



## Investigation on population fluctuation of cucurbit fruit flies, *Bactrocera cucurbitae* associated with cucurbit crops

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Received: 9/20/2018; Revised: 10/05/2018; Accepted: 10/06/2018

Available online: 13<sup>th</sup> October 2018

**Abstract:** The population of cucurbit fruit flies, *Bactrocera cucurbitae* of bitter gourd was observed vary much changeability at Block Daurala, District Meerut. Decreasing temperature negative effect was observed in cucurbits fruit flies population at District Meerut but positive effect of temperature was observed in cucurbit fruit population at District Saharanpur. Fruit flies population of cucurbits fruit increased with the increase of relative humidity, rainfall and decreased temperature while negative relationship was observed with maximum correlation in cucurbits in *zaid* and *Kharif*. Moderate to high negative correlation coefficients were observed between maximum temperature and population fluctuation of cucurbit fruit flies in cucurbits at both places. The significant positive and negative correlation coefficients were present between relative humidity, rainfall and temperature and percentage of fruit flies population.

**Keywords:** Fruit flies, Methyl eugenol trap, Correlation, Population

### Introduction

Cucurbits are infested by several insect pests which are considered to be the significant obstacles for economic production. Among them, cucurbit fruit fly is the serious pest responsible for considerable damage of cucurbits [1].

The cucurbit fruit fly *Bactrocera cucurbitae* can attack about 16 different types of cucurbit crops. Although the rate of attack varies among the crop, infestation reduced both the yield and quality of the cucurbit fruits. Yield losses due to fruit fly infestation vary from 19.19 to 69.96% in different fruits and vegetables [2]. The major constraint to sustainable increased productivity of cucurbits is the high incidence of insect pests. Cucurbits are infested by a number of pests such as cucurbit fruit fly, red pumpkin beetle, epilachna beetle etc. Among them cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett) is a devastating pest of different cucurbit vegetables in many parts of the world which may cause more than 60% yield loss [3]. Depending on the environmental conditions and susceptibility of the crop species, the extent of losses varies between 30 to 100%. In India, 31.27 per cent damage in bitter gourd and 28.55 per cent to watermelons [3]. Whereas, either partial or complete damage of above 60 percent of cucurbit crops [4]. The major constraint to sustainable increased productivity of cucurbits is the high incidence of insect pests. Cucurbits are infested by a number of pests such as cucurbit

fruit fly, red pumpkin beetle, epilachna beetle etc. The pest has been reported to damage about 81 host plants and as a major pest of cucurbitaceous vegetables, especially the bitter gourd, musk melon, snap melon, snake gourd, ridge gourd etc.

The pest has been reported to damage about 81 host plants and as a major pest of cucurbitaceous vegetables, especially the bitter gourd, musk melon, snap melon, snake gourd, ridge gourd etc. The tribe decinae with the genus *Bactrocera* is of great economic importance in India. Among *Bactrocera* spp., *B. dosalis* (Hendd), *B. corrctei* (Bezzi), *B. zonata* (Sounders) and *B. cucurbitae* (Coquillett) are of immense economic significance. Due to its nature of infestation, it is very difficult to control the pest. A cluster method have been developed and suggested by to control these pests [4]. Among all these methods, the chemical control method is still popular to the Indian farmers because of its quick and visible results. First three species mainly attack fruit crops, while *B. cucurbitae* attacks cucurbits. The increasing use of synthetic insecticides has led to a number of problems such as development of resistance to insecticides in some insect pests, high insecticide residues in market produce, resurgence or increased infestation by some insect species due to the destruction of natural predators and parasitoids, changing pest status of mites and other minor insect pests, ecological imbalance and danger to health of the pesticide applicator.

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DOI: <http://dx.doi.org/10.21746/ijbio.2018.7.6.1>



Considering the alarming consequences of pesticide usage and residual effect on the environment and pragmatic programme is now needed worldwide to minimize the dependency on insecticides without hampering crop production. IPM, undoubtedly since last few years has been a much talked scientific phenomenon in India, particularly in the area of the agricultural policy makers.

Approaches of IPM are thought to be the best and very effective in many countries of the world as well as in India, to control vegetable pests. In the contemporary usage, IPM is not limited to deal with pesticides and management; in fact IPM has a holistic approach to crop production based on sound ecological understanding and in this sense, IPM could even be termed as Eco-friendly pest management. “IPM targets changing of the farmer’s practices toward growing a healthy crop and increasing the farm output and farmers income on a sustainable basis while improving the environment and community health”.

Several efforts have been made in India and abroad to assess the relative performance of traps baited with parapheromones and to work out the species variation in fruit flies but information on these aspects in this part of Uttar Pradesh are quite scanty. Hence, keeping these observations in view, “*Studies on the damage assessment and field management of Cucurbit fruit fly, Bactrocera cucurbitae in cucurbitaceous vegetable in western plain zone in Uttar Pradesh*”. Evaluation of fruit fly catches in different locations at Meerut and Saharanpur and there was undertaken to assess the population fluctuation and host preference of cucurbit fruit fly associated with cucurbit crops.

## Materials and Methods

The present study on investigation on population fluctuation of cucurbit fruit flies, *Bactrocera cucurbitae* associated with cucurbit crops was conducted during *zaid* and *Kharif* season 2015. The experiment was carried out at the two locations on bitter gourd, bottle gourd, ridge gourd and pumpkin of cucurbitaceous vegetable field in *zaid* and *Kharif* season. First in Block Daurala, District Meerut (U.P.) which is located at Delhi to Dehradun road (N.H. 58) at distance of about 10 Km from Meerut city. It lies between latitude of 29°40' north and longitude of 77°42' East at an altitude of 237 m above sea level. The fruit flies separately collected from all the traps at weekly intervals and identified to the species level on the basis of morphological variations *viz*: wing venation, head capsule and ovipositor as per keys given by with the help of microscope. All infested fruits will be collected from experimental area. These fruits will be kept in laboratory for further studies.

Bottle fruit fly traps were used to conduct this experiment. Three fruit fly bottle traps were set up in (1 acre) 4 cucurbits vegetable crop fields at initiation of flowering stage of the crop. Four crops of bitter gourd, ridge gourd, bottle gourd and pumpkin were sown following recommended agronomic practices by farmers. Fields under each monitoring experiment at two districts were maintained. Methyl eugenol/cue-lure, ethyl alcohol and malathion 50 EC Solution was installed in each field. These traps were consisted of plastic bottles with four holes on the bottom. Plastic fibers were fixed at the bottom of bottles in the holes. These traps were installed in fields at the time of crop flowering at ground level. In each trap, cotton wicks were impregnated with different quantity of formulated methyl eugenol/cue lure, ethyl alcohol and malathion 50 EC [10 mL=(6:3:1)] and those were hung on iron hook between the inner holes of plastic bottles. The old pheromone traps were replaced with fresh traps every week. Data on attracted and trapped male melon fruit fly was collected on weekly basis. Meteorological data such as temperature, relative humidity and rainfall was collected to determine correlation between male fly population and physical factors of environment. Effectiveness of methyl eugenol and cue-lure in attracting male fly was determined. Bottle traps were hung after the completion of taking all required data for monitoring and management of cucurbit fruit fly. In case of trapping, number of trapped fruit flies was counted and means number was calculated. Relation between number of fruit flies (which trapped by methyl eugenol and cue lure) and metrological variables were found out by using correlation coefficient.

The correlation coefficient between factors and average population per plant were determined by using the following formula:

$$r_{xy} = \frac{\text{Cov.}(xy)}{\sqrt{\text{Var. X} \times \text{Var. Y}}}$$

Where,

$r_{xy}$  = Correlation coefficient between X and Y.

Cov. (xy) = Covariance between X and Y.

Var. (X) = Variance due to character X.

Var. (Y) = Variance due to character Y.

X = Average meteorological parameters.

Y = Average insect population.

$$\text{Cov. (XY)} = \frac{1}{n} \left[ \sum xy - \frac{(\sum x)(\sum y)}{n} \right]$$

$$\text{Var. (X)} = \frac{1}{n} \left[ \sum x^2 - \frac{(\sum x)^2}{n} \right]$$

$$\text{Var. (Y)} = \frac{1}{n} \left[ \sum y^2 - \frac{(\sum y)^2}{n} \right]$$

The significance of correlation coefficient (r) was tested by comparing the calculated value of t with tabulated t value at (n-2) df. [5].

The test statistic is as follows:

$$t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}}$$

Square root transformation =  $\sqrt{x + 0.05}$

Where,

x=Population

### Results and discussion

#### The population fluctuation of cucurbit fruit flies, *Bactrocera cucurbitae* associated with cucurbit crops at Block Daurala, District Meerut

The population of cucurbit fruit flies of bitter gourd was observed vary much changeability at Block Daurala, District Meerut. The population of cucurbit fruit flies on bitter gourd was fluctuated from 60 to 237 flies/3 traps/week of June and July (23<sup>rd</sup> and 28<sup>th</sup> standard week) 2015. The population of cucurbit fruit flies on bottle gourd was recorded between 19 to 69 flies/3 traps/week of June and July (24<sup>th</sup> and 28<sup>th</sup> standard week). The population of cucurbit fruit flies on ridge gourd was found between 49 to 203 fruit flies/3 traps/week of June and July (25<sup>th</sup> and 27<sup>th</sup> standard week). The population of cucurbit fruit flies on pumpkin was observed from 27 to 106 fruit flies/3traps week of July and August

2015 (31<sup>st</sup> and 27<sup>th</sup> standard week) by using methyl eugenol traps (Table 1 and Figure 1). The maximum population fluctuation of fruit flies was seen in bitter gourd cucurbit crop and when maximum and minimum temperature and relative humidity were reported 33.0°C, 25.0°C and 85.36% respectively. The minimum population fluctuation of fruit flies was found in bottle gourd cucurbit crops and when maximum and minimum temperature and relative humidity were also reported 33.0°C, 25.0°C and 85.36% respectively (28<sup>th</sup> standard week) of July in *zaid* and *Kharif* crop season.

#### The population fluctuation of cucurbit fruit flies, *Bactrocera cucurbitae* associated with cucurbit crops at Block Punwarka, District Saharanpur

The population of cucurbit fruit flies of bitter gourd was observed vary much variableness at Block Punwarka, District Saharanpur. The population of cucurbit fruit flies on bitter gourd was fluctuated from 60 to 237 flies/3traps/week June and July 2015 (23<sup>th</sup> and 28<sup>th</sup> standard week). The population

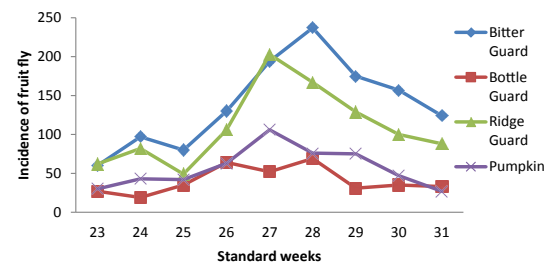


Figure 1: Population buildup of *Bactrocera cucurbitae* in four cucurbit vegetables crops at Daurala Block District Meerut.

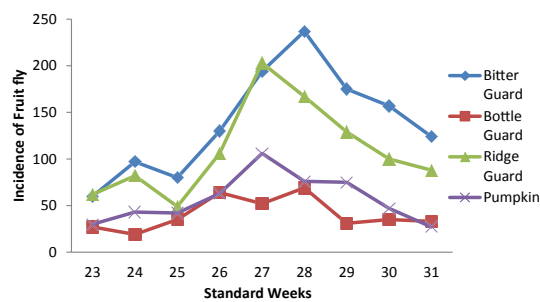
Table 1: Population buildup of *Bactrocera cucurbitae* in four cucurbit vegetables crops at Daurala Block District Meerut.

Period	S.W.	Incidence of fruit flies on 4 cucurbit crops/3 traps/ week/acre				Temperature °C		Avg. RH%	Avg. Rainfall
		Bitter gourd	Bottle gourd	Ridge gourd	Pumpkin	Max.	Min.		
3-9 June	23	60 (7.75)	27 (5.20)	62 (7.88)	30 (5.48)	35.50	25.20	48.9	05.10
10-16 June	24	97 (9.85)	19 (4.36)	82 (9.06)	43 (6.56)	36.94	25.64	51.42	07.20
17-23 June	25	80 (8.95)	35 (4.92)	49 (7.00)	42 (6.48)	36.34	25.77	58.64	11.80
24-30 June	26	130 (11.40)	64 (8.00)	106 (10.30)	63 (7.94)	33.69	23.83	75.78	54.30
1-7 July	27	194 (13.93)	52 (7.21)	203 (14.25)	106 (10.30)	33.80	25.10	67.71	84.60
8-14 July	28	237 (15.40)	69 (8.31)	167 (12.92)	76 (8.72)	31.06	25.27	85.36	86.60
15-21 July	29	175 (13.23)	31 (5.57)	129 (11.36)	75 (8.66)	34.16	26.60	72.28	77.00
22-28 July	30	157 (12.53)	35 (5.92)	100 (10.00)	47 (6.86)	34.04	25.89	66.21	00.00
29 July- 4 August	31	124 (11.14)	33 (5.75)	88 (9.38)	27 (5.20)	33.77	25.87	70.78	00.00

Note: Figure in parenthesis are square root transformation =  $\sqrt{x + 0.05}$

of cucurbit fruit flies on bottle gourd was recorded between 19 to 69 fruit flies/3 traps/week of June and July (24<sup>th</sup> and 28<sup>th</sup> standard week). The population of cucurbit fruit flies on ridge gourd was found between 49 to 203 fruit flies/3 traps/week of June and July (25<sup>th</sup> and 27<sup>th</sup> standard week). The population of cucurbit fruit flies on pumpkin was observed from 27 to 106 fruit flies/3 traps/week of July and August 2015 (31<sup>st</sup> and 27<sup>th</sup> standard week) by using methyl eugenol traps (Table 2 and Figure 2). Catches of 171.82 male fruit flies/trap/week by cue lure trap [6] and observed mean of catches of male fruit flies population were highest and lowest (6.09, 4.55, 3.87 and 3.60 flies/trap/week) and (4.73, 3.93, 273 and 2.73) on cucumber, bottle gourd, ridge gourd and pumpkin respectively at two cold places in (Jammu and Kashmir, India) [7]. The highest number of male fruit flies (55.67 fruit flies/traps/week) on the crop planted during *Kharif* and low (19.67 fruit flies/trap/week) on the crop planted in rabi [8].

The maximum population fluctuation of fruit flies



**Figure 2:** Population buildup of *Bactrocera cucurbitae* in four cucurbit vegetables crops at Block Punwarka, District Saharanpur.

was seen in bitter gourd cucurbit crop and when maximum and minimum temperature and relative humidity were reported 31.50, 250°C and 87.5%. The minimum population fluctuation of fruit flies was found in bottle gourd cucurbit crops and when maximum and minimum temperature and relative humidity were reported 38.80°C, 24.20°C and 38.5%. Reports of many authors support the present result [9-15]. They have been reported fruit flies populations are in general positively correlated with temperature and relative humidity. The fruit flies population was generally low during dry weather and rapidly with adequate rainfall according to above scientists. The fruit flies populations were reach on peak in July similarly this experiment result [16,17].

**Role of humidity, rainfall and temperature on population fluctuation of cucurbit fruit flies in bitter gourd, bottle gourd, ridge gourd and pumpkin at both experiment sites**

Moderate to high negative correlation coefficients were observed between maximum temperature and population fluctuation of cucurbit fruit flies in cucurbits at both places. The calculated value of r for average weekly maximum temperature were found -0.84, -0.80, -0.69 and -0.49°C respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Daurala, District Meerut while the calculated value of ‘r’ for average weekly maximum temperature were found -0.84, -0.68, -0.73 and -0.69°C respectively in bitter gourd, bottle gourd, Ridge gourd, and pumpkin at Block Punwarka, District Saharanpur in *zaid* and *Kharif* season. Low to moderate positive and negative correlation

**Table 2:** Population buildup of *Bactrocera cucurbitae* in four cucurbit vegetables crops at Block Punwarka, District Saharanpur.

Period	S.W.	Incidence of fruit flies on 4 cucurbit crops/3 traps/week/acre				Temperature °C		Avg. RH%	Avg. Rainfall
		Bitter gourd	Bottle gourd	Ridge gourd	Pumpkin	Max.	Min.		
3-9 June	23	61 (7.81)	21 (4.59)	55 (7.42)	36 (6.00)	38.8	24.2	38.50	2.1
10-16 June	24	100 (10.00)	27 (5.20)	87 (9.33)	49 (7.00)	38.9	24.2	51.00	0.8
17-23 June	25	78 (8.83)	33 (5.75)	54 (7.35)	40 (6.33)	36.1	24.4	68.50	36.3
24-30 June	26	138 (11.75)	74 (8.61)	110 (10.49)	68 (8.25)	33.3	23.8	74.00	67.6
1-7 July	27	209 (14.46)	65 (8.07)	182 (13.49)	86 (9.28)	32.2	28.8	73.50	123.7
8-14 July	28	230 (15.17)	66 (8.13)	199 (14.11)	106 (10.30)	31.5	25	87.50	137.2
15-21 July	29	185 (13.60)	39 (6.25)	138 (11.75)	76 (8.72)	33.0	26.2	83.00	32.2
22-28 July	30	157 (12.53)	35 (5.92)	100 (10.00)	47 (6.86)	33.6	26.2	72.00	0.0
29 July- 5 August	31	120 (10.96)	28 (5.30)	80 (8.95)	43 (6.56)	32.8	25.8	83.00	19.5

Note: Figure in parenthesis are square root transformation =  $\sqrt{x + 0.05}$



coefficients were observed between minimum temperature and population fluctuation of cucurbit fruit flies in cucurbits at Meerut and Saharanpur. The calculated value of  $r$  for average weekly minimum temperature were found 0.034, -0.63, -14 and -0.18°C respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Daurala, District Meerut while the calculated value of  $r$  for average weekly minimum temperature were found 0.61, 0.23, 0.56 and 0.38°C respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Punwarka, District Saharanpur in *zaid* and *Kharif* season (2015). Moderate to high degree positive correlation coefficients were observed between relative humidity, rainfall and population fluctuation of cucurbit fruit flies in cucurbits. The calculated value of  $r$  for average weekly relative humidity were found 0.84, 0.80, 0.63 and 0.52% respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Daurala, District Meerut while the calculated value of  $r$  for average weekly relative humidity were found 0.74, 0.54, 0.61 and 0.61% respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Punwarka, District Saharanpur in *zaid* and *Kharif* season 2015. The calculated value of  $r$  for average weekly rainfall were found 0.79, 0.67, 0.85 and 0.91°C respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Daurala, District Meerut while the calculated value of  $r$  for average weekly rainfall were found 0.76, 0.86, 0.86 and 0.89°C respectively in bitter gourd, bottle gourd, ridge gourd, and pumpkin at Block Punwarka, District Saharanpur in *zaid* and *Kharif* season. Increasing of relative humidity Rainfall had profound positive role in cucurbits fruit flies population whereas increasing temperature negative relationship were found for cucurbits fruit flies

population in *Zaid* and *Kharif*. (Table 3) However, decreasing temperature negative effect was observed in cucurbits fruit flies population at District Meerut but positive effect of temperature was observed in cucurbit fruit population at District Saharanpur. Fruit flies population of cucurbits fruit increased with the increase of relative humidity, rainfall and decreased temperature while negative relationship was observed with maximum correlation in cucurbits in *zaid* and *Kharif* (Table 4). Therefore, it could be concluded that significant positive and negative correlation coefficients were present between relative humidity, rainfall and temperature and percentage of fruit flies population. The values of coefficient of determination ( $R^2$ ) were moderate to high (0.76 to 0.91), it indicated that the population for *Bactrocera cucurbitae* governed significantly with the weather parameters in both of the crop season in *zaid* and *Kharif*.

Increasing of relative humidity rainfall and was found positive role in cucurbits fruit infestation whereas increasing temperature negative relationship were found for cucurbits fruit infestation. However, decreasing temperature negative effect was observed in cucurbits fruit infestation at District Meerut but positive effect of temperature was observed in cucurbit fruit infestation at District Saharanpur. Fruit infestation of cucurbits fruit increased with the increase of relative humidity, rainfall and decreased temperature while negative relationship was observed with maximum correlation. Therefore, it could be concluded that significant positive and negative correlation coefficients were presented between relative humidity, rainfall and temperature and percentage of fruit infestation. The correlation studies revealed that the maximum and minimum

**Table 3:** Correlation co-efficient between the population of *Bactrocera cucurbitae* and weather parameters on cucurbits vegetable crops.

Crop	Temperature (°C)				Relative Humidity		Rainfall	
	Maximum		Minimum		Daurala	Punwarka	Daurala	Punwarka
	Daurala	Punwarka	Daurala	Punwarka				
Bitter gourd	-0.84	-0.84	0.04 <sup>NS</sup>	0.61 <sup>NS</sup>	0.84	0.74	0.79	0.76
Bottle gourd	-0.80	-0.68	-0.63 <sup>NS</sup>	0.23 <sup>NS</sup>	0.80	0.54 <sup>NS</sup>	0.67	0.86
Ridge gourd	-0.69	-0.73	-0.14 <sup>NS</sup>	0.56 <sup>NS</sup>	0.63 <sup>NS</sup>	0.61 <sup>NS</sup>	0.85	0.86
Pumpkin	-0.49 <sup>NS</sup>	-0.69	-0.18 <sup>NS</sup>	0.38 <sup>NS</sup>	0.52 <sup>NS</sup>	0.61 <sup>NS</sup>	0.91	0.89

Note: NS=Non-significant

**Table 4:** Regression relationship between the population of *Bactrocera cucurbitae* and weather parameters on cucurbits vegetable crops.

Crop	Place	Regression equation	R <sup>2</sup>
Bitter gourd	Daurala	Y=-99.61+0.71X1+10.93X2-15.01X3 +0.65X4	0.71
	Punwarka	Y=777.97+0.65X1-13.94X2-8.04X3-1.95X4	0.63 <sup>NS</sup>
Bottle gourd	Daurala	Y=-950.80+2.83X1+4.96X2+27.93X3-0.14X4	0.60 <sup>NS</sup>
	Punwarka	Y=-555.96+2.32X1+6.27X2+8.78X3+0.90X4	0.78
Ridge gourd	Daurala	Y=-38.33+0.61X1+9.78X2-4.06X3+1.88X4	0.79
	Punwarka	Y=581.78+0.81X1-10.22X2-7.42X3-1.22X4	0.77
Pumpkin	Daurala	Y=-25.06+1.15X1-1.14X2-0.57X3+0.75X4	0.89
	Punwarka	Y=45.92+1.73X1-9.84X2-1.56X3-1.37X4	0.81

Note: NS=Non-significant

temperature had positive correlation with infestation to fruits. While, morning relative humidity had positive correlation ( $r=0.2160$ ) and evening relative humidity had negative correlation ( $r=-0.1738$ ) with fruit infestation [15]. The temperature (maximum and minimum) showed a significant positive correlation with adult abundance, fruit damage and pupal population. The temperature recorded during the preceding first, second and third weeks had a slightly greater impact than the temperature of the current week in which the fruit fly abundance has been checked. Other abiotic factors had a non-significant effect on fruit fly adult activity, fruit damage and pupal population [18]. There was no significant change was observed during the month of May but a significant reduction in infestation was recorded in the mid of June in Diraab [19]. The fruit infestations varied significantly with the variation of temperature, relative humidity and total number of fruits among three selected vegetables [20].

### Conclusion

The population of cucurbit fruit flies on bitter gourd was fluctuated from 60 to 237 flies/3 traps/week of June and July (23<sup>rd</sup> and 28<sup>th</sup> standard week). The population of cucurbit fruit flies on bottle gourd was recorded between 19 to 69 flies/3 traps/week of June and July (24<sup>th</sup> and 28<sup>th</sup> standard week). The population of cucurbit fruit flies on ridge gourd was found between 49 to 203 fruit flies/3 traps/week of June and July (25<sup>th</sup> and 27<sup>th</sup> standard week). The population of cucurbit fruit flies on pumpkin was observed from 27 to 106 fruit flies/3traps week of July and August (31<sup>st</sup> and 27<sup>th</sup> standard week) by using methyl eugenol traps. While the population of cucurbit fruit flies of bitter gourd was observed vary much variability at Block Punwarka, District Saharanpur. The population of cucurbit fruit flies on bitter gourd was fluctuated from 60 to 237 flies/3 traps/week June and July (23<sup>rd</sup> and 28<sup>th</sup> standard week). The population of cucurbit fruit flies on bottle gourd was recorded between 19 to 69 fruit flies/3 traps/week of June and July (24<sup>th</sup> and 28<sup>th</sup> standard week). The population of cucurbit fruit flies on ridge gourd was found between 49 to 203 fruit flies/3 traps/week of June and July (25<sup>th</sup> and 27<sup>th</sup> standard week). The population of cucurbit fruit flies on pumpkin was observed from 27 to 106 fruit flies/3traps/week of July and August (31<sup>st</sup> and 27<sup>th</sup> standard week) by using methyl eugenol traps.

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**Cite this article as:**

Sohrab, C.S. Prasad, Wajid Hasan. Investigation on population fluctuation of cucurbit fruit flies, *Bactrocera cucurbitae* associated with cucurbit crops. *International Journal of Bioassays* 7.6 (2018) pp. 5652-5658. DOI: <http://dx.doi.org/10.21746/ijbio.2018.7.6.1>