Study on the population dynamics of fruit flies (*Bactrocera* spp) in guava orchard in southwest Haryana

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ABSTRACT

The experiments on population dynamics of fruit flies (*Bactrocera dorsalis* and *B zonata*) were carried out in guava orchard of CCS Haryana Agricultural University, Regional Research Station, Bawal, Haryana during 2020-21.The fruit flies were recorded at weekly interval by using methyl eugenol pheromone trap. Results showed that fruit flies were present in the field from April to November in guava orchard in southwest Haryana. The highest number of fruit flies (132 /trap/week) were recorded during last week of August 2020. The peak of fruit flies population coincided with the ripening of guava fruits. The fruit fly population exhibited significant positive correlation with minimum temperature, morning and evening relative humidity and rainfall. The results of the present study revealed that peak infestation (75.0%) in guava fruits was during last week of August. These fruit flies were recorded as a serious pest of guava fruits in southwest Haryana.

Keywords: Fruit flies; methyl eugenol; pheromone; correlation; infestation

INTRODUCTION

Guava (*Psidium guajava* L) is a climacteric fruit of family Myrtaceae originated in tropical America. It is one of the most important fruits in India as it occupies fourth position in area and production after mango, banana and citrus. It is found to be quite resilient and prolific bearer, highly productive and remunerative. 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. The fruit quality is superior in winter rather than rainy season and for this reason, rainy season crop is avoided in some areas to fetch better yield in winter season. Guava fruit can be consumed as fresh or in processed form. The fruit is processed in number of products like jelly, jam and nectar. When a guava orchard is established in large area, the pest also gets gradually established in the orchard which in turn creates a serious threat to the crop, the main reason behind the low production of crop in spite of growing in the vast area.

Sarwar (2006) identified major insect species of guava which included scale insect, fruit fly, red-banded thrips, mealy bugs, mites, stink bug, guava moth and guava whitefly. Fruit fly of the genus *Bactrocera* is the most destructive pest and it infests 62 species of plants belonging 30 families, many of which are commercially important (Kunprom et al 2015). Due to its dispersal capacity, high mobility and fecundity, a lot of fruits and vegetables like peach, mango, guava, citrus, tomato, cucurbits etc are infested by fruit flies which affect the produce both qualitatively and quantitatively. Due to the fruit fly infestation, market value of the fruits gets reduced. The fruit fly caused serious incidence in guava fruits and it varied from 20.0 to 46.0 per cent which is a matter of serious concern (Haseeb 2007). Although a number of species attack the fruits but only few species are found in orchards. The documentation on the population dynamics of fruit fly in guava ecosystem gives both opportunities and challenges for proper planning and preceding the timely management practices. The present study was conducted on population dynamics of fruit flies in guava orchard in southwest Haryana.

MATERIAL and METHODS

The investigations on population dynamics of fruit flies, *Bactrocera* spp were carried out in the guava orchard of CCS Haryana Agricultural University, Regional Research Station, Bawal, Haryana located in the low rainfall zone of southwestern Haryana (28.1° N, 76.5° E and 266 m amsl) during 2020-21. The soil of the region is light-textured and loamy-sand with poor fertility and low water holding capacity. Population dynamics of fruit flies was recorded under natural field conditions. A pre-determined number of guava trees on the population dynamics of fruit flies were kept free from pesticides application during the course of the study.

Observations on population dynamics on fruit fly were recorded at weekly interval from April 2020 to December 2020. The per cent fruit damage was also calculated by counting fruits bearing pinhole damage/ovipositional marks and brown spots. Infestation symptoms of different fruit flies are similar therefore it was difficult to distinguish among them. Therefore the infestation percentage was estimated for all fruit flies together. The infestation per cent damage was determined as ratio of number of infested fruits and total of inspected fruits. The observations were recorded on five randomly selected trees.

Five traps filled with methyl eugenol were installed at an interval of 10 meter. 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 fruit flies attracted in traps (dead flies only) were counted at weekly interval and the mean captured flies per trap per week were calculated. The traps were hung at a height of approximately 1.5 m. The data on weather parameters viz maximum and minimum temperature, morning relative humidity, evening relative humidity and rainfall were collected from meteorological laboratory of Regional Research Station, Bawal, Haryana. Correlation analysis was made for the data on different abiotic parameters with the damage and population of fruit flies.

RESULTS and DISCUSSION

The results revealed that *Bactrocera dorsalis* and *B zonata* were the most serious pest of guava under the ecological conditions of Bawal, Haryana. The first appearance of fruit fly was recorded in 16th standard meteorological week and highest number of fruit flies (132/trap/week) was recorded during 35th SMW (last week of August) when temperature ranged from 24.2 to 32.8°C, relative humidity from 66.0 to 90.0 per cent and total rainfall 32.4 mm. The present findings are in close conformity with the reports of Gupta and Bhatia (2000) who reported that maximum population of *B dorsalis* and *B zonata* was recorded in August-September. Similar results were obtained by Rana et al (1992) from Haryana. They recorded the maximum (427.2 and 517.0 males/trap) catches of *B dorsalis* and *B zonata* respectively during September. Dale and Patel (2010) also studied the population dynamics of fruit flies (*B zonata* and *B dorsalis*) on guava at Sardarkrushinagar, Gujarat from January to December 2001 and observed that the maximum number of fruit fly population was in September and the minimum in May.

It is evident from Table 1 (Fig 1) that fruit fly remained active from third week of April up to third week of November during 2020 in the study area conditions. The population started declining after 4th week of August with lowest trap catches of 2 fruit flies/trap/week during third week of November 2020. The findings of Boscan de Martinez and Godoy (1989) are in confirmation with the present results as they also recorded the population peaks of fruit fly in guava orchard in September 1980. They further reported that population level was close to zero from April to June 1981. There was no fruit fly observed after third week of November in guava orchard in the present invetigations. The findings of the present investigations are more or less similar to the studies of Makhmoor and Singh (1998) who reported highest trap catches of *B dorsalis* during July in Jammu and Kashmir at maximum and minimum temperature of 33.6 and 22.5°C and relative humidity 90.3 and 57.0 per cent respectively. Dale (2002) observed the highest activity of fruit flies, *Bactrocera* spp in September concurring with fruiting season of guava and minimum activity in the month of May. In a study conducted by Chaudhary and Jamal (2002) it was found that maximum activity of *B dorsalis* and *B zonata* was observed from August to October which concurred with the ripening of guava at Rawalpindi, Pakistan

Fruit fly infestation was initially noticed during 25th SMW (third week of June 2020) with only 2.0 per cent infested fruits as evident from Table 1 (Fig 2). The results revealed that peak infestation (75.0%) was

Table 1. Population dynamics and fruit infestation of *Bactrocera* spp in guava orchard during 2020

SMW	Period of observation	Average temperature (°C)		Average RH (%)		Total rainfall (mm)	Average wind speed (km/h)	Average sunshine hours	Mean number of fruit flies trapped/trap /week	Fruit fly infestation in guava fruits (%)
		Max	Min	M	E					
13	26 Mar - 01 Apr	33.5	14.8	90.0	30.0	9.4	5.1	6.1	0.0	-
14	02 Apr - 08 Apr	33.3	13.5	73.0	24.0	4.2	4.3	8.5	0.0	-
15	09 Apr - 15 Apr	36.8	17.2	63.0	26.0	0.7	4.0	7.7	0.0	-
16	16 Apr - 22 Apr	36.7	20.9	59.0	36.0	0.7	5.2	7.0	4.0	-
17	23 Apr - 29 Apr	35.8	19.4	66.0	48.0	14.1	5.5	6.4	12.0	-
18	30 Apr - 06 May	37.7	22.0	72.0	42.0	4.9	5.4	8.3	4.0	-
19	07 May - 13 May	39.0	20.6	65.0	37.0	1.7	4.6	7.6	8.0	-
20	14 May - 20 May	40.1	21.2	50.0	19.0	1.0	5.2	8.4	10.0	-
21	21 May - 27 May	44.0	24.0	29.0	8.0	0.0	7.0	9.6	6.0	-
22	28 May - 03 Jun	37.4	22.2	66.0	36.0	69.1	8.0	7.7	12.0	-
23	04 Jun - 10 Jun	36.9	22.4	76.0	43.0	14.8	4.1	6.4	20.0	-
24	11 Jun - 17 Jun	40.8	26.3	64.0	32.0	2.0	4.5	7.4	22.0	-
25	18 Jun - 24 Jun	39.4	25.6	71.0	39.0	43.1	5.1	7.0	28.0	2.0
26	25 Jun - 01 Jul	38.4	26.4	67.0	49.0	1.0	6.5	5.1	20.0	2.0
27	02 Jul - 08 Jul	38.3	22.0	77.0	45.0	6.4	5.5	7.0	36.0	4.0
28	09 Jul - 15 Jul	36.2	25.1	81.0	64.0	12.1	5.2	6.0	48.0	6.0
29	16 Jul - 22 Jul	35.8	25.5	83.0	62.0	19.5	5.6	3.9	62.0	12.0
30	23 Jul - 29 Jul	35.1	24.9	86.0	60.0	14.6	4.7	6.7	68.0	18.0
31	30 Jul - 05 Aug	35.7	25.1	86.0	64.0	37.5	5.0	5.5	84.0	28.0
32	06 Aug - 12 Aug	35.0	25.9	89.0	66.0	9.1	5.6	5.2	80.0	34.0
33	13 Aug - 19 Aug	33.5	25.4	94.0	80.0	51.2	4.2	4.2	92.0	40.0
34	20 Aug - 26 Aug	30.8	23.7	94.0	82.0	44.3	6.3	3.6	112.0	56.0
35	27 Aug - 02 Sep	32.8	24.2	90.0	66.0	32.4	5.1	5.0	132.0	75.0
36	03 Sep - 09 Sep	34.7	23.8	90.0	65.0	11.3	5.1	4.8	82.0	50.0
37	10 Sep - 16 Sep	37.1	23.6	87.0	41.0	0.0	2.6	7.6	62.0	0.0
38	17 Sep - 23 Sep	38.1	24.4	79.0	38.0	0.0	4.1	6.9	48.0	0.0
39	24 Sep - 30 Sep	36.8	22.2	79.0	34.0	9.2	3.9	7.3	32.0	0.0
40	01 Oct - 07 Oct	37.6	17.6	66.0	17.0	0.0	4.5	8.2	24.0	0.0
41	08 Oct - 14 Oct	36.4	15.8	68.0	19.0	0.0	2.9	9.1	18.0	1.0
42	15 Oct - 21 Oct	35.3	15.8	74.0	17.0	0.0	2.4	7.5	14.0	1.0
43	22 Oct - 28 Oct	34.3	13.0	70.0	14.0	0.0	2.2	7.2	14.0	2.0
44	29 Oct - 04 Nov	31.0	9.5	66.0	12.0	0.0	2.9	7.5	10.0	2.0
45	05 Nov - 11 Nov	30.6	9.0	76.0	17.0	0.0	2.0	3.2	8.0	4.0
46	12 Nov - 18 Nov	27.0	10.2	87.0	43.0	14.0	2.1	4.4	5.0	4.0
47	19 Nov - 25 Nov	24.6	7.3	86.0	27.0	0.0	2.6	6.6	2.0	3.0
48	26 Nov - 02 Dec	25.1	9.1	82.0	28.0	0.0	2.9	6.1	0.0	0.0
49	03 Dec - 09 Dec	28.2	8.9	87.0	31.0	0.0	1.7	6.6	0.0	0.0
50	10 Dec - 16 Dec	19.3	9.9	90.0	53.0	0.0	3.0	4.3	0.0	0.0
51	17 Dec - 23 Dec	20.3	3.9	73.0	31.0	0.0	3.7	6.6	0.0	0.0
52	24 Dec - 31 Dec	19.4	3.6	92.0	38.0	0.0	2.6	6.0	0.0	0.0

SMW= Standard meteorological week, Max= Maximum, Min= Minimum, M= Morning, E= Evening

recorded during 35th SMW (last week of August) when temperature ranged from 24.2 to 32.8°C and relative humidity 66.0 to 90.0 per cent. However infestation remained quite high (34.0 to 75.0%) during 32nd to 35th SMW. The present observation corroborates with the findings of Jose et al (2013) who recorded the highest fruit fly infestation on guava (92.49 ± 0.21%) followed by almond (67.32 ± 2.71%) and mango (56.50 ± 0.12%). Sarwar et al (2014) also recorded the peak population of *B dorsalis* (30-40 fruit flies/trap/week) and fruit infestation (7.05-9.05%) from June to August. These results are in agreement with the findings of Chaudhary and Jamal (2002) who recorded maximum (10.76 to 14.74%) damage of *B zonata* in guava orchard during August to September.

The correlation analysis between different weather parameters and *Bactrocera* spp population (Table 2, Fig 1) reveal that fruit fly exhibited highly significant positive correlation with minimum temperature (r= 0.615) morning relative humidity (r= 0.483) and evening relative humidity (r= 0.776) and total rainfall (r= 0.534). Thus when there was an increase in minimum temperature, relative humidity and total rainfall, fruit flies population also increased.

The correlation analysis between different weather parameters and *Bactrocera* spp infestation (Table 2, Fig 2) show that fruit fly infestation exhibited significant positive correlation with minimum temperature (r= 0.424), morning relative humidity (r= 0.473) and evening relative humidity (r= 0.573). Therefore with the increase in minimum temperature and relative humidity, fruit fly infestation also increased. The present findings are supported by the results of Jalaluddin et al (2001) who reported that fruit fly, *B correcta* exhibited positive correlation with minimum and maximum temperature, RH and rainfall during July-August in Tamil Nadu. Similarly Sarada et al (2001) reported that fruit fly population had positive correlation with minimum temperature and rainfall and a positive non-significant correlation with maximum temperature. These results are also supported by the work of Rana et al (1992) as there was positive correlation of fruit fly infestation with abiotic factors viz humidity and rainfall.

Dale and Patel (2010) studied the population dynamics of fruit flies (*B zonata* and *B dorsalis*) on guava at Sardarkrushinagar, Gujarat from January to December 2001 and observed that fruit fly population exhibited a highly significant positive correlation with minimum temperature and relative humidity. Mishra et al (2012) also studied seasonal abundance of oriental fruit fly, *B dorsalis* in relation to environmental factors and observed non-significant correlation with maximum temperature but positive significant correlation with minimum temperature. Rajitha and Viraktamath (2006)

Table 2. Correlation of weather parameters with fruit fly population and infestation

Parameter	Fruit fly population	Fruit fly infestation
Maximum temperature (°C)	r= 0.181^{NS}	r= 0.079^{NS}
Minimum temperature (°C)	r= 0.615**	r= 0.424**
Morning RH (%)	r= 0.483**	r= 0.473**
Evening RH (%)	r= 0.776**	r= 0.573**
Total rain (mm)	r= 0.534**	r= 0.284^{NS}
Average wind speed (km/h)	r= 0.313*	r= 0.106^{NS}
Sunshine hours	r= -0.458**	r= -0.355*

*Significant at 5% LoS, **Significant at 1% LoS, NS= Non-significant

Table 3. Regression equation 5 – 6

Dependant variable (Y)	Regression equation	R^2
Fruit fly infestation	Y= –29.741 – 1.70 T_{max} + 3.41 T_{min} + 0.721 RHm – 0.193 RHe – 0.052 RF – 2.649 WS + 0.16 SSH	0.73
Fruit fly population	Y= –34.941 – 1.304 T_{max} + 3.99 T_{min} + 0.564 RHm + 0.343 RHe + 0.291 RF – 4.524 WS – 0.941 SSH	0.73

Y= Per cent infestation, T_{max}= Maximum temperature, T_{min}= Minimum temperature, RHm= Relative humidity in the morning, RHe= Relative humidity in the evening, RF= Rainfall, WS= Wind speed, SSH= Sunshine hours

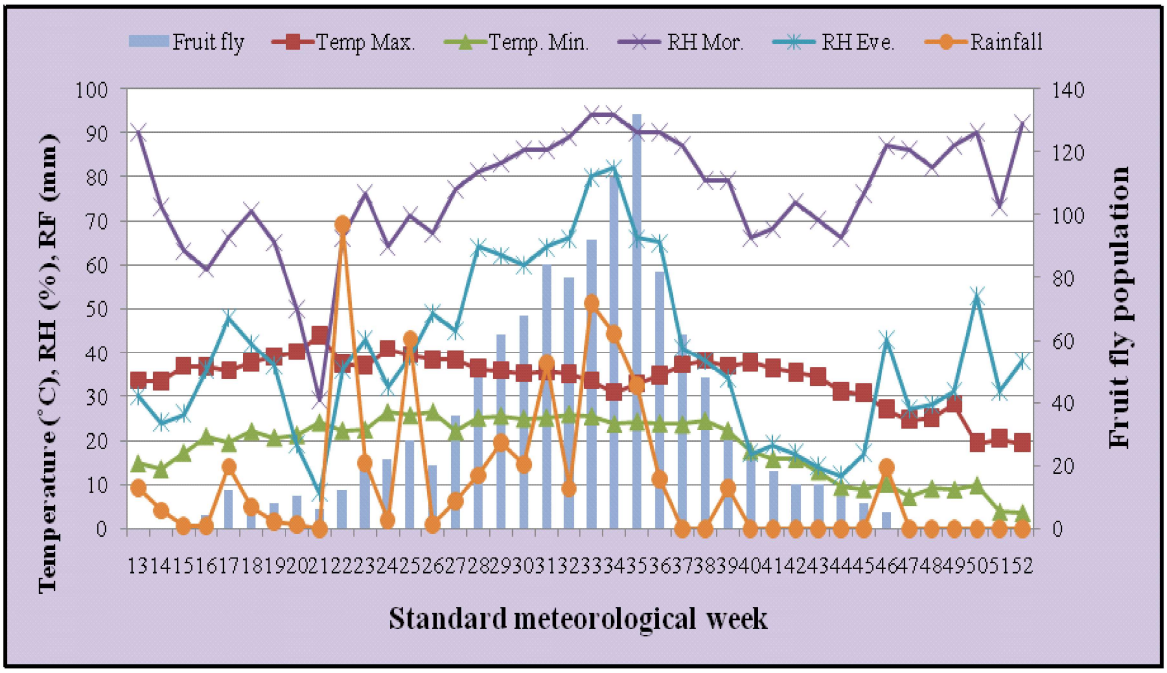

Fig 1. Fruit fly population relationship with temperature, relative humidity and rainfall

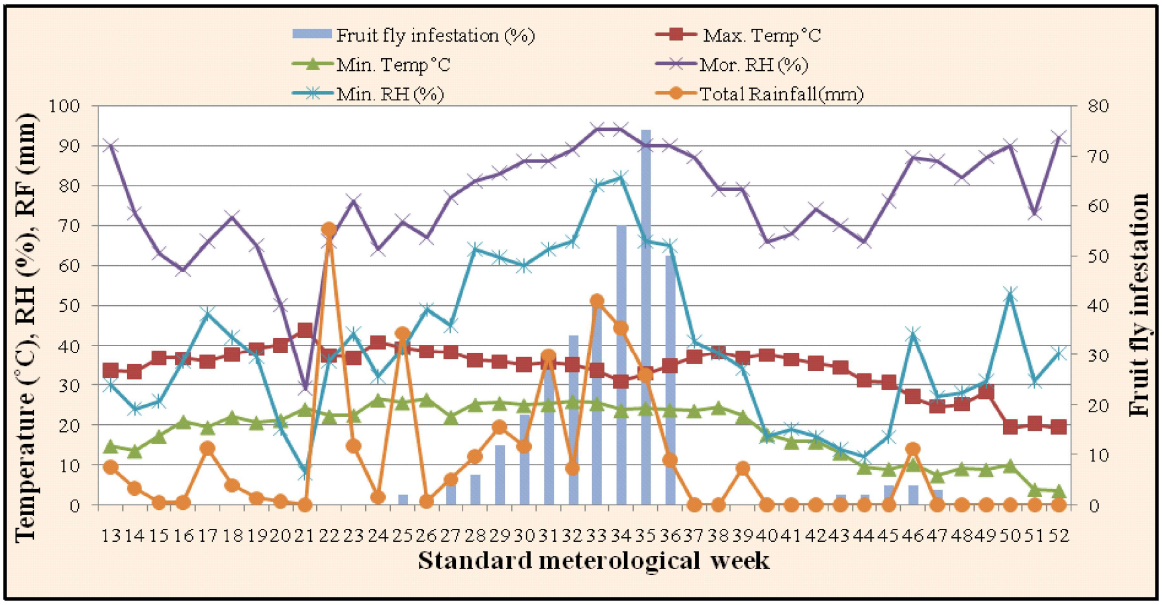

Fig 2. Fruit fly infestation relationship with temperature, relative humidity and rainfall

reported that the *B dorsalis* showed a highly significant and positive correlation with minimum temperature and relative humidity.

The multiple regression analysis between infestation of guava fruit fly population and weather parameters (Table 3) indicated that all the weather parameters collectively accounted for 73 per cent variability. The present findings also show that influence of all weather parameters was significant (R^2= 0.73) on guava fruit fly infestation and fruit fly population.

CONCLUSION

On the basis of results it is concluded that first appearance of fruit fly was recorded in 16th standard meteorological week and highest number of fruit flies (132/trap/week) was recorded during last week of August. The guava fruit fly, *B dorsalis* Hendel and *B zonatus* Saunder were found to be the dominant species in guava ecosystem causing considerable damage to guava in southwest Haryana. The peak infestation (75.0%) was recorded during third week

of September. Among the abiotic factors viz minimum temperature and relative humidity appeared to have overall influence in regulating the fruit flies of guava.

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