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Seasonal incidence of fruit fly on Summer squash (*Cucurbita pepo* L.) and effect of weather parameters on population dynamics of fruit fly *Bactrocera cucurbitae* (Coquillett)

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Abstract
In the present experiment, Green victory Methyl Eugenol (ME) fruit fly traps were used to determine the seasonal incidence of fruit fly for 2017-2018 and further effect of weather parameters on population dynamics of fruit fly *Bactrocera cucurbitae* (Coquillett) was obtained. The studies revealed that, for seasonal incidence the fruit fly was found damaging and remained active on summer squash attaining peak value in the 26th Standard week (317 fruitflies/trap). The correlation studies showed that the fruit fly population was highly significant and positively correlated with mean relative morning humidity, relative evening humidity and rainfall but highly negatively correlated with maximum temperature.

Keywords: Summer squash, *Bactrocera cucurbitae*, methyl eugenol

1. Introduction
Vegetable cultivation in last few decades has been immensely playing a great role in fulfilling the needs of food and nutritional security for urban masses. Now a days, cultivation of exotic vegetables got momentum and became popularized in the market due to taste, food supplements and nutritional value beside they are a good source of income generation, increased employment opportunities and livelihood to the farming community. The unique agro-ecological condition of Jammu region encourages the cultivation of diverse categories of vegetables. Among the vegetables, mostly cucurbitaceous are preferred and grown at large number. Thus, one such crop among the cucurbits is summer squash (*Cucurbita pepo* L.) whose cultivation is now gaining the momentum and popularization among farmer community as short duration cash crop. It ranks high in economic importance and is a good source of fiber, vitamin C, beta-carotene and potassium. In India, squash and gourd crops are grown in about 4.77 m ha area with production of about 4.42 million tones with average productivity of 9.27 tonnes/ha which is very low in comparison to its potential [1]. In Jammu region of J&K state, the total area under cucurbits is 2486 ha with production of about 51707.11 MT [2].
Like other vegetables the major limiting factors in causing considerable damage to the crops at different stages from nursery raising to the harvest are insect pests. Among, Cucurbit fruit fly, *Bactrocera cucurbitae* (Coquillett), is one of the most serious and destructive pests of cucurbits and squash [3]. This serious pest scauses destructive damage to cucurbits including summer squash which leads to considerable reduction in the yield, quality and marketable value. As per a report, near about 50 per cent of cucurbits are partially or completely damaged by the pest every year in India [4]. The extent of losses inflicted by these Dipteran flies is varying from 30 to 100 per cent depending upon cucurbit species and environmental conditions [5, 6, 7]. Their attack not only reduces the yield but also affect fruit quality and rendering them unfit for the consumption and unprofitable farming. The infestation often reaches cent per cent leading to complete loss of the crop [8]. Based on studies, it was found that the dry periods and adequate rainfall have a direct impact on the increase and reduction of the fruit fly population. The population expand with adequate rainfall and contracts during dry periods [9]. Among the weather parameters, Temperature (Maximum and Minimum), Minimum humidity and Rainfall have positive impact on fruit fly abundance while Maximum humidity and sunshine hours have negative impact on its abundance [10].

Therefore, weather factors play important role in fruit fly abundance. Thus, seasonal incidence of the pest also vary according to weather factors and according to crop stage [11].
Hence, the present experiment was carried out with the objective to find out the seasonal incidence of fruit fly on summer squash crop under Jammu climate and to study the effect of weather parameters on population dynamics of fruit fly for better knowledge on seasonal population fluctuations of the pest which would serve as yardstick in future in pest monitoring and pest surveillance programmes.

2. Materials and Methods

In the present experiment, Green victory Methyl Eugenol (ME) fruit fly traps were used to determine the seasonal incidence of fruit fly for 2017-2018 and further effect of weather parameters on population dynamics of fruit fly *Bactrocera cucurbitae* (Coquillett) was studied. The experiment was conducted at experimental farm Division of Entomology, SKUAST-Jammu. The summer squash variety "DON 17" was sown in polybags in month of March 2017 and transplanted in main field in the month of April 2017.All cultural practices were adopted according to the package of practices of SKUAST-Jammu recommended for summer squash.

2.1 Recording of observations

The traps count of fruit fly was recorded at weekly interval by emptying the traps and constituents were refilled. For this purpose the traps were brought to the laboratory and replenished again with fresh solution before setting them in the field at their place. The number of flies retrieved from each trap determined the population build up of the pest during the week and it helped in determining the seasonal incidence of the fruit fly and further the influence of weather parameters on population dynamics of fruit fly was studied through correlation studies using SPSS software Package.

3. Results and Discussion

The result on seasonal incidence of fruit fly was recorded on summer squash. Data was recorded at weekly intervals starting from 18th standard week (one week before flowering) to 29th standard week during 2017. The data of seasonal incidence of fruit fly captured in the trap was correlated with the weather parameters *i.e.* Mean maximum and minimum temperature, relative humidity at morning and evening and rainfall) during 2017. Results of correlation and regression on seasonal incidence of fruit fly were presented here under the following sub heads.

3.1 Seasonal incidence of fruit fly population on summer squash

During 2017, the seasonal population fluctuation ranged from 20 to 317 (Table 1). The first observation was taken nearly 7 days after transplanting *i.e.* from 18th standard week with an initial population of 25 fruit flies per trap.
The population was observed to be decreasing during the 19th standard week, and after that the population was observed to be increasing gradually till 23rd standard week with the value of 121 fruit flies per trap. During 23rd standard week the value of maximum temperature (39 ^{0}C), minimum temperature (23.9 ^{0}C), morning relative humidity (65%), evening relative humidity (29%) and rainfall (18.6mm) was recorded. In 24th standard week, the population of fruit fly decreased (55 fruit fly/trap). However, the population of fruit fly was again increasing and the maximum (317 fruit fly/trap) in the 26th standard week. (Table 1, Fig 1). The peak population of fruit fly in June was in accordance with results of Agarwal and Kumar, Sarada *et al.* and Mandal *et al.* [12, 11, 13].

3.2 Correlation studies

The correlation studies indicated that weather parameters played an important role in population build up of fruit fly, and its trap catches on summer squash. The highest number of trap catches was treated as the seasonal population fluctuation and were correlated with the weather data obtained from Meteorology Division SKUAST-Jammu, Chatha for the year 2017.
The effect of key weather parameters on the incidence of fruit fly was studied using correlation matrix. The relationship between maximum and minimum temperature, morning and evening relative humidity, rainfall and fruit fly captured per trap were worked out during 2017, it was observed that fruit fly populations was found significantly positive correlation between fruit fly captured per trap with mean minimum temperature, mean relative humidity (morning and evening) and rainfall (Table 2). It was found to be statistically significant with correlation value of 0.707, 0.828, 0.835 and 0.947, respectively. Whereas, maximum temperature was negatively correlated (0.764). (Table 2).
The value of linear regression equations for fruit fly population were calculated to be $Y= -62.564–6.065X1^{ns} +3.984X2^{ns}+5.836X3^{ns} -2.980X4^{ns} +1.609X5^{*}$.These equations showed the increasing trend of fruit fly population due to increase in rainfall, preferably to some extent. The corresponding multiple determination (R^2) values worked out to 0.973for fruit fly population, and was found statistically significant at 1% level of significance. The overall impact of weather factors on population build up was 97.3 per cent on fruit fly per traps during 2017 (Table 3). The present findings are in conformity with Nishida [9] who reported that dry periods and adequate rainfall have a direct bearing on the increase and reduction of the fruit fly population. The population was found to expand with adequate rainfall and contracts during dry periods. Wong *et al.* [14] have also reported that among different weather factors rainfall was found positively correlated with trap catches of adult fruit fly.

Table 1: Seasonal incidence of fruit fly on summer squash during 2017

SW	Month and year	Adult fruit fly population/trap	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)	Relative Humidity morning (%)	Relative Humidity Evening (%)	Rainfall (mm)
18	30-04-17	25	36.1	16.4	56	24	0
19	07-05-17	20	39.9	20.6	56	30	0
20	14-05-17	34	37.8	20.9	55	27	1
21	21-05-17	55	37.8	21.7	60	33	2.8
22	28-05-17	65	37.6	22	58	32	7.6
23	04-06-17	121	39.9	23.9	65	29	18.6
24	11-06-17	55	37.2	22.9	59	31	2.6

25	18-06-17	242	33.6	23.2	80	61	68
26	25-06-17	317	34	25.8	77	62	147.2
27	02-07-17	86	36.3	24.8	78	57	13
28	09-07-17	170	34.5	25.5	83	67	33.2
29	16-07-17	248	33.9	24.9	82	66	71.4

Table 2: Correlation between seasonal population incidence of fruit fly, *Bactrocera cucurbitae* (Coquillett) and abiotic factors

Insect pest	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)
	Maximun	Minimum	Morning	Evening	
Adult population fruit fly	-0.764**	0.707*	0.828**	0.835**	0.947**

** Significant at the 0.01 level
* Significant at the 0.05 level

Table 3: Regression equations and co-efficient of multiple determination (R^2) of adult fruit fly in relation to abiotic factors

Regression linear equations of adult fruit fly	Multiple correlation (R)	Co-efficient of determination (R^2)	F-value (P-value)
$Y= - 62.564 - 6.065X_1^{ns}+3.984X_2^{ns} +5.836X_3^{ns}-2.980X_4^{ns}+1.609X_5^{*}$	0.986	0.973	43.34** (<0.01)

Where,
Y= Adult fruit fly / trap
X_1=Maximum temperature
X_2=Minimum temperature
X_3= R.H morning
X_4= R.H Evening
X_5= Rainfall (mm)

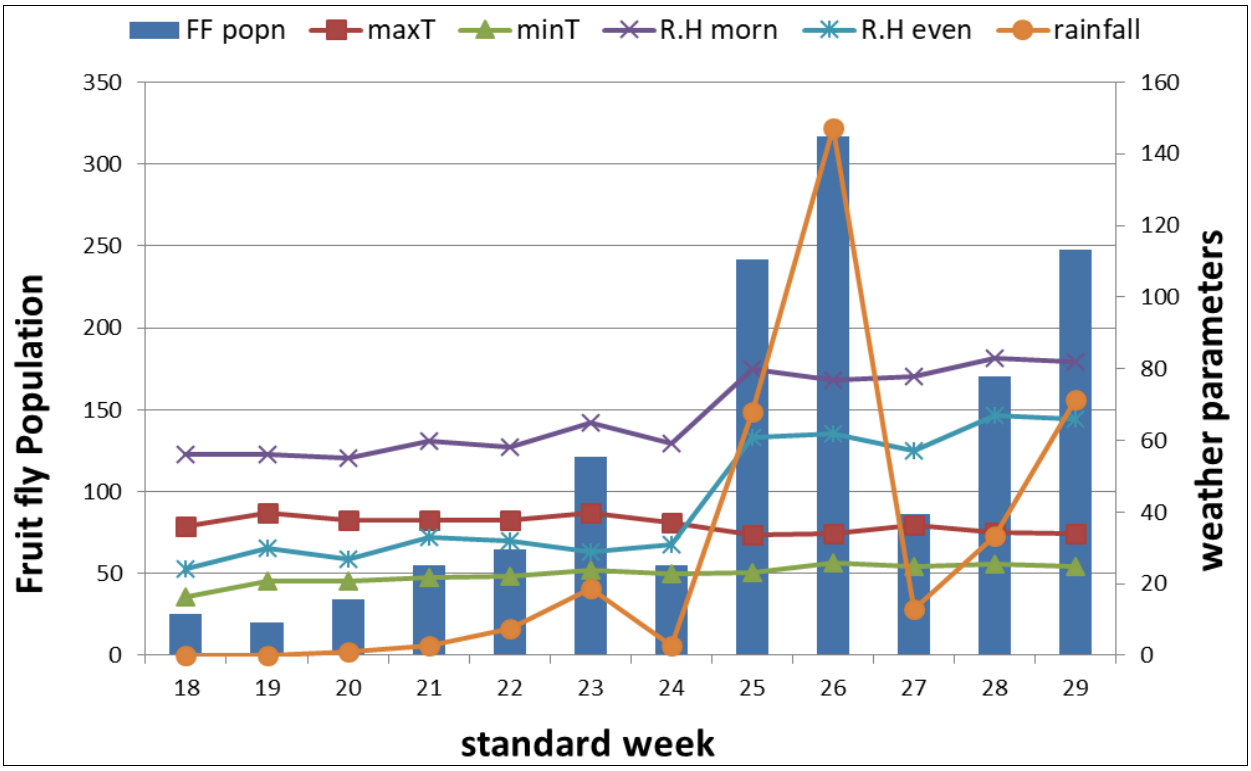

Fig 1: Seasonal incidence of fruit fly in summer squash during 2017-18.

4. Conclusion

It is evident from the experiment during 2017-18 season that among weather parameters a positive correlation was established with Minimum Temperature, Relative humidity (Morning and evening) and Rainfall while as negative correlation was established with Maximum Temperature. Peak population was recorded during 26th standard week, coinciding around ending June (317 fruit fly/trap). Hence, the overall impact of weather factors on population build was 97.3 per cent which reflects that there were some other factors such as solar radiation, Sunshine, Rainy days and Wind velocity that were responsible to govern the rest 2.7 per cent role in population build-up of fruit fly on summer squash.

5. References

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