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Effect of abiotic factors on population of aphid and damage by shoot & fruit borer in okra during summer and *kharif season* at Anand in Gujarat

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ABSTRACT

A field experiment was conducted at Anand Agricultural University, Anand, Gujarat to study the impact of weather variables on population dynamics of aphid, *Aphis gossypii* and shoot & fruit borer, *Earias vittella* in summer and *kharif* okra for two consecutive years (2005-06 and 2006-07). Peak activity of aphid population was found during 12^{th} & 14^{th} and 13^{th} & 15^{th} Meteorological Standard Week (MSW) whereas, the peak infestation to fruits due to *E. vittella* observed in the 13^{th} & 15^{th} and 29^{th} & 32^{nd} MSW during summer and kharif season, respectively. Bright sunshine hours, temperature (maximum and minimum), vapour pressure (morning and evening) and wind speed had significant positive effect on population of aphid during summer season, while Bright sunshine hours, maximum temperature and temperature range showed significant negative impact with aphid population during *kharif* season. Maximum and minimum temperature had significantly negative effect, while morning and evening relative humidity significant positive effect on fruit damage due to *E. vittella* during *kharif* season. However, per cent fruit damage showed significant positive impact with BSS, temperature (maximum and minimum) and vapour pressure deficit (morning and evening) during summer season.

Key words **:** Weather, Aphid, Shoot & fruit borer, Correlation

Okra is cultivated in summer as well as *kharif* season. In India, the crop is widely cultivated in Bihar, Orissa, West Bengal, Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat and Assam.

In Gujarat, it is mainly grown in Vadodara, Surat, Junagadh, Banaskantha, Bhavnagar, Valsad, Gandhinagar, Kheda and Anand districts. Pest species have been recorded in Gujarat (Patel *et al.*, 1970) among which shoot and fruit borer, aphid, jassid and whitefly are the destructive pests. Among sucking pest, aphid *Aphis gossypii* is a serious pest of okra throughout India which suck cell sap from the leaves of plant (Srinivasan and Krishnakumar, 1983). The loss in fruit yield due to *E. vittella* in okra is estimated to be 45% in Karnataka (Krishanakumar and Srinivasan, 1983), 22.5 % in Uttar Pradesh (Verma *et al.*, 1985) and 50.58% (Brar *et al.*, 1995). During present study, an attempt has been made to workout relation of *A. gossypii* and *E. vittella* with prevailing weather, so that this information can be utilized in formulating pest management programme.

MATERIALS AND METHODS

The study on population dynamics of aphid and shoot & fruit borer was carried out for two consecutive years (2005-06 and 2006-07) on organically and inorganically cultivated okra (variety Gujarat Okra-2). The okra crop was raised organically and inorganically, each in area of 20 x 10 m with a spacing of 45 x 30 cm and 60 x 30 cm for summer and *kharif* season, respectively at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. In order to maintain the organic conditions, F.Y.M @ 12 tonnes/ha was applied in the plot, whereas in other plot N: P: K @ 100: 50 :50 kg/ha (basal application N: P: K @ 50: 50 :50 kg/ha & split application at flowering stage N: P: K @ 50: 0 : 0 kg/ha) was applied to create the inorganic condition. The experiment plots (organic and inorganic) were divided into 10 equal quadrates and 25 plants were randomly selected in each quadrate to record observations on aphid population on three leaves (top, middle and bottom) per plant at weekly interval starting from germination to harvest of the crop. The per cent fruit damage was worked out on the basis of number of healthy and damaged fruits at every picking. The data on aphid population and per cent fruit damage were correlated with different weather factors recorded following meteorological standard weeks (MSW).

Table 1 : Population of aphid, A. gossypii and per cent fruit damage due to E. vittella on okra grown under organic and inorganic conditions

Standard Week		WAS	Pooled mean population of aphid per leaf				Pooled fruit damage (%)			
			Summer		*Kharif*		Summer		*Kharif*	
Summer	*Kharif*		Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic
8	23	2	0.16	0.29	2.80	3.05	0.00	0.00	Organic	0.00
9	24	3	0.36	0.52	2.23	2.50	0.00	0.00	0.00	0.00
10	25	4	0.33	0.51	3.69	4.06	0.00	0.00	0.00	0.00
11	26	5	1.20	1.53	6.30	6.68	0.00	0.00	0.00	0.00
12	27	6	2.21	2.88	6.10	6.68	25.87	29.78	0.00	10.26
13	28	7	2.01	2.50	7.02	7.67	29.36	32.00	5.22	16.87
14	29	8	2.94	3.69	7.49	7.87	27.29	31.19	11.54	29.16
15	30	9	3.51	4.01	5.91	6.30	27.56	30.90	22.33	27.72
16	31	10	3.67	4.40	7.06	8.17	22.46	25.17	22.22	25.76
17	32	11	3.82	4.78	7.45	8.42	16.28	20.66	19.51	30.04
18	33	12	4.37	5.03	3.76	4.25	17.91	23.01	26.22	22.50
19	34	13	4.84	5.43	4.07	4.57	19.28	23.84	18.00	21.83
20	35	14	5.03	5.56	3.23	3.80	14.97	19.93	17.22	19.44
Seasonal mean		2.65	3.16	5.16	5.69	15.46	18.19	12.06	15.66	

WAS = Weeks After Sowing

Table 2: Correlation coefficient between weather parameters, aphid population and fruit damage (%) due to *E. vittella* in okra

Sr. No.	Weather parameters	Mean aphid population				Mean fruit damage (%)			
		Summer		*Kharif*		Summer		*Kharif*	
		Organic	Inorganic	Organic	Inorganic	Organic	Inorganic	Organic	Inorganic
1	Bright Sunshine hour (BSS)	0.689**	0.682**	-0.784**	-0.815**	0.366	0.438**	-0.735**	-0.776**
2	Maximum Temp. (Max T)	0.903**	0.913**	-0.641*	-0.680*	0.789**	0.826**	-0.803**	-0.835**
3	Minimum Temp. (Min T)	0.987**	0.984**	-0.270	-0.323	0.566*	0.636*	-0.741**	-0.749**
4	Morning Relative Humidity (RH_1)	0.168	0.136	0.625*	0.653*	-0.276	-0.423	0.725**	0.747**
5	Evening Relative Humidity (RH_2)	0.551	0.508	0.663*	0.703**	-0.189	-0.115	0.747**	0.772**
6	Morning Vapour Pressure (VP_1)	0.936**	0.921**	0.626*	0.572	0.351	0.430	-0.023	-0.022
7	Evening Vapour Pressure (VP_2)	0.869**	0.844**	0.695**	0.722**	0.252	0.332	0.558*	0.596*
8	Morning Vapour Pressure Deficit (VPD_1)	0.375	0.379	-0.516	-0.540	0.671*	0.650*	-0.947**	-0.934**
9	Evening Vapour Pressure Deficit (VPD_2)	0.665*	0.666*	-0.442	-0.483	0.707**	0.711**	-0.933**	0.929**
10	Wind speed (WS)	0.856**	0.831**	0.044	0.052	0.300	0.374	-0.251	-0.243
11	Rainfall (RF)	—	—	0.576*	0.613*	—	—	-0.376	-0.393
12	Temperature Range (TR)	-0.782**	- 0.763**	-0.746**	-0.777**	-0.133	-0.213	-0.770**	-0.808**

* Significant at 5% level

** Significant at 1% level

RESULTS AND DISCUSSION

Aphid, *A. gossypii*

The incidence of *A. gossypii* on okra crop commenced at 8th and 23rd MSW (2nd WAS) and continued almost throughout the crop period in summer and *kharif* okra, respectively (Table 1). The pest population fluctuated during early part of crop growth, increased gradually from 11th MSW (5th WAS) and attained its peak at the end of crop *i.e.* 19th and 20th MSW (13th & 14th WAS) in summer crop. During *kharif* season, this pest attained its peak activity in 29th and 32nd MSW (8th and 11th WAS). The aphid population was relatively low in organically grown crop as compared to inorganically grown crop. However, the trend of its occurrence was more or less same in organic and inorganic crops. These finding is in agreement with the report of Narangalkar (2003).

Significant positive association between aphid population and sunshine hours was noticed (r = 0.689** and 0.682** for organic and inorganic crop, respectively) during summer season, while the significant negative association (r = -0.784** and -0.815** for organic and inorganic crop, respectively) found during the *kharif* season. The more or less same trend was observed for maximum and minimum temperature in organic and inorganic crop during both the seasons. Relative humidity did not show any notable influence on aphid incidence in summer, while *kharif*, it showed significant positive correlation. Significant positive relationship was found between the summer aphid population and vapour pressure (morning and evening) in both the crops (organic and inorganic). Vapour pressure deficit influenced positively on occurrence of aphids. Wind speed showed significant positive relationship with aphid population during both the season. Significant negative correlation was established between aphid population and temperature range in pooled analysis in both the season.

The regression equation was computed based on the goodness of fit by taking aphid population (Y) as dependent variable and weather parameters as independent variables. The regression equation fitted was: Y= -5.777 + 0.512** Min T- 5.34* E-02 RH_2 (R^2 = 0.982) for inorganic crop and Y= -6.257 + 0.409** Min T + 0.127* VPD_1 (R^2 = 0.993) for organic crop during summer season, while Y= -29.329-1.020**BSS + 1.526** Min T (R^2 = 0.862) for inorganic crop and Y= -74.886-0.666**BSS +2.345** Min T (R^2 = 0.921) during *kharif* season where, Y = Aphid populaiton, Min T = Minimum Temperature, RH_2 = Evening Relative Humidity and VPD_1 = Morning Vapour Pressure Deficit

The regression study revealed that minimum temperature played the important role on aphid population when the crop grown under inorganic and organic condition in summer season, while Bright sunshine hours and minimum temperature played the important role on aphid population during *kharif* season. The coefficient of determination (R^2) for inorganic and organic crop was to the tune of 0.98 & 0.99 and 0.86 & 0.92 suggesting that as much as 98 & 99 and 86 & 92 % variation in aphid population can be predicted under the inorganic and organic crop as well as summer and *kharif* season, respectively. These observation is in close agreement with the report of Araujo and Sales (1985). The study also showed significant negative correlation between aphid population on okra and temperature range. Almost similar findings were supported by Jondhale (2007).

Shoot and fruit borer, *E. vittella*

The data summarized in Table 1 revealed that incidence of this pest increased in organic as well as inorganic crop at 5th WAS (11th & 26th MSW) during both the seasons. First and second peak was during 7th & 8th (13th & 29th MSW) and 13th & 11th (19th & 32nd MSW) WAS, respectively during summer and *kharif* season. Thus, incidence of fruit borer was found to be low in okra grown organically than inorganically. Sharma *et al*. (2010) have also reported peak level of infestation during 29th MSW in okra at Udaipur, India.

The bright sunshine hours had significant negative impact with fruit infestation in organic as well as inorganic crops during *kharif* season, while it was found to be positive with bright sunshine hours. The maximum and minimum temperatures were negatively correlated with infestation by *E. vittella*, while morning and evening relative humidity had significant positive correlation with the incidence of shoot and fruit borer during *kharif* season. However, significant negative impact was found with above mentioned weather parameters during summer season. However in none of the cases, vapour pressure during morning hours had significant impact. Vapour pressure deficit (morning and evening) showed significant negative and positive impact with the fruit borer incidence during *kharif* and summer season, respectively. Temperature range showed negative impact in both the seasons. The present results are in the report of agreement with Sharma *et al*. (2010).

The regression equation fitted by considering the data on per cent fruit damage (Y) as dependent variable and weather parameters as independent variables was, Y = 76.356 – 3.928** VPD_1 – 1.331* Max T (R^2 = 0.924) for inorganic grown crop and Y = 30.875 – 4.364** VPD_1 (R^2 = 0.897) for organic grown crop during *kharif* season. The regression equation was, Y = -77.901 + 4.240**Max T – 0.824** RH_1 (R^2 = 0.862) for inorganic crop and Y= -55.009 + 3.528** Max T – 0.815** RH_1 (R^2 = 0.840) during summer season.

The regression study revealed that maximum temperature found to be effective weather parameters during both the seasons of study. The coefficient of determination (R^2) for inorganic and organic crop, was computed to the tune of 0.92 & 0.89 and 0.89 & 0.86 suggesting that 92 & 89 and 86 & 84 per cent variation in shoot and fruit borer incidence can be predicted under the inorganic and organic crops and *kharif* and summer season, respectively.

CONCLUSION

Population of aphid, *A. gossypii* recorded in two different types of okra crops (organic and inorganic) indicated that incidence of the pest commenced from fifteen days after sowing and continued more or less throughout the crop period in both the crops and seasons. Incidence of fruit borer, *E. vittella* to okra after one month of sowing and remained at higher level during 7th (29th & 13th MSW) to 13th and 9th (32th & 15th MSW) WAS in *kharif* and summer season, respectively (inorganically and organically grown crop). Bright sunshine hours, maximum and minimum temperature, evening vapour deficit and wind speed showed significant positive relationship with aphid population during summer season. However, Bright sunshine hours, maximum temperature and temperature range was found to be significant negative impact with aphid population during *kharif* season. Bright sunshine hours and temperature (maximum and minimum) had significant negative effect, while humidity (morning and evening) and evening vapour pressure had significant positive effect on damage by *E. vittella*. However, per cent fruit damage showed significant positive impact with BSS, temperature (maximum and minimum) and vapour pressure deficit (morning and evening) during summer season.

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