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Effect of weather parameters on population dynamics of pollen beetle, *Oxycetonia versicolor* fab infesting okra

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Abstract
Present investigation on population dynamics against Pollen beetle, *Oxycetonia versicolor* F. infesting okra. Dominant invertebrate animal, insect, have capacity to change their behavior and habitat with the changing of the environment and so, it is necessary to see the impact of changing pattern in abiotic factors on Pollen beetle infesting Okra with provide information regarding this utility. The results showed that the population (18.33%) was started from 2nd week of August (33th SMW) and showed its peak (55.15%) during 1st week of September (36th SMW). In subsequent weeks, the population was decreased and reached to 8.77% during week of September (39th SMW). Association between *O. versicolor* infestation and weather factors indicated that there was negative significant impact due to maximum temperature (-0.726*) on incidence of pollen beetle. Morning relative humidity (RH_1 0.791*) and rainfall (0.704*) were positively significantly correlated with the population of Pollen beetle.

Keywords: Population dynamics, *Oxycetonia versicolor* fabricius, okra

Introduction
Among the different vegetables, Okra [*Abelmoschus esculentus* (L.) Moench] is one of the important vegetable crops. It is a kind of food grown in tropical and sub-tropical parts of the world which has its own importance in terms of its taste, flavor and nutritional values. Okra is known by many local names *viz*., lady's finger in UK, Gumbo in the United States of America, Guino-gombo in Spanish, Guibeiro in Portuguese and Bhindi in India. It is quite popular in India because of easy cultivation, dependable yield and adaptability to diversified climatic conditions. In India, the okra crop has been grown in 5.09 lakh ha area having production of 6095 MT with productivity of 11.60 MT. The okra growing states are Andhra Pradesh, Gujarat, Maharashtra, Uttar Pradesh, Tamilnadu, Karnataka, Haryana and Punjab (Anon., 2018[a]) [1]. Among the different states, Gujarat comes at second rank having 0.75 lakh ha of land under okra crop. The production of okra is 9.30 lakh tonne having productivity of 12.25 MT. In Gujarat, Surat, Tapi, Navsari, Banaskantha, Vadodara, Chhota Udepur, Gandhi agar, Mahesana, Anand, Bharuch and Junagadh are major okra growing district. In Junagadh district, okra grown in 810 ha with production of 14.26 MT and productivity of 17.60 MT per hectare (Anon., 2018[b]) [2]. In the view of global warming, abiotic factors are fluctuating and so the impact on biotic factors is also fluctuating. The minor pests are becoming major and potential pests are causing economic damage to the crop and it was happen during last few years *i.e*., pollen beetle, which was a minor pest of solanaceous crop, becoming major. According to (Kalawate, 2018) [4] pollen beetle distributed in different countries of the world *i.e*., Afghanistan, Bangladesh, Bhutan, India (Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttarakhand, West Bengal), Mauritus, Madagascar, Sri Lanka. Pollen beetle (flower chafer beetle) was documented as a pest on cotton from central India for the first time. The survey was undertaken to understand the infestation levels on cotton. Results revealed that low-to-moderate level infestation was observed in the surveyed districts. Damage of 12.92 per cent was noticed in Rajkot, Gujarat, while, negligible damage (0.40%) it recorded in Wardha, Maharashtra, India (Naik *et al.* 2019) [5]. It is also found in Saurashtra region of Gujarat since two years and obtained a pest status in recent years. However, no concrete attempts have been made to carry out a detailed study of the pest in this region.

Materials and Methods

Experimental Layout

In order to determine the population dynamics of okra pollen beetle, an experiment was carried out at Instructional farm, College of Agriculture, Junagadh Agricultural University, Junagadh on okra variety GJO-3 during *kharif*, 2018. The crop was grown in a plot size of 15 m x 12 m at the spacing of 60 cm x 30 cm. All other agronomical practices were followed as per the scientific recommendations in vogue. The crop under the experiment was kept free from any insecticidal sprays throughout the crop season.

Observations

For recording the observations, the plot was divided in ten equal quadrates each of size 6 m x 3 m from which 10 plants were randomly selected and tagged. Observations were recorded at weekly interval starting from the flowering till the harvesting of crop. Observations on incidence of pollen beetles were recorded from starting from germination of the crop till to harvesting of the crop. The incidence of pollen beetle was started appearing after the flowering. If the beetle found present inside the flower with absent pollen / half fed stamen were considered as infested flower. Thus, the obtained data were converted in per cent infestation by using following formula.

$$\text{Infestation (\%)} = \frac{\text{Number of infested flowers}}{\text{Total number of flowers observed}} \text{ x } 100$$

Data analysis

With a view to study the impact of different abiotic factors [*i.e.*, Maximum Temperature (Max T ^{0}C), Minimum Temperature (Min T ^{0}C), Morning Relative Humidity (RH_1 %), Evening Relative Humidity (RH_2 %), Rainfall (mm R), Wind Speed (WS kmhr^{-1}) and Bright Sunshine Hours, (BSS hrday^{-1})] on pest incidence, a simple correlation between pest population and weather parameters was worked out. The weekly meteorological data were obtained from the Meteorological Observatory of Junagadh Agricultural University, Junagadh.

Results and discussion

In the present investigation, it was observed that the incidence of pollen beetle was not commenced after the germination of the okra crop but once there was an emergence of flowering, *O. versicolor* was appeared and started to damage the flowers. Due to feeding on pollens from the stamen of the flower, the flower growth was retarded and it was affected on setting of the fruits /pods.

The data (Table 1) indicated that the incidence of pollen beetle, *O. versicolor* was commenced from second week of August *i.e.,* 33rd Standard Meteorological Week (SMW) and 34 Days After Sowing (DAS) and continued till last week of September (39th SMW) *i.e.,* 76 DAS which ranged from 8.77 per cent to 55.15 per cent infestation by *O. versicolor*. The infestation of *O. versicolor* was fluctuated during the flowering season of the crop period. The infestation (18.33%) was started from 2nd week of August (33th SMW) and showed its peak (55.15%) during 1st week of September (36th SMW). In subsequent weeks, the population was decreased and reached to 8.77 % during 4th week of September (39th SMW). In September, there was a decline in population of pollen beetle and no incidence was recorded thereafter. The similar trend was observed by Kumar *et al*. (2009) [3] in which emergence of scarabaeids adults *viz., H. seerata, S. ruficollis* and *A. versutus* (Coleoptera: Scarabaeidae) was began after the first rain and it was continued up to the last week of September. As the reports on this pest are very limited, the data were compared with the other families of the same order. Overall, the results of the present investigation follow more or less similar trend with earlier reports of insects belongs to different families of the same order and it increases the need of farmers to combat this pest at flowering stage of the crop.

Table 1: Infestation of pollen beetle, *O. versicolor* in okra during 2018

Sr. no.	Month	SMW	Per cent infestation by *O. versicolor*
1.	August	32	0.00
2.		33	18.33
3.		34	39.78
4.		35	48.34
5.	September	36	**55.15**
6.		37	35.23
7.		38	17.39
8.		39	8.77
9.	October	40	0.00
Note: SMW- Standard Metrological Week			

The data (Table 2) on association between pollen beetle, *Oxycetonia versicolor* infestation and weather factors indicted that there was negative significant impact due to maximum temperature (-0.726*) on incidence of pollen beetle. There was a significant positive correlation between pollen beetle and morning relative humidity (0.791*). Rainfall (0.704*) and infestation of *O. versicolor* has significantly positive correlation, too. There was no any significant linear correlation either negative or positive between incidences of pollen beetle population for rest of the abiotic factors. However, bright sunshine hours (-0.425), wind speed (-0.015) and minimum temperature (-0.135) were negatively and as well as evening relative humidity (0.575) was positively correlated with the incidence of pollen beetle population. According to Skellern *et al.* (2017) [6], the population of pollen beetles had significant negative linear relationship with wind speed (m/s). Whereas, rainfall had positive linear relationship but it was found non-significant. Overall, the results of the present investigation are more or less tally with the recent or earlier researchers. Some variation in the results are due to different regions, sowing periods, crop stages, environmental condition *etc*. but it is cleared that the pollen beetle population is highly fluctuated by temperature, humidity and rainfall effect.

Table 2: Correlation of *O. versicolor* infestation with abiotic factors infesting okra during *kharif*, 2018

Abiotic factors	Per cent infestation of *O. versicolor*
Maximum Temperature, ^{0}C (Max T)	-0.726*
Minimum Temperature, ^{0}C (Min T)	-0.135
Morning Relative Humidity, % (RH_1)	0.791*
Evening Relative Humidity, % (RH_2)	0.575
Rainfall, mm (R)	0.704*
Wind Speed, kmhr^{-1} (WS)	-0.015
Bright Sunshine Hours, hrday^{-1} (BSS)	-0.425
* Significant at 5% level (r = 0.666)	

Conclusion

The incidence of pollen beetle, *O. versicolor* was commenced from second week of August *i.e.,* 33rd Standard

Meteorological Week and 34 Day after sowing and continued till last week of September. The population of *O. versicolor* was fluctuated during the crop period. Association between pollen beetle infestation and weather factors indicated that there was negative significant impact due to maximum temperature on incidence of pollen beetle. Morning relative humidity and rainfall were positively significantly correlated with the population of pollen beetle.

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