Species diversity and infestation indices of fruit flies (Diptera: Tephritedae) in guava ecosystem of southwest Haryana

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ABSTRACT

The fruit flies are major pests of fruits and cause direct damage to guava fruits which has great impact on quality and quantity of fruits. In the present study, fruit fly diversity and infestation indices in guava fruits were investigated. Pheromone traps were installed, captured adults of species were examined and diversity was recorded. Two species viz *Bactrocera dorsalis* Hendel and *B zonata* Saunders were found in guava ecosystem in southwest Haryana. During the study, 1,179 specimens of fruit flies were collected from the traps and 179 from the fruits. The results revealed that *B dorsalis* was dominant species over *B zonata* which were 55.13 and 44.87 per cent respectively. While studying fruit fly diversity from infested fruits, 57.22 per cent of flies were those of *B dorsalis* and 42.22 per cent of *B zonata*. The mean pupal viability was found 52.49 per cent for entire observation period. The infestation indices were 45.88 pupae/kg and 7.8 pupae/fruit recorded during 2nd fortnight of September 2020.

Keyword: Guava; diversity; indices; *Bactrocera dorsalis*; *B zonata*

INTRODUCTION

Guava (*Psidium guajava* L) is largely grown in tropical and sub-tropical regions of the world (Omayio et al 2019). Guava is the fourth most widely grown fruit crop in India planted in an area of about 2.9 lakh hectares having a production of 43.59 lakh MT (Anon 2020). Owing to high nutraceutical value of guava, there has been a growing consumer's preference resulting in expansion of area in many countries.

In India, guava is widely grown in Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Andhra Pradesh, West Bengal, Tamil Nadu, Gujarat, Punjab and Haryana. It requires minimal care and provides high economic returns. This fruit is a rich source of nutrition as it is a major source of vitamin A, B and C (Anita et al 2012). It also contains good amount of pectin, calcium and phosphorus with a characteristic flavour. According to Omaiyo et al (2019) the vitamin C content is four times higher in guava fruit as compared to citrus fruits.

The marketing of fresh fruit in the world is limited by the occurrence of fruit fly (Diptera: Tephritidae) which is considered as one of the main pests of the fruits due to the direct damage flies cause and the ability to adapt in other areas where introduced (Godoy et al 2011). The tephritids economic importance is due to the yield losses they cause in the world fruit production and are quarantine pests (Araujo et al 2013).

Knowledge regarding fruit fly species in a particular area can only be obtained through intensive surveys made directly from host fruits which enables detection of larvae present in the fruits, the degree of infestation in an orchard and the direct damage caused by the flies. Therefore, there is a need to determine the guava fruit infestation indices and to identify the fruit fly species that occur in the guava ecosystem in order to develop low environmental impact strategies to control fruit flies (Maciel et al 2017). Thus in the present study, fruit fly diversity and infestation indices in guava fruits in guava ecosystem in southwest Haryana were investigated.

MATERIAL and METHODS

The investigations on the species diversity and infestation indices of fruit flies in guava orchard were carried out at the Research Farm of Regional Research Station, CCS Haryana Agricultural University, Bawal, Haryana during 2020-21. The orchard was thirty years old and plant spacing was 20 m × 20 m. The orchard was surface irrigated and soil was sandy loam.

Five traps baited with methyl eugenol were installed in the guava orchard at an interval of 10 meters. The installation of pheromone traps was continued from April 2020 to December 2020 and wooden blocks filled with methyl eugenol replaced at monthly interval. The number of fruit flies attracted (dead flies only) were recorded at weekly interval and the mean captured flies per trap per week were calculated. The traps were hung at a height of about 1.5 m on the trees and were emptied after each observation.

The captured adults were water-sieved, separated species-wise, counted, preserved in bottles containing 70 per cent alcohol solution for taxonomic identification, identified with the help of key or got identified from authentic sources and diversity of fruit flies was worked out. The number and percentage of each species were calculated. Ten fruits/plant were picked randomly from all sides of the five selected plants and mixed properly. Out of these, ten fruits were brought to the laboratory, weighed and placed in individual plastic containers containing dry sand at the bottom and covered by voile. The pupae were counted and individually transferred to other plastic containers which had sugar solution in them. Pupae were kept in laboratory allowing for maximum emergence of adults. These adults were separated species-wise. Two parameters were used to obtain the infestation indices. The first was the number of pupae per fruit (pupae/fruit) and second, the number of pupae per kg of fresh fruits (pupae/kg) (Araujo and Zucchi 2003). Pupal viability was calculated based on the percentage of puparia that resulted in fly emergence.

RESULTS and DISCUSSION

Diversity study of fruit flies using methyl eugenol as attractant

Studies on the species diversity under guava ecosystem using methyl eugenol as attractant revealed the presence of two species viz *Bactrocera dorsalis* Hendel and *B zonata* Saunders in guava ecosystem of southwest Haryana. The emergence of fruit flies started from the 16 standard meteorological week (SMW) that were trapped up to 47 SMW. Out of the total number of fruit flies trapped (1,179), the species *B dorsalis* (650) were more in number than *B zonata* (529). This clearly indicates that *B dorsalis* was dominant species with 55.13 per cent over *B zonata* with 44.87 per cent (Table1). The maximum number of fruit flies was trapped (*B dorsalis* 69 and *B zonata* 63) in the 35th SMW (4th week of August) followed by (*B dorsalis* 58 and *B zonata* 54) in the 34th SMW (3rd week of August) as compared to other weeks. The fruit flies gradually disappeared from 48th SMW. Morde (2003) studied the fruit fly complex of the Konkan region and identified six fruit fly species viz *B dorsalis*, *B correcta*, *B zonata*, *B caryeae*, *B cucurbitae* and *B tau* in the region. Out of these six species, three species viz *B dorsalis*, *B caryeae* and *B zonata* were attracted towards methyl eugenol traps installed in guava orchards in Dapoli area.

Das et al (2017) studied the species complex under mango ecosystem using methyl eugenol as attractant and reported the presence of two species viz *B dorsalis* and *B zonata* where the dominant species was *B dorsalis*. Similarly, Math et al (2018) recorded a total of five species of fruit flies from guava ecosystem viz *B dorsalis*, *B zonata*, *B correcta*, *B duplicata* and *B cucurbitae* in Bagalkote. The more diversity might be due to the different locations and host food availability. Vignesh et al (2020) recorded two species of fruit flies viz *B dorsalis* and *B correcta* in guava orchards. Adhikari et al (2018) studied the composition of fruit fly species and reported that the *B dorsalis* was highest ie 90.07 per cent followed by *B zonata*, *B tau*, *B scutelaris* and *B cucurbitae* which were 4.56, 4.21, 0.66 and 0.49 per cent respectively.

Diversity study of fruit flies through adult emergence from infested fruits

Table 2 depict that 179 adults emerged from 341 pupae during July to November 2020 from infested fruits collected from guava orchard. The mean pupal viability was found 52.49 per cent for entire observation period. In the composition of species, 57.22 per cent of total adults of flies were of *B dorsalis* (103.0) and 42.22 per cent of *B zonata* (76.0). Maximum adults of *B dorsalis* (22.0) and *B zonata* (18.0) emerged in 2nd fortnight of September

Table 1. Species diversity of fruit flies, *Bactrocera* spp in the guava orchard

SMW	Fruit flies trapped /week/trap	*Bactrocera* trap catches/week			
		B dorsalis		*B zonata*	
		Number	Percentage	Number	Percentage
16	4	3	75.00	1	25.00
17	12	8	66.67	4	33.33
18	4	3	75.00	1	25.00
19	8	5	62.50	3	37.50
20	10	6	60.00	4	40.00
21	6	4	66.67	2	33.33
22	12	7	58.33	5	41.67
23	20	12	60.00	8	40.00
24	22	12	54.54	10	45.45
25	28	18	64.28	10	35.71
26	20	13	65.00	7	35.00
27	36	20	55.55	16	44.44
28	48	28	58.33	20	41.67
29	62	34	54.83	28	45.16
30	68	38	55.88	30	44.12
31	84	46	54.76	38	45.23
32	80	42	52.50	38	47.50
33	92	50	54.34	42	45.65
34	112	58	51.78	54	48.21
35	132	69	52.27	63	47.73
36	82	44	53.65	38	46.34
37	62	36	58.06	26	41.94
38	48	28	58.33	20	41.67
39	32	20	62.50	12	37.50
40	24	12	50.00	12	50.00
41	18	10	55.56	8	44.44
42	14	7	50.00	7	50.00
43	14	6	42.85	8	57.14
44	10	4	40.00	6	60.00
45	8	4	50.00	4	50.00
46	5	2	40.00	3	60.00
47	2	1	50.00	1	50.00
48	0	0	0.00	0	0.00
49	0	0	0.00	0	0.00
50	0	0	0.00	0	0.00
51	0	0	0.00	0	0.00
52	0	0	0.00	0	0.00
Total	1179	650	55.13	529	44.87

SMW = standard meteorological week

2020. Thus *B dorsalis* was dominant in guava ecosystem. Kadam (2012) reported that *B dorsalis*, *B zonata*, *B correcta* and *B dorsalis* were dominant in Rahuri area in guava orchards. According to Amin et al (2019) two species of fruit flies, namely *B tryoni* and *B dorsalis* were found in the guava orchards and *B tryoni* was in more abundance as compared to *B dorsalis*, both in winter and summer seasons. However, in the present study, the dominant species in guava was *B dorsalis.* This might be due to the different locations and host food availability.

Infestation indices of *Bactrocera* spp in guava fruits

A total of 110 guava fruits were evaluated for infestation indices from June to December 2020 and it was found that average number of pupae from these fruits ranged from 1.0 to 78.0 (Table 3). The average fruit weight per piece varied from 108 to 170 g. The infestation indices were 45.88 pupae/kg and 7.8 pupae/fruit recorded during 2nd fortnight of September 2020 in Ambe Bahar crop. However, in Mrig Bahar crop, the infestation indices were very low (1.36 pupae/kg

Table 2. Number of pupae and adults of *Bactrocera* spp recorded in guava fruits

Month	Fortnight	Number of pupae	Number of adults	Pupal viability (%)	*B dorsalis*		*B zonata*	
					Number	Percentage	Number	Percentage
July	I	12.0	7.0	58.33	5.0	71.43	2.0	28.57
	II	40.0	20.0	50.00	14.0	70.00	6.0	30.00
August	I	60.0	32.0	53.30	20.0	62.50	12.0	37.50
	II	72.0	37.0	52.80	19.0	51.35	18.0	48.65
September	I	74.0	39.0	52.70	21.0	53.80	18.0	46.15
	II	78.0	40.0	51.28	22.0	55.00	18.0	45.00
October	I	-	-	-	-	-	-	-
	II	1.0	1.0	100.0	1.0	100.00	-	-
November	I	2.0	2.0	100.0	1.0	50.00	1.0	50.00
	II	2.0	1.0	50.0	-	-	1.0	100.00
Total	-	341.0	179.0	52.49	103.0	57.22	76.0	42.22

Table 3. *Bactrocera* spp indices from the guava orchard

Month	Fortnight	Fruit season	Number of samples	Average fruit weight (g)/piece	Average fruit weight (kg)	Number of pupae	Pupae/kg	Pupae/fruit
June	II	Ambe Bahar	10	108	1.08	-	-	-
July	I	-do-	10	122	1.22	12	9.83	1.2
	II	-do-	10	130	1.30	40	30.76	4.0
August	I	-do-	10	140	1.40	60	42.85	6.0
	II	-do-	10	159	1.59	72	54.28	7.2
September	I	-do-	10	162	1.62	74	45.67	7.4
	II	-do-	10	170	1.70	78	45.88	7.8
October	I	Mrig Bahar	10	121	1.21	-	-	-
	II	-do-	10	135	1.35	1	0.74	0.1
November	I	-do-	10	146	1.46	2	1.36	0.2
	II	-do-	10	162	1.62	2	1.23	0.2
Total	-	-	110	-	-	341	232.60	34.1

and 0.2 pupae/fruit) in 1st fortnight of November 2020. Similarly, Maciel (2017) reported that infestation rates for guava commercial orchard in Sao Luis state of Maranhao, northeastern Brazil were higher in August and September 2008 reaching 231.2 pupae/kg and 26.42 pupae/fruit, and 125.8 pupae/kg and 9.43 pupae/fruit respectively.

CONCLUSION

On the basis of results it is concluded that two species viz *Bactrocera dorsalis* Hendel and *B zonata* Saunders were prevalent in guava ecosystem of southwest Haryana where *B dorsalis* was dominant over *B zonata*. The infestation indices were 45.88 pupae/kg and 7.8 pupae/fruit in Ambe Bahar crop of guava.

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