. affinis* constituted only 0.14 per cent of the total catch of fruit flies. Shannon index of diversity was maximum in Bidar followed by Mudigere. Simpson index (D) was more in the Krishnarajapet, which indicates that the diversity of fruit fly species was minimum. Higher diversity of fruit flies was recorded in Bidar followed by Raichur and Mudigere.

**Keywords:** Diversity, fruit flies, Shannons index, Simpson index

### 1. Introduction

Fruit flies belong to the family Tephritidae and order, Diptera. It contains more than 4000 species in which about 700 species of sub family Dacinae has been presented all over the world [1]. There are about 250 species, which are distributed in subtropical, temperate and tropical regions of the world [2]. Among 250 species, 44 species belongs to genus *Bactrocera* [3]. Tephritid fruit flies are among the major pests of fleshy fruits, which affect their production throughout the world and represent the most economically important group of polyphagous dipterous pests [2]. The fruit flies are one of the most important insect pest groups of horticultural production and export throughout the world. Four hundred species belonging to the genus *Bactrocera* are widely distributed in tropical regions of Asia, South Pacific and Australia [4]. There are about 325 species of fruit flies occurring in the Indian subcontinent, of which 205 are from India alone. The major pest species belong to the genus *Bactrocera* includes *B. dorsalis* Hendel and *B. zonata* Saunders while other species, such as *B. correct* Coquillet, *B. diversa* and *B. latifrons*, are still localized in their distribution [5]. The objective of this study was to record the species of fruit flies in the mango orchard and to calculate the diversity indices in different agro-climatic zones of Karnataka.

### 2. Material and Methods

An extensive study was undertaken during 2014 in different agro-climatic zones of Karnataka to study the diversity of fruit flies. Different agro-climatic zones were selected and at each zone, two places were covered for the collection of fruit flies. The collection of fruit flies was carried during April to June 2014. The orchards were selected randomly in the respective places. Study was carried out in such a manner that the sites were separated each other at least by 50-60 km. Totally 20 places were covered in ten agro-climatic zones.

Fruit flies were collected by two methods. Initially the infested mango fruits were collected and were kept under the laboratory conditions for the emergence of fruit flies. Second method followed is by utilizing the parapheromone for attracting and collecting the male fruit flies. Parapheromone 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, so in most of the cases the collection was undertaken using the lure, methyl eugenol.

After two days of placing the traps in the mango orchard, the flies that were caught in the traps were collected. 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.

## 2.1 Identification of specimens

All the collected specimens were sorted out and then keyed out individually using the keys and diagrams developed by David and Ramani [6]. 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.

## 2.2 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.

## 2.3 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 [7].

Shannon's index,  $H'$  was computed as

$$H' = -\sum P_i \ln P_i$$

Where  $P_i$  = Proportion of individuals in the  $i^{\text{th}}$  species and is given by  $P_i = n_i/N$  where  $n_i$  = number of individuals of the  $i^{\text{th}}$  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  $i^{\text{th}}$  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.

## 3. Results and Discussion

### 3.1 Species of fruit flies from different agro-climatic zones

The survey undertaken in the different agro climatic regions of Karnataka revealed that four species of fruit flies were attracted to the chemical methyl eugenol. All species belong to the genus *Bactrocera* Macquart under the tribe Dacini of the subfamily Dacinae

In ten agro climatic zones of Karnataka, the chemical methyl eugenol attracted four species of fruit flies. They were *Bactrocera dorsalis* (Hendel), *Bactrocera zonata* (Saunders), *Bactrocera correcta* (Bezzi), *Bactrocera affinis* (Table 2) and all the species captured were known previously and to be attracted by methyl eugenol. In total, 2089 fruit flies were collected in the mango orchards. Of these 71.66 per cent belonged to *B. dorsalis*, while the second and third most common species (*B. correcta* and *B. zonata*) represented 23.70 and 4.50 per cent, respectively. *B. affinis* constituted only 0.14 per cent of the total catch. Raichur (North East Dry Zone), Gandhi Krishi Vignana Kendra (GKVK, Bengaluru,

Eastern Dry Zone) showed the highest diversity with four species found at each site. Chincholi (North Eastern Dry Zone) and Krishnarajapet (Southern Dry Zone) had a much lower diversity with only two species found at each site. The most common species is the *B. dorsalis*, which was trapped in all the study sites. In Chincholi no *B. zonata* adults were trapped.

The diversity indices and richness of fruit flies in each agro-climatic zone was calculated. Shannon index of diversity was maximum in Bidar ( $H' = 0.860$ ) followed by Mudigere ( $H' = 0.844$ ). Shannon index, which assumes all species are represented in a sample and that they were sampled randomly. Simpson index ( $D$ ) was more in the Krishnarajapet ( $D = 0.917$ ) which indicated the diversity of flies was minimum. Higher diversity of fruit flies were recorded in Bidar ( $D = 0.447$ ) followed by Raichur and Mudigere ( $D = 0.489$ ). Simpson index is a dominance index because it gives more weight to common or dominant species (Table 3).

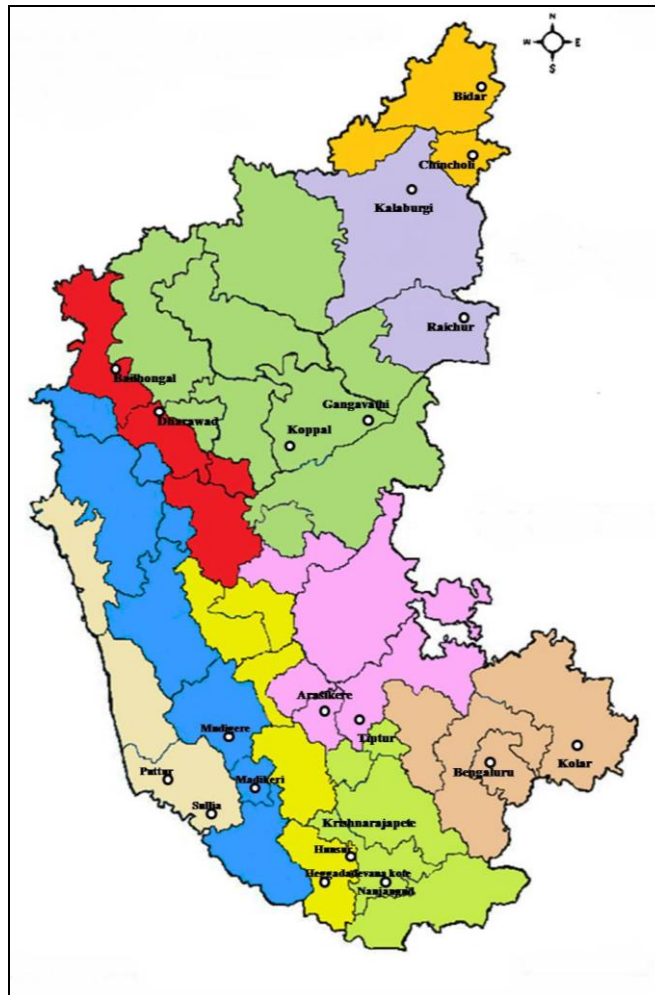
All the species belonged to the genus *Bactrocera* under the subfamily Dacinae and tribe Dacini. All the species that were recorded have been previously reported in Karnataka [8].

These findings are corroborated with the reports of Verghese and Sudhadevi [9] who also reported the catches of *B. dorsalis* and *B. correcta*. Madhura and Viraktamath [10] recorded five species of fruit flies viz., *B. dorsalis*, *B. correcta*, *B. verbascifoliae*, *B. affinis* and *B. zonata* which were attracted to methyl eugenol. Morde [11] observed *B. caryeae*, *B. dorsalis* and *B. zonata* in the methyl eugenol traps installed in Konkan area. Kawashita [12] reported catches of *B. correcta*, *B. dorsalis* and *B. zonata*. Satarkar [13] in coastal region reported four species of fruit flies viz., *B. caryeae*, *B. zonata*, *B. affinis* and *B. correcta* that were attracted to methyl eugenol in the guava orchard.

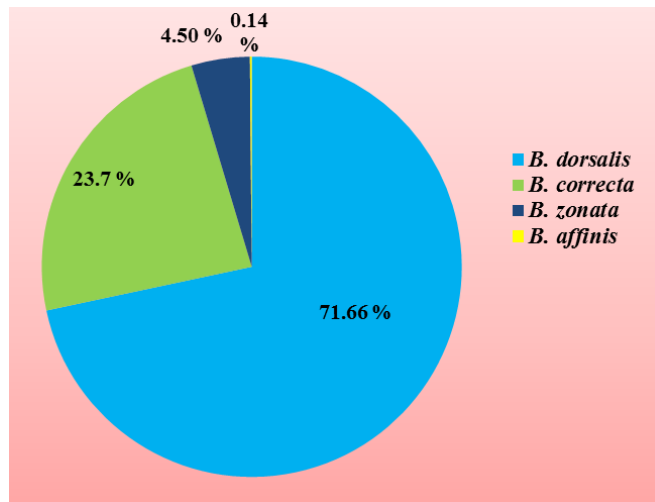
Ukey [14] opined that *B. dorsalis* was the dominant species followed by *B. zonata* and *B. correcta* at Ahmednagar district of Maharashtra in the guava orchard. While the reports by Nagaraj [15] shows that *B. dorsalis* was the dominant species with relative abundance of 49.41 per cent followed by *B. correcta* with 34.22 per cent abundance at GKVK campus. But at Srinivasapur, Kolar he noticed *B. correcta* was the dominant species with per cent relative abundance of 67.88 followed by *B. dorsalis* (24.07 per cent) and *B. zonata* (8.04 per cent). The present study also endorse with his reports.

Present findings are also in accordance with the reports of Ravikumar [16], Stonehouse [17], Deepa [18] and Galande and Ukey [19] who reported *B. dorsalis*, *B. correcta* and *B. zonata* from the mango orchards attracted to methyl eugenol.

This study shows the species of fruit flies associated with mango in the different agro-climatic zones of Karnataka by using the parapheromone, methyl eugenol. However, use of more intensive methods such as long-term usage of parapheromones like methyl eugenol and collecting the infested fruits at every location should be carried out in order to have a clear picture of the species associated with the hosts. But the study made an attempt in establishing the abundance of species and diversity of fruit flies in the different agro-climatic zones of Karnataka.



**Fig 1:** Sampling sites at different agro-climatic zones of Karnataka



**Fig 2:** Species diversity of fruit flies in different agro-climatic zones of Karnataka.

**Table 1:** Sampling sites at different agro-climatic zones of Karnataka for collecting fruit flies.

Sl. No.	Agro-climatic zones	Locations
1	North East Transitional Zone	Bidar (Agriculture Research Station), Chincholi (Chandrampalli)
2	North East Dry Zone	Raichur (UAS, Raichur campus), Kalburgi (Agriculture Research Station)
3	Northern Dry Zone	Gangavathi (Basapattana), Koppal (Miyapur)
4	Central Dry Zone	Arasikere (Soppinahalli), Tiptur (Rampura)
5	Eastern Dry Zone	Kolar (Punganuru), Bengaluru (GKVK)
6	Southern Dry Zone	Nanjanagadu (Chinnamballi), Krishnaraja Pet (Maruvanahalli)
7	Southern Transitional Zone	Hunsur (Ramenahalli), HeggadadevanaKote (Heggadahalli)
8	Northern transitionalZone	Bailhongal (Agriculture Research Station), (UAS, Dharwad campus)
9	Hill Zone	Mudigere (College of Horticulture), Madikeri (Maragodu)
10	Coastal Zone	Sullia (Sullia), Puttur (Cashew research station)

**Table 2:** Abundance of fruit flies collected from the different agro-climatic zones of Karnataka.

Sl. No.	Zones	Locations	Species abundance of fruit flies				Total
			<i>Bactrocera dorsalis</i>	<i>Bactrocera correcta</i>	<i>Bactrocera zonata</i>	<i>Bactrocera affinis</i>	
1	North East Transition Zone	Bidar	29	22	3	0	54
		Chincholi	34	29	0	0	63
2	North East Dry Zone	Raichur	79	44	5	1	129
		Gulbarga	56	28	2	0	86
3	Northern Dry Zone	Gangavathi	87	56	3	0	146
		Koppal	108	62	4	0	174
4	Central Dry Zone	Arasikere	108	13	7	0	128
		Tiptur	96	8	4	0	108
5	Eastern Dry Zone	Kolar	126	34	12	0	172
		GKVK	108	28	5	2	143
6	Southern Dry Zone	Krisnarajapet	89	0	4	0	93
		Srirangapatna	64	2	3	0	69
7	Southern Transition Zone	Hunsur	49	4	5	0	58
		H. D. Kote	58	7	3	0	68
8	Northern Transition Zone	Bhailahongala	77	69	1	0	147
		Dharwad	96	28	10	0	134
9	Hill Zone	Mudigere	64	28	8	0	100
		Mercera	48	11	6	0	65
10	Coastal Zone	Sullia	59	14	4	0	77
		Puttur	62	8	5	0	75

**Table 3:** Diversity indices of species of fruit flies collected from the different agro-climatic zones of Karnataka.

Sl. No.	Zones	Locations	Shannon index (H')	Species richness	Simpson index (D)	Simpson Reciprocal index (1/D)
1	North East Transition Zone	Bidar	0.860	3	0.447	2.236
		Chincholi	0.689	2	0.495	2.020
2	North East Dry Zone	Raichur	0.731	4	0.489	2.045
		Gulbarga	0.735	3	0.525	1.905
3	Northern Dry Zone	Gangavathi	0.755	3	0.499	2.003
		Koppal	0.750	3	0.510	1.961
4	Central Dry Zone	Arasikere	0.534	3	0.723	1.383
		Tiptur	0.419	3	0.795	1.258
5	Eastern Dry Zone	Kolar	0.734	3	0.578	1.730
		GKVK	0.708	4	0.607	1.646
6	Southern Dry Zone	Krisnarajapet	0.177	2	0.917	1.091
		Srirangapatna	0.308	3	0.861	1.161
7	Southern Transition Zone	Hunsur	0.538	3	0.721	1.387
		H.D.Kote	0.507	3	0.736	1.358
8	Northern Transition Zone	Bhailahongala	0.727	3	0.491	2.035
		Dharwad	0.759	3	0.559	1.788
9	Hill Zone	Mudigere	0.844	3	0.489	2.044
		Mercera	0.744	3	0.576	1.736
10	Coastal Zone	Sullia	0.667	3	0.618	1.618
		Puttur	0.576	3	0.695	1.439

#### 4. Conclusion

Species of fruit flies from different agro-climatic zones of Karnataka in the mango orchard revealed four species of fruit flies that were attracted to methyl eugenol viz., *Bactrocera dorsalis*, *B. correcta*, *B. zonata* and *B. affinis*. Among them, *B. dorsalis* was found to be dominant species. Of the total species collected, 71.66 per cent belonged to the *B. dorsalis*, 23.70 and 4.50 per cent represented by *B. correcta* and *B. zonata* respectively. *B. affinis* constituted only 0.14 per cent of the total catch of fruit flies. Diversity indices showed that higher diversity of fruit flies was recorded in Bidar and lower diversity was recorded in Krishnarajpet.

#### 5. Acknowledgement

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