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Impact of weather aspects on the prevalence and correlation of okra shoot and fruit borer (*Earias vittella* Fab.) during summer season

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Abstract
Field experiment was carried out with an aspect to scrutinize the seasonal incidence of okra shoot and fruit borer at odds with prevailing weather criterions at Horticultural field, BTC College of Agriculture, Raipur during summer 2018. The outcomes revealed that the prevalence of the pest was noticed on shoot during 10th standard meteorological week (3.45%) and reached to its peak infestation (5.00%) during the second week of March. Initial fruit infestation (6.89%) was descry during the third week of March and thereafter the infestation level gradually increased and reached to highest infestation (43.41%) during second week of April. Fruit infestation caused by okra shoot and fruit borer was significantly positively correlated with maximum temperature (r =0.66), minimum temperature (r =0.63), average temperature (r=0.66) and sun shine hours per day (0.57) and non –significantly positive correlated with rainfall (r=0.37) and evening relative humidity (r=0.22) and non- significantly negatively correlated with morning relative humidity (r =-0.33).

Keywords: Okra shoot and fruit borer, correlation, seasonal incidence, weather parameters

1. Introduction
Vegetables are an imperative part of our nutriment, bestowing important nutrients integral for an equitable diet. It is worthy enough predominantly in developing countries like India, where malnutrition is a crucial problem among children and adults. Okra (*Abelmoschus esculentus* (Moench) belonging to family Malvaceae, is an economically important vegetable crop cultivated in different parts of the world. This crop has its prevalence not only as a kitchen garden crop but also on large high- tech commercial farms.

It is quite favored in India because of well-known practices of its cultivation, reliable yield and pliancy to fluctuating moisture conditions. Cultivation of okra is substantially for its fibrous fruits or pods containing round, white seeds. The immature fruits are harvested and eaten as a vegetable. In various manners okra can be cooked. Okra roots and stems are deployed for scouring the sugarcane juice from which jaggery is produced [1].

In some countries okra ripe seeds are roasted, grind and used as a substitute for coffee. The aliment of developing countries has a dearth of vitamins, calcium, potassium and mineral which can be accomplished by having okra. It is well competent to provide nourishment [2]. Okra fruits also possess some medicinal value.

Apart from the various significance, okra is prone to stress due to onslaught from a variety of restraints in the cultivation of okra. Numerous pests prevailing on cotton are also found on bhendi [3]. To a maximum of 72 species have been reported in bhendi, of which the pests *viz* okra shoot and fruit borer, *Earias* spp. *;* aphids, *Aphis gossypii* (Glover)*;* white fly *Bemisia tabaci* (Gennadius) and leaf hopper, *Amrasca biguttula biguttula* (Ishida) causes noteworthy detriment to the crop. Among these okra shoot and fruit borer, *Earias* spp. is the most destructive and the major limiting factor in quantitative as well as qualitative harvest of okra fruits. It is a widely distributed insect pest the ambushment of okra shoot and fruit borer has led to 69%loss in marketable produce [4].

Sundry weather factors *viz.*, temperature, relative humidity and rainfall are responsible for the frequency and unfurl of the pest. Enlightment on the reciprocity of weather variables and insect burgeon can furnish indispensable role in pest inspection, prophesying, monitoring and combating the pest population by timely decision making. Hence, this endeavour could be fruitful in designing pest management strategy.

2. Materials and Methods

The experiment was carried out at Horticultural research field of BTC, CARS Bilaspur. The okra seeds (Var. Super Green) were sown in the plot arena of 10 m × 9.9 m with planting distance of 30 cm × 10 cm during second week of February with all the improved recommended package and practices for raising the crop. To record the observations ten plants were randomly preferred and tagged. The observations of the pest population was recorded at weekly intervals from the germination of the crop till its harvest. The withered or drooped shoot depicted the initiation of shoot infestation. The extent of shoot infestation was reckoned from the percentage ratio of infested shoots to the total number of shoots per plant while percent fruit infestation was deduced by garnering all the marketable fruits from the tagged plants and subsequent categorizing and tallying of damaged and healthy fruits. By enumerating and weighing healthy and mangled fruits at each picking separately prevalence of okra shoot and fruit borer in terms of percentage of damaged fruits on number and weight was perceived.

For the effortlessness of scrutinizing and findings, meteorological data were also amalgamated at weekly interval and simple correlations were worked out for perceiving an idea about the pest occurrence. The graphical super-imposition technique was employed to depict the seasonal incidence of the pest.

3. Results and Discussions

The present findings of population dynamics of *Earias vittella* are presented in table 1.The initial infestation of the pest was noticed on shoot during 10thstandard meteorological week (3.45%) and reached to its peak infestation (5.00%) during the second week of March. Initial fruit infestation (6.89%) was seen during the third week of March and thereafter the infestation level gradually increased and reached to highest infestation (43.41%) during second week of April. The present findings were analogous with previous researches i.e. *Earias vittella* infestation was highest during second week of April [5]. The weather conditions prevailed during this period were maximum temperature (39.5 ^{0}C), minimum temperature (22.6 ^{0}C), average temperature (31.05 ^{0}C), morning relative humidity (70.4%), evening relative humidity (35.1%), rainfall (0.3mm) and sun shine(9.9hrs per day). Thereafter there was a sudden decrease in the fruit infestation with minimum (15.38%) during second week of May. Okra shoot and fruit borer remained active from reproductive phase and persisted up to the crop maturity phase.

Correlation between weather parameters and incidence of *E. vittella* in okra are presented in table 2. Fruit infestation was significantly positively correlated with maximum temperature (r =0.66), minimum temperature (r =0.63), average temperature (r=0.66) and sun shine hours per day (0.57) and non –significantly positive correlated with rainfall (r =0.37) and evening relative humidity (r= 0.22) and non- significantly negatively correlated with morning relative humidity(r =-0.33). The present findings were in accordance with some other researches. Incidence of okra shoot and fruit borer had a significant positive association with maximum, minimum and average temperature [6][7] and non-significant negative association with relative humidity. The results were also analogous to okra shoot and borer infestation having a positive association with maximum temperature, minimum temperature and sunshine hours per day [5][8][9]. Present findings were also in collaboration with previous experiments which reported significant positive correlation of fruit infestation with maximum and minimum temperature and non-significant positive association with relative humidity and rainfall [5][10]. The regression equation between okra shoot and fruit borer and weather factors are depicted in Fig 1, 2, 3 and 4. The regression equation with maximum temperature [y= 3.329x-107.56, R^2=0.4338] depicts that at every 1 ^{0}C increase the infestation level increases to 3.329 units, for minimum temperature [y=2.3914x-32.329, R^2=0.3924] depicts that at every 1 ^{0}C decrease the infestation level decreases to 2.3914units, for average temperature [y= 2.9506x-68.703, R^2= 0.4344] depicts that at every 1 ^{0}C increase the insect infestation level increases to 2.9506 units and for sunshine hours per day [y=6.7523x-36.567, R^2=0.3304] at every 1hr increase the infestation level increases to 6.7523units respectively.

Table 1: Seasonal incidence of okra shoot and fruit borer during summer 2018

SMW	Temperature (^{0}C)			Relative Humidity (%)			Rainfall (mm)	Sunshine (hrs)	Okra shoot and fruit borer
	Maximum	Minimum	Average	Morning	Evening	Average			
9	34.8	16.1	25.45	79.4	34.6	57	0	9.1	0
10	34.1	17.5	25.8	65.7	32.6	49.15	0	7.3	3.45 (S)
11	34.5	17.6	26.05	75.6	39.7	57.65	0.2	6.1	5 (S)
12	36.1	18	27.05	64.9	30.7	47.8	0	7.6	6.89 (F)
13	38.3	18.7	28.5	63.7	25.4	44.55	0	7.9	15.15 (F)
14	37.4	21.3	29.35	70.9	43	56.95	0.4	7	16.67 (F)
15	36.1	21.6	28.85	75.6	48.7	62.15	4.4	7.4	29.41 (F)
16	39.5	22.6	31.05	70.4	35.1	52.75	0.3	9.9	43.14 (F)
17	40.4	22.5	31.45	57.7	34.1	45.9	0.6	9.3	36 (F)
18	39.3	24.3	31.8	70.4	43	56.7	4.3	9.2	24.32 (F)
19	42.4	26.9	34.65	63.7	35.3	49.5	0	8.8	21.43 (F)
20	40	25.8	32.9	71.7	43.4	57.55	1	7.5	15.38 (F)

Where s = shoot infestation (%) and f= fruit infestation (%)

Table 2: Simple correlation coefficient (r) between different okra shoot and fruit borer and meteorological parameters

Meteorological Parameters	Okra shoot and fruit borer
Max. Temp (ºC)	0.66*
Min. Temp (ºC)	0.63*
Morning RH (%)	-0.30
Evening RH (%)	0.22
Sunshine (hr/d)	0.57*
Rainfall (mm)	0.37
Avg. Temp. (ºC)	0.66*
Avg. RH (%)	-0.04

*Significant at 5% level of significance; **Significant at 1% level of significance

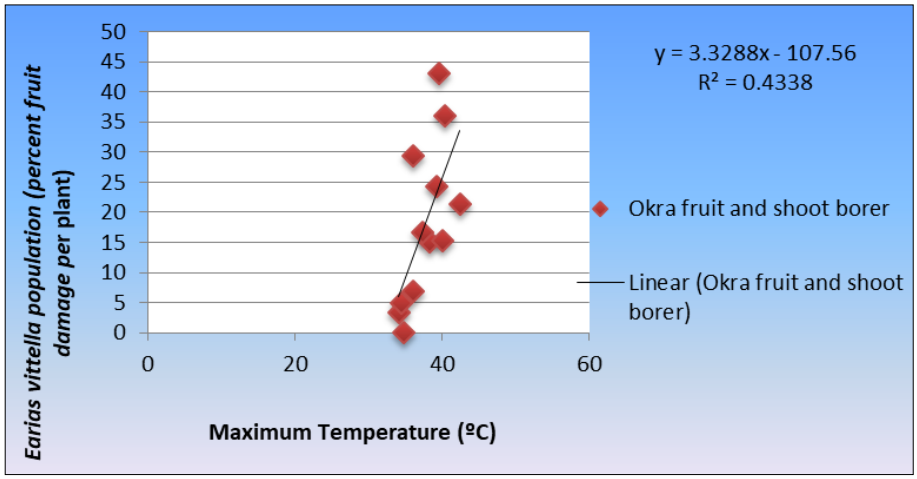

Fig 1: Regression of okra shoot and fruit borer infestation on maximum temperature (^{0}C)

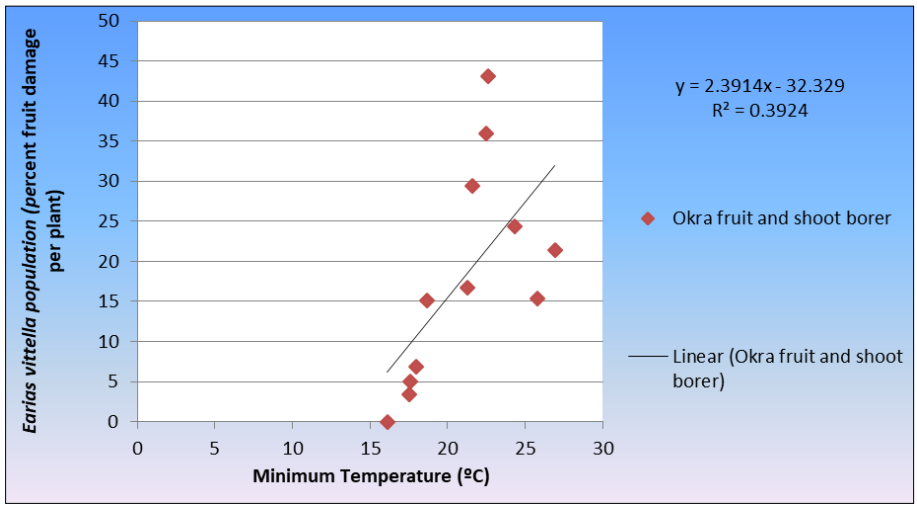

Fig 2: Regression of okra shoot and fruit borer on minimum temperature (ºC)

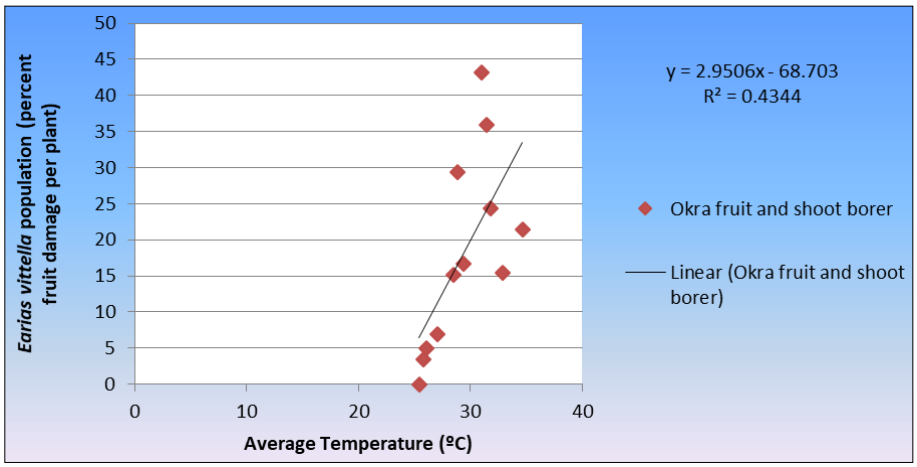

Fig 3: Regression of okra shoot and fruit borer infestation on average temperature (ºC)

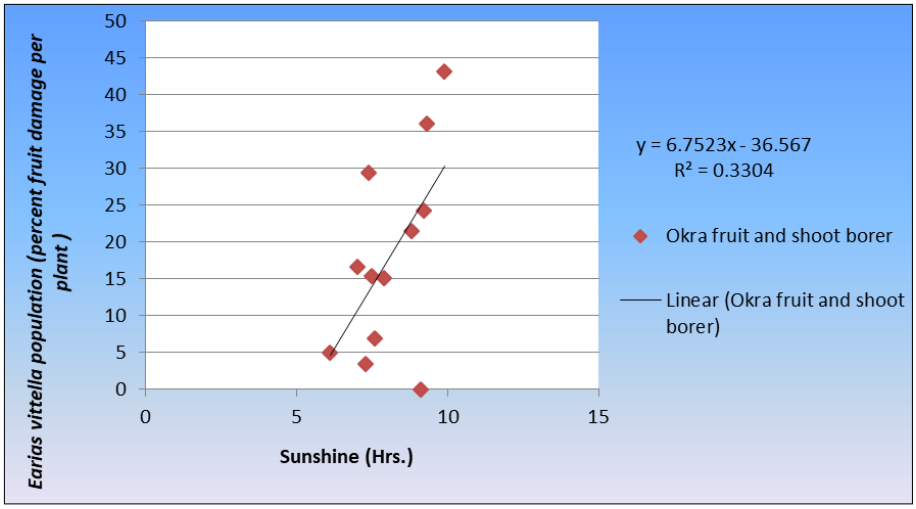

Fig 4: Regression of okra shoot and fruit borer infestation on sunshine (hours/day)

4. Conclusion

Earias vittella reached its highest shoot infestation (5.00%) during the second week of March whereas fruit infestation reached its peak (43.41%) during second week of April. The borer remained active from reproductive phase and endured up to crop maturity phase. The pest has a significantly positively association with maximum temperature (r =0.66), minimum temperature (r =0.63), average temperature (r=0.66) and sun shine hours per day (0.57) and non –significantly positive association with rainfall (r =0.37) and evening relative humidity (r= 0.22) and non- significantly negatively association with morning relative humidity(r =-0.33).

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