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Sita Nehra
Department of Entomology, SKN College of Agriculture, Jobner, Rajasthan, India

Swaroop Singh
Rajasthan Agricultural Research Institute (RARI), Durgapura, Jaipur, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

SK Choudhary
Rajasthan Agricultural Research Institute (RARI), Durgapura, Jaipur, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

RG Samota
Department of Entomology, SKN College of Agriculture, Jobner, Rajasthan, India

AL Choudhary
Department of Entomology, SKN College of Agriculture, Jobner, Rajasthan, India

Correspondence
Sita Nehra
Department of Entomology, SKN College of Agriculture, Jobner, Rajasthan, India

Seasonal incidence of fruit fly, *Bactrocera cucurbitae* (Coquillett) on round gourd in relation to abiotic factors

Sita Nehra, Swaroop Singh, SK Choudhary, RG Samota and AL Choudhary

Abstract
The investigations on the "Seasonal incidence of fruit fly, *Bactrocera cucurbitae* (Coquillett) on round gourd in relation to abiotic factors" were carried out at Horticultural farm of SKN College of Agriculture, Jobner, Jaipur during Summer, 2016. The initial infestation of fruit fly with 8.52 per cent was observed in mid March *i.e*. 30-35 days after sowing of the crop which increased gradually and reached to its peak, 36.42 per cent in the first week of April and there after it started declining. However, the infestation was observed till last picking of the fruits of the season. During peak period infestation the maximum and minimum temperatures 36.40 °C and 20 °C, respectively and relative humidity 38.5 per cent. There was no rainfall observed during the study period. The correlation studies revealed that the infestation of fruit fly on round gourd showed significantly positive correlation with maximum and minimum temperature (r = 0.6072 and 0.6119, respectively), while significant negative with relative humidity (r = -0.5678).

Keywords: Seasonal incidence, *Bactrocera cucurbitae*, round gourd, abiotic factors

Introduction
Round gourd or squash melon, *Citrullus vulgaris var. fistulosus* (Watt) commonly known as Tinda which is one of the most popular summer and rainy season vegetable crop, commercially cultivated in the Indo- Gangatic plains of North India, especially in Rajasthan, Punjab and Western Uttar Pradesh. In the warm and rainy months, the flies were more active as compared to that of dry and winter months (Laskar and Chatterjee, 2010) [13]. In Rajasthan cucurbits are extensively cultivated because of greater suitability of climate and soil. India is the second largest producer of vegetable in the world after china, accounting for about 10% of the world`s production. In India the area under the cultivation of vegetables during 2015-16 was 9775.38 thousand hectares, with an annual production of 166608.16 thousand ton and productivity of 17.04 ton per hectare (Anonymous, 2015-16) [1]. In Rajasthan the area under the cultivation of round gourd during 2015-16 was 6645 hectares, with an annual production of 14650 metric ton and productivity of 2.20 metric ton per hectare (Anonymous, 2016) [2].
The various factors are responsible for low productivity and production of round gourd include adverse climate, poor quality seeds, diseases, insect and mite pests. The insects and mites are of prime importance which significantly affects both the quality and production of round gourd. The continuous growing of round gourd crop in the region has made it susceptible to the attack of several insect pests like fruit fly, *Bactrocera cucurbitae* (Coquillett); red pumpkin beetle, *Aulacophora foveicollis* (Lues); hadda beetle, *Epilachna dodecastigma* (Wiebemal); Jassid, *Amrasca biguttula biguttula (*Ishid) and mites, *Tetraynchus cinnabarinus* (Boisduvol). Among these pests, fruit fly, *Bactrocera cucurbitae* (Coq.) is an important pest of cucurbit fruits in the world (Dhillon *et al*., 2005) [6]. It is also the most common and destructive pest of cucurbits throughout Indo-Pakistan subcontinent (Jain Hu *et al*., 2008) [10]. The fruit fly species is considered a serious insect pest and is classified as an organism subject to quarantine restrictions (Bateman, 1972 [5]; Shukla and Prasad, 1985) [21]. For cucurbits, the melon fruit fly damage is the major limiting factor in obtaining good quality fruits and high yield (Srinivasan, 1959; Lall and Singh, 1969; Mote, 1975; Rabindranath and Pillai, 1986) [20, 12, 15, 17]. Barma and Jha (2013) opinioned that *B. cucurbitae*, Coq. is one of the most important pests of cucurbits [4]. The extent of losses varies between 30 to 100%, depending on the cucurbit species and the season (Sapkota *et al*., 2010, Nath and Bhusan 2006) [19, 16].

Maggots feed inside the fruits; generally, the females prefer to lay the eggs in soft tender fruit tissues by piercing them with the ovipositor. The eggs are laid into unopened flowers, and the larvae successfully develop in the taproots, stems, and leaf stalks (Weems and Heppner, 2001) [22]. The fruits attack in early stages fail to develop properly and drop or rot on the plant. The cucurbit fruit fly remains active throughout the year on one or the other host. During the severe winter months, they hide and huddle together under dried leaves of bushes and trees. During the hot and dry season, the flies take shelter under humid and shady places and feed on honeydew of aphids infesting the fruit trees (Dhillon *et al*., 2005) [6]. Suitable understanding of the environment for the control of pests at appropriate time and methods it is essential to knowledge about pests and environment, therefore, present study was undertaken for the incidence of the pest. The study would give an idea about their peak period of pests' activity which may be helpful in developing pest management strategy against them. Thus the knowledge of the influence of weather parameters on the incidence of insect pests on round gourd will help to develop a forecasting system to implement timely plant protection measures.

Materials and Methods

Seasonal incidence of *Bactrocera cucurbitae* was studied in crop sown in five plots each measuring 3 m x 1.5 m on round gourd in relation to abiotic factors. Each plot was separated by irrigation channel. Seeds of most susceptible variety Ujjawal of round gourd were sown on 15th February, 2016. All agronomical practices were followed as per recommended package and practices. The crop was raised without any insecticidal spray, so that the population of the pests could build up freely.

Methods of observation

The crop was kept under constant observation for fruit fly damage from the day initiation of fruit formation, damage of fruit fly was observed till the last picking of the fruits. The fruit fly damage was judged on the basis of per cent fruit infestation which was worked out on number and weight basis of five tagged plants per plot. The marketable size fruits were picked at an interval of three days. The fruits of round gourd were harvested and examined for fly puncture and healthy fruits. Infested and healthy fruits were counted separately and per cent of fruit damage were calculated and for weight basis weigh the infested and healthy fruits separately and per cent of fruit damage were also calculated.

Correlation with abiotic factors

The simple correlation was computed between the mean fruit fly infestation with key abiotic factors (prevailing whether parameters *viz*. minimum, maximum temperature, relative humidity and total rainfall). Calculations were made on the basis of three days mean fruit fly infestation recorded at three days interval was correlated with mean data of meteorological parameters of preceding three days. The following formula was used for calculating correlation coefficient (Gupta, 1996) [9].

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{N \sum x^2 - (\sum x)^2 . N \sum y^2 - (\sum y)^2}}$$

Where,

R = Simple correlation coefficient

x = Independent variable *i.e.* abiotic component

y = Number of observations

N = Dependent variable *i.e.* pest

Results and Discussion

The results presented in Table 1 revealed that the initial infestation of fruit fly with 8.52 per cent was observed in mid March *i.e.* 30-35 days after sowing of the crop which increased gradually and reached to its peak, 36.42 per cent in the first week of April and there after it started declining. However, the infestation was observed till last picking of the fruits of the season. During peak period infestation the maximum and minimum temperatures 36.40 °C and 20 °C, respectively and relative humidity 38.5 per cent. There was no rainfall observed during the study period. The correlation studies also presented in Table 1 revealed that the infestation of fruit fly on round gourd showed significantly positive correlation with maximum and minimum temperature (r = 0.607 and 0.612, respectively), while significant negative with relative humidity (r = -0.568). In the present investigation the infestation of fruit fly commenced in the third week of March and remained up to third week of April during Summer, 2016. The infestation increased gradually and reached to its peak in the first week of April with 36.42 per cent fruit damage. The correlation studies showed that abiotic factors played an important role in the population build up of fruit fly. The present findings are in conformity with that of Dhillon *et al*. (2005) who reported that the extent of losses caused by, *Bactrocera cucurbitae* (Coq.) varied from 30 to 100 per cent depending on the cucurbit species and season [5]. Similarly Ghule and Jha (2014) recorded the peak larval incidence of *B. cucurbitae* (15.1 maggots / fruit) in the first week of May on pointed gourd [7]. They found that the highest fruit damage of 68.89 per cent was observed in the third week of May on pointed gourd. However, the highest infestation 36.42 per cent was recorded in the first week of April during the present investigation. This differentiation may probably be due to the difference in local environment conditions of the period, date of sowing and duration of the crop. The similar findings were also reported by the other workers, Mandal *et al.* (2006) [14] and Raghuvanshi *et al.* (2012) [18] reported that most activity of the fruit fly was observed in March- April on gourds and melons in different parts of India and other countries. Kate *et al*. (2009) also reported that the fruit fly infestation reached to its peak in second week of April on cucumber [11]. The infestation of fruit fly on round gourd fruits commenced when the maximum temperature touched to 30.25 °C, minimum temperature to 12.80 °C and relative humidity reached to 55 per cent during 2016. The maximum and minimum temperature showed significant positive correlation (r = 0.6072 and r = 0.6119, respectively) with fruit fly infestation. The present investigations corroborate with Barma and Jha (2011) [3], Raghuvanshi *et al.* (2012) [18] and Ghule *et al*. (2014) [7] who reported the significant positive correlation of fruit fly infestation with maximum and minimum temperature on pointed gourd, bitter gourd and cucumber, respectively. In this study the relative humidity showed negative significant correlation (r = -0.5678) with fruit fly infestation. Similarly, Barma and Jha (2011) reported the relative humidity per cent of morning hours had significantly negative correlation and that of evening slightly positive [3]. Kate *et al.* (2009) also reported that significant positive correlation was observed

with morning relative humidity and negative correlation with evening relative humidity [11]. There was not occurred rainfall during the course of investigation hence, could not be discussed.

Table 1: Seasonal incidence of fruit fly, *Bactrocera cucurbitae* (Coquillett) in relation to abiotic factors on round gourd during Summer, 2016

S. No.	Date of observation	Temperature (^{0}C)		Relative humidity (%)	Fruit fly infestation (%)*
		Maximum	Minimum		
1.	16.03.2016	30.25	12.80	55	8.52
2.	19.03.2016	33.70	19.20	55	10.98
3.	22.03.2016	33.20	11.80	50	14.32
4.	25.03.2016	38.50	10.20	48	18.45
5.	28.03.2016	33.60	13.40	44	23.82
6.	31.03.2016	38.10	16.00	48	28.86
7.	03.04.2016	39.35	22.60	43	34.18
8.	06.04.2016	36.40	20.00	38.5	36.42
9.	09.04.2016	36.90	16.60	44.5	32.46
10.	12.04.2016	34.80	16.40	44.5	25.63
11.	15.04.2016	40.00	17.20	27.5	22.44
Maximum temperature (r)					0.607**
Minimum temperature (r)					0.612**
Relative humidity (r)					-0.568**

**significant at 5% level of probability *Average of three replications Mean of preceding three days from date of observations

Conclusion

In the present study it can be concluded that the maximum incidence of fruit fly, *B. cucurbitae* on round gourd was observed in the first week of April. The maximum and minimum temperature showed significant and positive correlation with fruit fly infestation whereas; relative humidity showed significant and negative correlation with fruit fly infestation.

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