

Original Research Article

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## Species Diversity and Population Dynamics of Fruit Flies in Guava Ecosystem

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### ABSTRACT

Studies related to species diversity and seasonal incidence of fruit flies in guava ecosystem was conducted at University of Horticultural Sciences (UHS), Udyanagiri, Bagalkot, India during 2015-16 and 2016-17. The species diversity indices of fruit flies during 2015-16 showed that Shannon index of diversity of the fruit fly population was maximum during 48<sup>th</sup> standard matereological week (SMW) of (November) 2015 ( $H' = 1.06$ ), followed by 27<sup>th</sup> SMW of (July) 2015 ( $H' = 0.83$ ). Maximum J' value was recorded ( $J' = 0.98$  and  $0.96$ , respectively) during 40<sup>th</sup> and 51<sup>st</sup> SMW of 2015 and 1<sup>st</sup>, 3<sup>rd</sup> and 48<sup>th</sup> SMW 2016. The maximum Simpson diversity index value was recorded (0.84) during 1<sup>st</sup> SMW of (January) 2016. During 2016-17, Shannon index of diversity of the fruit fly population was maximum during 25<sup>th</sup> SMW of (June) 2017 ( $H' = 1.08$ ). Maximum J' value was recorded (0.98) during 25<sup>th</sup> SMW followed by 23<sup>rd</sup> SMW of (June) 2017 (0.95). The maximum Simpson diversity index value (0.84) was recorded during 23<sup>rd</sup> SMW of (June) 2017. When the total fruit flies were considered irrespective of the species, the first major peak population (80.25 flies per trap/week) was observed during 27<sup>th</sup> SMW of 2015 and during 29<sup>th</sup> SMW of (July) 2017 (71.50 fruit flies/trap/week).

#### Keywords

Guava, Species diversity, Population dynamics, Fruit flies, Northern dry zone

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### Introduction

The fruit flies, pests of quarantine importance and difficult to control have great impact on Agri or Horti ecosystem causing enormous damage to fruits posing serious threat in guava particularly in northern dry zone of Karnataka, India. In India, the total area under guava cultivation is 2.60 lakh hectares with an annual production of 38.26 lakh metric tonnes (Anonymous, 2017). About 80 species of insects have been recorded on guava (Butani, 1979; Singh *et al.*, 2003) affecting yield and

quality of fruits. Spiraling whitefly, guava kajji bug and fruit fly are the major constraints. The Oriental fruit fly, *Bactrocera dorsalis* Hendel is the most important and destructive pest associated with guava (Verghese and Sudhadevi, 1998 and Rajitha and Viraktamath, 2005). There are very few studies regarding diversity of fruit flies in guava ecosystem particularly in Northern dry zone of Karnataka. Hence the research work was undertaken to record the species diversity and population dynamics of fruit flies in guava ecosystem.

**Materials and Methods**

Studies related to species diversity and seasonal incidence of fruit flies in guava ecosystem was conducted at University of Horticultural Sciences (UHS), Udyanagiri, Bagalkot, India during 2015-16 and 2016-17. The data on seasonal incidence of fruit flies were collected by installing water bottle trap for the period of two years during 2015-16 and 2016-17. A total of four bottle traps were set up at 30 feet apart from each other to avoid the interference of the traps. A bottle trap was prepared using one litre capacity mineral water bottle and made with four holes of 20 mm diameter on four sides 8 cm above the bottom. A card board piece of 6 x 1.5 x 1.5 cm was charged with 2 per cent methyl eugenol along with 1 ml malathion in 100 ml of water. Total Number and species of fruit flies trapped in each trap were counted at weekly interval. After each observation traps were emptied. Observations were recorded throughout the year. Methyl eugenol traps were charged at weekly interval. Number of fruit flies trapped per trap per week for each species was averaged and correlated with weather parameters viz., minimum and maximum temperature, minimum and maximum relative humidity, rainfall and wind speed.

**Diversity index**

The species diversity was worked out by using the following Simpson’s index ( $\lambda$ ) (Simpson, 1949) and Shannon’s Weiner index (H') (Shannon and Wiener, 1949) formulae to know the species richness in different ecosystems and within the cropping season at different stages.

$$\text{Simpson index} = \sum_{i=1}^S P_i^2$$

i=1

Where,  $P_i$  is the proportional abundance of the  $i^{\text{th}}$  species given by

$$P_i = \frac{n_i}{N}, i = 1, 2, 3, \dots, S.$$

N

Where,  $n_i$  number of individuals of the  $i^{\text{th}}$  species and N is the total number of individuals for all S species in the population.

$$\text{Simpson diversity} = 1 - \sum p_i^2$$

Where,  $n_i$  number of individuals of the  $i^{\text{th}}$  species and N is the total number of individuals for all S species in the population.

$$\text{Simpson diversity} = 1 - \sum p_i^2$$

$$\text{Shannon Index } (H^{-1}) = \sum_{i=1}^S [P_i \ln P_i]$$

i=1

Where,  $H^{-1}$  is the average uncertainty per species in an infinite community made up of S species with known proportional abundance.

$$P_i = P_1, P_2, P_3, \dots, P_S$$

Where,  $P_i$  is the proportion of individuals found in  $i^{\text{th}}$  species given by  $n_i/N$ .

$n_i$  and N are the number of individuals of  $i^{\text{th}}$  species and total number of individuals respectively.

**Evenness indices**

Indices of evenness of Pielou’s (J') (Pielous, 1969) were calculated using the following equations.

**Pielou’s evenness (J')**

$$J' = \frac{H'}{\ln(S)} = \frac{H'}{H_{\max}}$$

H' is Shannon’s Weiner index

$H_{max}$  is the maximum diversity given by In (S).

Where, S is the total number of species.

To know the diversity of the fruit flies occurring in the guava ecosystem, the collected specimens were mounted on paper point and were also preserved in 70 per cent alcohol with proper label and were sent for identification to Dr. K.J. David, Scientist (Agril. Entomology), Division of Insect Systematics, ICAR-National Bureau of Agricultural Insect Resources, Bengaluru. Species diversity was documented after getting identity of the fruit fly specimens.

## Results and Discussion

A total of five species of fruit flies were identified from guava ecosystem viz., *B. dorsalis*, *B. zonata*, *B. correcta*, *B. duplicata* Bezzi and *B. cucurbitae*. The species diversity indices of fruit flies during 2015-16 showed that Shannon index of diversity of the fruit fly population was maximum during 48<sup>th</sup> standard meteorological week (SMW) of (November) 2015 ( $H' = 1.06$ ), followed by 27<sup>th</sup> SMW of (July) 2015 ( $H' = 0.83$ ). A low H value indicated during particular SMW indicated the low species diversity. The Pielou's evenness (J') estimated ranged from 0.00 to 0.98. Maximum J' value was recorded (J' = 0.98 and 0.96 respectively) during 40<sup>th</sup> and 51<sup>st</sup> SMW of 2015 and 1<sup>st</sup>, 3<sup>rd</sup> and 48<sup>th</sup> SMW 2016. This indicated that species present in the community have equal number of individuals. The low J' value recorded during 30<sup>th</sup> and 28<sup>th</sup> SMW of 2015 (0.39 to 0.49) indicated that the species present in the community have unequal number of individuals during particular week. Simpson diversity index ranged from 0.22 to 0.84. The maximum Simpson diversity index value was recorded (0.84) during 1<sup>st</sup> SMW of (January) 2016 followed by 3<sup>rd</sup> SMW of 2016 and 48<sup>th</sup> SMW

of 2016 (0.80) which indicated that the diversity of fruit fly species was maximum during 1<sup>st</sup> SMW compared to the other weeks (Table 1).

The species diversity indices of fruit flies in guava during 2016-17 showed a variation in the species diversity in different SMW. Shannon index of diversity of the fruit fly population was maximum during 25<sup>th</sup> SMW of (June) 2017 ( $H' = 1.08$ ) followed by 23<sup>rd</sup> SMW of (June) 2017 and 27<sup>th</sup> SMW of (July) 2017 ( $H' = 1.08$  and 1.04, respectively). A low H value indicated that in particular standard week, species diversity was low. The Pielou's evenness (J') ranged from 0.00 to 0.98. Maximum J' value was recorded (0.98) during 25<sup>th</sup> SMW followed by 23<sup>rd</sup> SMW of (June) 2017 (0.95). The low J' value was recorded during other standard weeks of 2016-17 indicated that the species present in the community have unequal members of individuals. Simpson diversity index ranged from 0.00 to 0.84. The maximum Simpson diversity index value (0.84) was recorded during 23<sup>rd</sup> SMW of (June) 2017 followed by 25<sup>th</sup> SMW of (June) 2017 (0.73) which indicates that the diversity of fruit fly species was maximum when compared to the other weeks (Table 2). All the species that were observed during the present study have been previously reported from Karnataka (Drew and Raghu, 2002; David and Ramani, 2011). Similarly these three species of *Bactrocera* were reported on mango and guava from Dharwad district (Ravikumar, 2006 and Rajitha and Viraktamath, 2006). According to Kadam (2012), among the three species viz., *B. dorsalis*, *B. zonata*, *B. correcta*, and *B. dorsalis* was dominant in Rahuri area in guava orchard. But in the present study, the dominant species in guava was *B. correcta*. This might be due to the different locations, host food availability and stage of fruits. Nagaraj *et al.*, (2014) reported that, *B. dorsalis* was the dominant species in GKVK campus,

Bangaluru (49.41%) followed by *B. correcta* (34.22) and *B. zonata* (16.35), where as in Srinivaspur of Kolar district, *B. correcta* was the dominant species with 67.88 per cent followed by *B. dorsalis* (24.07%) and *B. zonata* (8.04%), which indicates that in certain localities *B. correcta* became dominant replacing *B. dorsalis* for which the reasons are not known. Trap catches of *Bactrocera dorsalis* Hendel ranged from 0.00-15.00 flies per trap per week.

The highest numbers of *B. dorsalis* males were trapped during 27<sup>th</sup> SMW of July 2015 with a trap catches of 15.00 flies per trap per week. The catches declined rapidly reaching zero during 43<sup>rd</sup> SMW. The fruit flies gradually disappeared from 45<sup>th</sup> SMW. The highest number of *B. correcta* was trapped during 27<sup>th</sup> SMW with trap catches of 55.75 fruit flies per trap per week. Again a small peak activity was observed during 42<sup>nd</sup> SMW (28.75 flies/trap/week). The catches declined reaching the lowest catches of 3.00 fruit flies per trap per week during 39<sup>th</sup> SMW. The catches declined rapidly after 46<sup>th</sup> SMW. The population of *B. zonata* was at the lower level throughout the study period. The trap catches varied from 0.00 to 9.50 fruit flies per trap per week during 2015-16. The highest catches were recorded during 27<sup>th</sup> SMW (9.50 fruit flies/trap/week) and then the population was at lower level and disappeared from 33<sup>rd</sup> SMW till 3<sup>rd</sup> SMW with irregular lower appearance (Table 3). When the total fruit flies were considered irrespective of the species, the first major peak population of 80.25 fruit flies per trap per week was observed during 27<sup>th</sup> SMW. The population declined to 3.00 fruit flies per trap per week during 45<sup>th</sup> SMW and remained more or less at the same level from 40<sup>th</sup> SMW to 3<sup>rd</sup> SMW (Table 3). Trap catches of *B. dorsalis* ranged from 0.50 to 9.50 flies per trap per week. The highest numbers of *B. dorsalis* males were trapped during 28<sup>th</sup> SMW of (July) 2017 (trap catches of 9.50 flies/trap/week).

The fruit fly catches declined rapidly reaching zero during 30<sup>th</sup> SMW. The catches remained more or less similar after 30<sup>th</sup> SMW to 48<sup>th</sup> SMW during 2016. There was no fruit fly activity observed after 49<sup>th</sup> SMW of 2016 to 20<sup>th</sup> SMW of 2017. The peak activity of *B. correcta* was noticed during 26<sup>th</sup> SMW to 29<sup>th</sup> SMW with highest peak during 29<sup>th</sup> SMW of (July) 2017 (60.50 flies/trap/week). The fruit fly activity declined after 30<sup>th</sup> SMW reached another small peak during 40<sup>th</sup> SMW of (October) 2016 (8.50 flies/trap/week). No fruit fly activity was observed from 1<sup>st</sup> SMW to 18<sup>th</sup> SMW of 2016. The population of *B. zonata* was at the lower level throughout the study period. The trap catches varied from 0.00 to 4.00 fruit flies per trap per week during 2016-17. The highest catches were recorded during 27<sup>th</sup> SMW. After 30<sup>th</sup> SMW fruit fly catches were lowest ranging from 0.00 to 1.50 flies per trap per week and remained constant up to 46<sup>th</sup> SMW of (November) 2016. No fruit fly activity was observed during 50<sup>th</sup> SMW of (December) 2016 to 22<sup>nd</sup> SMW of (May) 2017. Considering the total number of fruit flies irrespective of the species, the first major peak (71.50 fruit flies/trap/week) was observed during 29<sup>th</sup> SMW of (July) 2017. The next smaller peak activity was observed during 36<sup>th</sup> SMW of (September) 2016 (11.00). No fruit fly catches (0.00 flies/trap/week) observed during 1<sup>st</sup> SMW of (January) 2017 to 18<sup>th</sup> SMW of (May) 2017 (Table 4).

Jalaluddin *et al.*, (2001) reported that population of guava fruit fly, *B. correcta*, in guava orchards showed a distinct population peak, which coincided with the fruit ripening and was recorded from July to August in both years. Chaudhary and Jamal (2002) observed peak activity of *B. zonata* and *B. dorsalis* from August to October, which coincided with the maturity of guava under various environmental conditions of Rawalpindi, Pakistan.

**Table.1** Species diversity indices for fruit flies in guava during 2015-16

SMW	Shannon's index (H')	Pielou's evenness (J')	Simpson index (D)	Simpson diversity index (1-D)
27	0.83	0.76	0.52	0.48
28	0.54	0.49	0.70	0.30
29	0.72	0.66	0.58	0.42
30	0.43	0.39	0.78	0.22
31	0.74	0.67	0.57	0.43
32	0.78	0.71	0.55	0.45
33	-	-	-	-
34	0.67	0.97	0.49	0.51
35	0.43	0.62	0.71	0.29
36	0.46	0.66	0.71	0.29
37	0.42	0.61	0.72	0.28
38	0.53	0.76	0.62	0.38
39	-	-	-	-
40	0.68	0.98	0.40	0.60
41	0.81	0.74	0.50	0.50
42	0.63	0.57	0.65	0.35
43	-	-	-	-
44	0.55	0.79	0.60	0.40
45	-	-	-	-
46	0.00	0.00	0.00	0.00
47	-	-	-	-
48	1.06	0.96	0.20	0.80
49	-	-	-	-
50	-	-	-	-
51	0.68	0.98	0.31	0.69
52	-	-	-	-
1	0.68	0.98	0.16	0.84
2	0.00	0.00	0.00	0.00
3	0.68	0.98	0.20	0.80

SMW- Standard Meteorological Weeks

(\*There was no incidence of fruit flies in guava from 4<sup>th</sup> to 26<sup>th</sup> SMW during 2016)

(- Species diversity was not noticed)

**Table.2** Species diversity indices for fruit flies in guava during 2016-17

<b>SMW</b>	<b>Shannon's index (H')</b>	<b>Pielou's evenness (J')</b>	<b>Simpson index (D)</b>	<b>Simpson diversity index (1-D)</b>
33	0.77	0.70	0.50	0.50
34	0.75	0.68	0.52	0.48
35	0.43	0.62	0.70	0.30
36	0.76	0.69	0.52	0.48
37	0.50	0.72	0.63	0.37
38	0.62	0.89	0.49	0.51
39	-	-	-	-
40	0.66	0.60	0.61	0.39
41	0.57	0.82	0.50	0.50
42	0.41	0.59	0.65	0.35
43	0.91	0.83	0.39	0.61
44	0.46	0.66	0.66	0.34
45	0.41	0.59	0.71	0.29
46	0.41	0.59	0.72	0.28
47	0.50	0.72	0.60	0.40
48	0.64	0.92	0.46	0.54
49	0.41	0.59	0.72	0.28
50	-	-	-	-
51	-	-	-	-
52	-	-	-	-
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00

*Contd....*

SMW	Shannon's index (H')	Pielou's evenness (J')	Simpson index (D)	Simpson diversity index (1-D)
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00
19	-	-	-	-
20	-	-	-	-
21	0.57	0.82	0.25	0.75
22	-	-	-	-
23	1.04	0.95	0.16	0.84
24	0.85	0.77	0.31	0.69
25	1.08	0.98	0.27	0.73
26	0.38	0.35	0.80	0.20
27	0.90	0.82	0.45	0.55
28	0.61	0.56	0.66	0.34
29	0.51	0.46	0.72	0.28
30	-	-	-	-
31	-	-	-	-

SMW- Standard Meteorological Weeks

(\*There was no incidence of fruit flies in guava from 32<sup>nd</sup> SMW 2017 onwards)

(- Species diversity was not noticed)



**Table.3** Population dynamics of fruit flies in guava ecosystem during 2015-16

SMW	No./trap/week*			Total
	<i>B. dorsalis</i>	<i>B. correcta</i>	<i>B. zonata</i>	
27	15.00	55.75	9.50	80.25
28	2.50	25.50	2.50	30.50
29	3.75	21.88	3.25	28.88
30	2.00	35.50	2.50	40.00
31	3.00	20.00	3.75	26.75
32	5.00	25.50	4.50	35.00
33	0.00	8.25	0.00	8.25
34	6.25	10.25	0.00	16.50
35	3.00	15.50	0.00	18.50
36	4.00	20.20	0.00	24.20
37	2.75	15.00	0.00	17.75
38	3.00	10.50	0.00	13.50
39	0.00	3.00	0.00	3.00
40	3.00	3.00	0.00	6.00
41	2.00	9.50	2.00	13.50
42	5.00	28.75	2.00	35.75
43	0.00	15.50	0.00	15.50
44	3.50	11.00	0.00	14.50
45	0.00	3.00	0.00	3.00
46	0.00	0.00	0.00	0.00
47	0.00	1.00	0.00	1.00
48	2.00	2.00	1.00	5.00
49	0.00	2.50	0.00	2.50
50	0.00	5.00	0.00	5.00
51	2.00	1.50	0.00	3.50
52	0.00	1.00	0.00	1.00
1	1.25	1.25	0.00	2.50
2	0.00	0.00	0.00	0.00
3	1.00	1.50	0.00	2.50
<b>Total</b>	<b>70.00</b>	<b>353.33</b>	<b>31.00</b>	<b>454.33</b>

\*Average of 4 fruit fly traps SMW- Standard Meteorological Weeks



**Table.4** Population dynamics of fruit flies in guava ecosystem during 2016-17

SMW	No./trap/week*			Total
	<i>B. dorsalis</i>	<i>B. correcta</i>	<i>B. zonata</i>	
33	1.00	5.50	1.00	7.50
34	1.00	7.00	1.50	9.50
35	0.00	8.00	1.50	1.50
36	2.00	8.00	1.00	11.00
37	0.00	6.00	1.50	7.50
38	2.00	4.50	0.00	6.50
39	0.00	7.50	0.00	7.50
40	1.00	8.50	1.25	10.75
41	0.00	3.00	1.00	4.00
42	0.00	3.00	0.50	3.50
43	2.00	5.00	1.00	8.00
44	0.00	5.00	1.00	6.00
45	1.00	6.00	0.00	7.00
46	0.00	6.25	1.00	7.25
47	1.00	4.00	0.00	5.00
48	2.00	4.00	0.00	6.00
49	0.00	4.75	0.75	5.50
50	0.00	1.50	0.00	1.50
51	0.00	1.75	0.00	1.75
52	0.00	0.25	0.00	0.25
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00

*Contd....*

SMW	No./trap/week*			Total
	<i>B. dorsalis</i>	<i>B. correcta</i>	<i>B. zonata</i>	
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00
19	0.00	0.50	0.00	0.50
20	0.00	1.00	0.00	1.00
21	0.50	1.50	0.00	2.00
22	0.00	1.00	0.00	1.00
23	1.00	2.00	1.00	4.00
24	1.50	2.50	0.25	4.25
25	2.25	3.50	3.75	9.50
26	1.75	19.75	0.50	22.00
27	6.50	18.50	4.00	29.00
28	9.50	45.50	2.00	57.00
29	8.00	60.50	3.00	71.50
30	0.00	2.00	0.00	2.00
31	0.00	3.00	0.00	3.00
<b>Total</b>	<b>44.00</b>	<b>260.75</b>	<b>27.50</b>	<b>324.25</b>

\*Average of 4 ME traps SMW- Standard Meteorological Week

**Table.5** Correlation coefficients of trap catches of fruit flies with weather parameters in guava during 2015-16

Fruit fly species	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
<i>B. dorsalis</i>	0.017	0.326	-0.276	-0.073	0.182
<i>B. correcta</i>	0.084	0.507*	-0.271	-0.111	0.501
<i>B. zonata</i>	0.194	0.444*	-0.259	-0.126	-0.082

\* Significant at 5%

**Table.6** Correlation coefficients of trap catches of fruit flies with weather parameters in guava during 2016-17

Fruit fly species	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
<i>B. dorsalis</i>	-0.071	-0.013	0.363*	0.206	0.110
<i>B. correcta</i>	-0.141	-0.031	0.385*	0.243	0.099
<i>B. zonata</i>	-0.172	-0.019	0.462*	0.206	0.379*

\* Significant at 5%

**Table.7** Multiple linear regression of trap catches of fruit flies with weather parameters in guava during 2015-16

Fruit fly species	Regression model	Regression coefficient (R <sup>2</sup> )
<i>B. dorsalis</i>	Y= -2.21 + 0.17 x <sub>1</sub> + 0.46 x <sub>2</sub> -0.15 x <sub>3</sub> + 0.03 x <sub>4</sub> + 0.20 x <sub>5</sub> + 2.86	0.26
<i>B. correcta</i>	Y= -40.54 + 0.92 x <sub>1</sub> + 3.07 x <sub>2</sub> -1.08 x <sub>3</sub> + 0.74 x <sub>4</sub> + 0.97 x <sub>5</sub> + 10.37	0.47
<i>B. zonata</i>	Y = -4.93 + 0.19 x <sub>1</sub> + 0.35 x <sub>2</sub> -0.15 x <sub>3</sub> + 0.08 x <sub>4</sub> + 0.04 x <sub>5</sub> + 1.91	0.32

x<sub>1</sub> = maximum temperature; x<sub>2</sub> = minimum temperature; x<sub>3</sub> = relative humidity in the morning; x<sub>4</sub> = Relative humidity in the evening; x<sub>5</sub> = rain fall; Y = number of fruit flies.

**Table.8** Multiple linear regression of trap catches of fruit flies with weather parameters in guava during 2016-17

Fruit fly species	Regression model	Regression coefficient (R <sup>2</sup> )
<i>B. dorsalis</i>	Y = - 11.48 + 0.17 x <sub>1</sub> + 0.04 x <sub>2</sub> + 0.03 x <sub>3</sub> + 0.04 x <sub>4</sub> + 0.00 x <sub>5</sub> + 1.84	0.19
<i>B. correcta</i>	Y = - 49.11 + 0.61 x <sub>1</sub> + 0.30 x <sub>2</sub> + 0.21 x <sub>3</sub> + 0.21 x <sub>4</sub> -0.06 x <sub>5</sub> + 10.16	0.19
<i>B. zonata</i>	Y = -3.04 + 0.03 x <sub>1</sub> + 0.02 x <sub>2</sub> + 0.02 x <sup>3</sup> + 0.01 x <sub>4</sub> + 0.01x <sub>5</sub> + 0.83	0.29

x<sub>1</sub> = maximum temperature; x<sub>2</sub> = minimum temperature; x<sub>3</sub> = relative humidity in the morning; x<sub>4</sub> = relative humidity in the evening; x<sub>5</sub> = rain fall; Y = number of fruit flies

Similarly, in guava, the maximum (10.76 to 14.74%) infestation of *B. zonata* was observed in the month of August and September in Pakistan (Khan *et al.*, 2005). Bansode (2009) noticed the occurrence of fruit flies throughout the year and peak activity coincided with fruiting and harvesting period of guava. He also observed that, the fruit fly activity was higher during June to November. Present findings are also in agreement with the Dale and Patel (2010) who reported that highest number of fruit flies, *Bactrocera* spp population was observed in the month of September and lowest in the month of May in the guava orchard. The activity and dominance of the fruit fly species differed, which may be attributed to different agro climatic factors and crop phenology and corresponding to fruiting period and fruit maturity.

#### **Influence of weather parameters on population dynamics of fruit fly species in guava during 2015-16 and 2016-17**

Studies were made to find out the relationship between trap catches of different species of fruit flies and weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity and rainfall. Influence of weather parameters on *B. dorsalis* population was worked out by calculating correlation coefficient of trap catches. The correlation analysis between the weather parameters and fruit fly trap catches revealed that *B. dorsalis* had no significant relationship with any of the weather parameters. *B. correcta* and *B. zonata* had a significant positive correlation with minimum temperature ( $r=0.507$  and  $0.444$ , respectively). There was no significant relationship with other weather parameters during 2015-16 (Table 5). Influence of weather parameters on fruit fly population of trap catches during 2016-17, indicated that *B. dorsalis*, *B. correcta* and *B. zonata* had a

significant positive correlation with morning relative humidity ( $r=0.363$ ,  $0.385$  and  $0.462$ , respectively). *B. zonata* showed a significant positive correlation with rainfall ( $r=0.379$ ). There was no significant relationship with other weather factors *viz.*, maximum and minimum temperature and evening relative humidity (Table 6).

Multiple regression analysis on the effect of different weather parameters together on the fruit fly trap catches showed that predictability of the equation ranged from 26.7 to 47.1 per cent on fruit fly species during 2015-16. The regression model showed the highest predictability of 47.1 per cent in *B. correcta* while, *B. zonata* and *B. dorsalis* recorded 32 and 26 per cent accuracy respectively (Table 7). During 2016-17 weather factors collectively influenced trap catches of *B. zonata* to an extent of 29 per cent. The other two species, *B. correcta* and *B. dorsalis* recorded trap catches to the tune of 19 per cent (Table 8).

According to findings of Jalaluddin *et al.*, (2001), abiotic factors played an important role in regulating *B. correcta* population. Weather parameters showed significant positive correlation with mean maximum temperature, minimum temperature, day-degrees (thermal units), morning relative humidity and rainfall. Agarwal and Deepa (2013) reported three species *viz.*, *B. dorsalis*, *B. zonata* and *B. correcta*, of which *B. correcta* was predominant followed by *B. zonata* and *B. dorsalis* in horticulture ecosystems. Population of *B. correcta* was influenced by temperature, which had a positive correlation at three places, negative correlation two other places ( $r = -0.034$  and  $0.2811$ ). Relative humidity negatively correlated at four locations while it showed positive correlation at Indian Institute of Pulses Research (IIPR) ( $r = 0.273$ ). Rainfall showed a positive correlation with catches of

*B. correcta* at three locations while it showed positive correlation at two places. *B. zonata* and *B. dorsalis* had positive correlation with temperature. Present findings are more or less similar to the earlier results. Fruit fly showed differential responses to all weather parameters due to topography and agro climatic regions. Sarada *et al.*, (2001) found significant positive correlation of fruit fly with maximum temperature and non-significant positive correlation with minimum temperature. According to Rajitha and Viraktamath (2006), *B. dorsalis* in guava had significant positive correlation with minimum temperature and morning and afternoon relative humidity, but had significant negative correlation with maximum temperature. Abiotic factors played an important role in the regulation of *B. correcta* population; however, in the current findings it differed which might be due to the availability of the host and variation in the weather factors. However, Singh and Mann (2003) reported positive correlation between population build up and rainfall. Variation might be due to the difference in host food availability and stage of fruits.

In conclusion, the present findings indicated that diversity of fruit flies, *B. duplicata* in guava ecosystem is very low. The dominant species found in guava ecosystem was *B. correcta*, *B. dorsalis* and *B. zonata*. When the total fruit flies were considered irrespective of the species, the first major peak population (80.25 flies per trap/week) was observed during 27<sup>th</sup> SMW of 2015. Considering the total number of fruit flies irrespective of the species, the first major peak (71.50 fruit flies/trap/week) was observed during 29<sup>th</sup> SMW of (July) 2017.

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