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Incidence of major pests of okra in relation to weather factors and cropping systems

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ABSTRACT: Incidence of major pests (shoot and fruit borer, *Earias vittella*; leafhopper, *Amrasca biguttula biguttula*; whitefly, *Bemisia tabaci* and red spider mite, *Tetranychus urticae*) of okra (cv. AO-1) was studied in two cropping systems (organic and conventional) in relation to weather parameters at Navsari Agricultural University, Navsari Gujarat, India during 2017-18. The investigation indicated peak shoot and fruit borer population (3.88 and 3.27 larvae/plant) and its associated fruit damage (39.56 and 35.60 %) during 20th week after germination (WAG) (11 SMW) indicating significant positive association with temperature (minimum and average), relative humidity (evening and average), bright sunshine in both the farming systems whereas, positive association with wind velocity in conventional farming system was also reported. Peak leafhopper population (11.66 and 12.70/ leaf) was noticed at 6 WAG (15 SMW) exhibiting significant positive correlation with maximum temperature. Adult whitefly population remained highest (3.07 and 3.61/ leaf) during 11 WAG (20 SMW) exhibiting significantly positive correlation with average temperature and bright sunshine in both the farming systems. Red spider mite population peaked (23.69 and 27.52 /2 cm^2 leaf area) during 13 WAG (22 SMW) and 11 WAG (20 SMW) at organic and conventional farms, respectively which in turn indicated significant positive association with minimum and average temperature, evening and average relative humidity and wind velocity.

Keywords: Okra, incidence, organic, conventional, cropping system and weather parameters

INTRODUCTION

Okra (*Abelmoschus esculentus* (L) Moench) belonging to the family Malvaceae, is a popular and commercially cultivated vegetable crop of tropical and sub-tropical parts of the world. However, one of the major constraints in okra production is heavy infestation of several pests which not only cause quantitative loss but are also responsible for qualitative loss to the crop. As many as seventy two insect species have been recorded on okra (Srinivas and Rajendran, 2003). Infestation by sucking insect-pests not only affects the crop but also hamper the crop health by transmitting pathogenic diseases (Sheedi, 1980). Kanwar and Ameta (2007) recorded 48.97 per cent reduction in pod yield due to attack by the insect-pests. Information on diversity of insects and mites in a particular farming system is a pre-requisite, which helps in designing a successful pest management strategy. However, not many systematic studies have been conducted to observe their diversity, seasonal abundance in relation to weather factors in both conventional and organic farming systems of okra. Therefore, the present study was conducted to assess the pest incidence in relation to weather factors comparing organica and conventional cropping systems.

MATERIALS AND METHODS

The experimental investigation based on insect and mite biodiversity in organic and conventional farming systems of okra (cv. AO-1) in relation to weather parameters was carried out under field conditions at certified organic farming unit, ASPEE College of Horticulture and Forestry as well at conventional farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat from 2016 to 2018. The experimental plots in each farming system measured 20m x 20m (400m^2) wherein five spots (1m x 1m) were randomly selected in "W" shape or manner for taking observations of pests. Five plants were randomly selected in each spot thus total 25 plants of okra (AO-1) were tagged for recording pest observations in each plot.

The shoot and fruit borer (*Erias vitella*) larvae were counted on 25 tagged plants at standard week wise interval in both the farming systems from germination to flowering stage of the crop. During fruiting stage, fruit borer oriented fruit damage was recorded at each picking by counting number of healthy and damaged fruits thus, per cent fruit damage was calculated. Observations on leafhopper, *Amrasca biguttula biguttula* and whitefly

Table 1. Abundance of major pests in organic and conventional farming systems of okra during 2016-18

SW	WAG	Shoot & fruit borer (*Earlias vitella*) Larva/plant		Shoot & fruit borer Fruit damage/ plant (%)		Leaf hopper/ leaf		Whitefly adults/ leaf		Mite/leaf	
		ORG	CNV	ORG	CNV	ORG	CNV	ORG	CNV	ORG	CNV
10	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	2	0.00	0.00	0.00	0.00	2.37	2.85	0.00	0.00	0.00	0.00
12	3	0.88	0.70	0.00	0.00	4.30	5.66	0.00	0.00	0.00	0.00
13	4	1.32	0.91	0.00	0.00	11.39	12.43	0.00	0.00	0.00	0.00
14	5	1.64	1.31	0.00	0.00	6.82	7.26	0.64	0.87	0.00	0.00
15	6	2.00	1.52	0.00	0.00	11.66	12.70	0.83	0.98	0.00	0.00
16	7	2.34	1.70	9.30	5.98	9.79	11.81	1.66	2.09	0.00	0.00
17	8	2.42	1.99	13.02	8.94	4.96	5.64	2.57	2.87	0.00	0.00
18	9	2.61	2.28	25.82	21.60	6.24	7.38	1.42	2.04	6.53	8.24
19	10	2.74	2.39	31.62	28.44	6.22	7.05	2.33	3.01	16.40	15.28
20	11	3.88	3.27	39.56	36.50	4.69	5.63	3.07	3.61	20.95	27.52
21	12	2.04	1.82	29.84	28.82	3.46	4.62	1.26	1.70	22.81	25.21
22	13	1.32	1.22	24.50	22.02	2.54	3.30	0.72	0.88	23.69	26.78
23	14	0.98	0.80	14.92	11.19	2.13	2.84	0.00	0.00	17.02	21.28
Mean		**1.73**	**1.42**	**13.47**	**11.68**	**5.47**	**6.37**	**1.03**	**1.29**	**7.67**	**8.88**

SW- Standard Meteorological Week, WAG- Weeks after germination , ORG- Organic farming system
CNV- Conventional farming system

Bemesia tabaci population were counted from three (top, middle and bottom) leaves of each selected plant whereas, red spider mite, *Tetranychus urticae* population was recorded on the same leaves in 2 cm^2 leaf area.

Weather data (temperature, relative humidity, wind velocity and bright sunshine hours) from 10^{th} to 23^{rd} standard weeks (SW) (one SW prior to the pest observation to the last appearance of the pest) were recorded in meteorological observatory of Navsari Agricultural University during both the years. The data thus obtained were subjected to statistical analysis individually for each pest and farming system using simple correlation. Lastly, step wise regression analysis based on significant variables was carried out to know the critical factor responsible for fluctuation of the pest during the investigation.

RESULTS AND DISCUSSION

Abundance of major pests infesting okra in relation to meteorological factors was studied in the present investigation and data recorded during 2016-2018 are presented and discussed under the following heads.

Shoot and fruit borer larval population

Larval population of shoot and fruit borer in okra grown under organic and conventional farming systems was observed during 3 WAG (12^{th} SMW) and 23 WAG (14^{th} SMW) wherein the pest population attained peak (3.88 and 3.27 larvae/plant) at 20 WAG (11^{th} SW) while, it was lowest (0.88 and 0.70 / plant) at 3 WAG (12^{th} SMW) in both the farming systems, respectively. Okra crop grown under organic farming system indicated relatively higher population of shoot and fruit borer larva (1.73 larvae/ plant) than the conventional farming system (1.42) (Table 1).

Table 2. Correlation of major pests of okra with weather parameters at organic farm

Weather Parameter		*E. vitella* larval population (Y_1)		*E. vitella* Fruit damage (%) (Y_2)		Leaf hopper/leaf (Y_3)		Whitefly/leaf (Y_4)		Mite/leaf (Y_5)	
		Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.
Maximum temp.	(X_1)	0.212	-	-0.185	-	0.807**	1.173	0.377*	-	-0.154	-
Minimum temp.	(X_2)	0.575**	-	0.816**	3.016	-0.126	-	0.344	-	0.822**	2.202
Average temp.	(X_3)	0.648**	0.336	0.711**	-	0.225	-	0.465*	0.195	0.731**	-
Morning RH	(X_4)	0.049	-	0.054	-	-0.052	-	0.009	-	0.011	-
Evening RH	(X_5)	0.448*	-	0.738**	-	-0.301	-	0.231	-	0.733**	-
Average RH	(X_6)	0.390*	-	0.631**	-	-0.270	-	0.188	-	0.609**	-
Wind velocity	(X_7)	0.338	-	0.684**	-	-0.352	-	0.087	-	0.757**	-
Bright Sunshine	(X_8)	0.511**	0.546	0.302	4.330	0.242	-	0.596**	0.778	-0.019	-
A value			-13.04		-95.45		-54.64		-11.76		-42.87
R^2 value			0.630		0.740		0.648		0.605		0.676
Variation Explained (%)			63.00		74.00		64.8		60.50		67.6
R value			0.794		0.860		0.805		0.778		0.822

*Significant at 5%, **Significant at 1%, Regression coefficients are mentioned on the basis of significant variables in stepwise analysis

Larval population indicated significant positive association with minimum ('r' = 0.575 and 0.617) and average ('r' = 0.648 and 0.649) temperature, evening ('r' = 0.448 and 0.512) and average ('r' = 0.390 and 0.434) relative humidity, wind velocity ('r' = 0.417 in conventional farming system) and bright sunshine ('r' = 0.511 and 0.511). This implies that with the increase in values of these variables, there was corresponding increase in larval population of *E. vitella* in both the farming systems and vice-versa (Table 2 and 3).

Pankaj Kumar *et al.* (2017) observed initiation of shoot and fruit borer from second week after sowing the okra crop. The pest varied till the harvest of okra which is also reported in the present findings. Siddhartha *et al.* (2017) also recorded average larval population of shoot and fruit borer to the tune of 1.34 ± 0.18 larvae per plant.

Shoot and fruit borer fruit damage (%)

The fruit damage (%) due to shoot and fruit borer in okra grown under organic and conventional farming systems indicated its peak (39.56 & 36.50 %) at 11 WAG (20th SMW), whereas it remained lowest (9.30 and 5.98 %) at 7 WAG (16th SMW). The okra crop grown under organic farming system recorded relatively higher infestation of shoot and fruit borer (13.47 % fruit damage) than under conventional farming system (11.68) (Table 1).

Fruit damage (%) exhibited significant positive correlation with minimum ('r' = 0.816 and 0.799), average ('r' = 0.711 and 0.697) temperature, evening ('r' = 0.738 and 0.707) and average ('r' = 0.631 and 0.602) relative humidity and wind velocity ('r' = 0.684 and 0.687). This implies that with the increase of unit value of temperature (minimum and average), relative humidity (evening and average) and wind velocity, there was corresponding increase in fruit damage of okra under both the farming systems and vice- versa (Table 2 & 3).

The present finding is in close conformity with Ahmad *et al*. (2010) wherein infestation of fruit and shoot borer was observed in the first batch of harvested fruit and it continued throughout the season indicating its peak (58.62%) during 39th SMW in *kharif* while, pest remained absent for first six weeks of the crop growth. Significant positive correlation of minimum temperature ('r' = 0.765) with per cent fruit infestation was reported. The present findings are more or less similar to the results of Dave and Pandya (2017) who reported peak fruit damage of *E. vittella* (48.05 and 45.15 % /week) at 10th WAS (36 SW) and 13th WAS (38 SW) during 2015 and 2016, respectively. The workers also found significant and negative correlation with maximum ('r' =-0.605) and average temperature ('r'=-0.687) with fruit damage of *E. vittella* on okra whereas, significant positive correlation was found with evening ('r' = 0.516) and average relative humidity ('r' = 0.500) (Table 2 & 3).

Leafhopper

Seasonal abundance of leafhopper, *A. biguttula biguttula* in organic and conventional farming systems of okra indicated pest initiation at 2 WAG (11th SMW) and it continued throughout the crop period up to 14 WAG (23rd SMW). The leafhopper population increased gradually and attained peak (11.66 and 12.70/ leaf) at 6 WAG (15th SMW). The pest population was lower in organic plots (5.47/leaf) than the conventional plots (6.37) (Table 1).

The pest population exhibited significant positive correlation with maximum temperature ('r' = 0.807 and 0.796), while rest of the abiotic factors could not indicate any significant association with the pest population implying that with increase in maximum temperature, there was corresponding increase in the pest population (Table 2 & 3).

The current findings corroborates the results of Dabhi (2008) who observed peak activity of leafhopper *A. biguttula biguttula* during 16, 18, 24 and 33 SWs in summer and *kharif* seasons. Significant and positive effect of maximum temperature on leafhopper population was also reported. This trend was also observed in the present findings wherein peak population was observed at 15 SMW in *kharif* okra. Likewise, Jayasimha *et al.* (2012) reported highest incidence of *A. biguttula biguttula* (16.44 / plant) during March second fortnight and lowest (0.25 / plant) during December second fortnight and also observed significant positive correlation of leafhopper population with maximum temperature and significant negative correlation with rainfall. The present findings are also in agreement with the results of Pathan *et al.* (2018) indicating highly significant positive association of leafhopper with bright Sunshine (BSS) ('r' = 0.72) and maximum temperature ('r' = 0.70). In the present investigation, association of hopper population with maximum temperature was significantly positive, thus corroborates the present findings.

Whitefly

Appearance of adult whitefly population commenced in organic and conventional farming systems from 5 WAG (14th SMW) during summer 2016-17 and it continued

Table 3. Correlation of major pests of okra with weather parameters at conventional farm

Weather Parameter		*E. vitella* larval population (Y_1)		*E. vitella* Fruit damage (%) (Y_2)		Leaf hopper/leaf (Y_3)		Whitefly/leaf (Y_4)		Mite/leaf (Y_5)	
		Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.	Correlation Coeff. ('r')	Reg. Coeff.
Maximum temp.	(X_1)	0.118	-	-0.179	-	0.796**	2.202	0.361	-	-0.154	-
Minimum temp.	(X_2)	0.617**	-	0.799**	2.727	-0.078	-	0.302	-	0.834**	2.556
Average temp.	(X_3)	0.649**	0.292	0.697**	-	0.267	-	0.419*	0.162	0.742**	-
Morning RH	(X_4)	0.029	-	0.047	-	-0.051	-	0.003	-	0.010	-
Evening RH	(X_5)	0.512**	-	0.707**	-	-0.254	-	0.207	-	0.750**	-
Average RH	(X_6)	0.434*	-	0.602**	-	-0.231	-	0.166	-	0.622**	-
Wind velocity	(X_7)	0.417*	-	0.687**	-	-0.283	-	0.055	-	0.767**	-
Bright Sunshine	(X_8)	0.511**	0.476	0.272	3.557	0.262	-	0.576**	0.904	-0.062	-
A value			-11.41		-83.49		-42.87		-10.69		-50.01
R^2 value			0.633		0.697		0.676		0.661		0.695
Variation Explained (%)			63.30		69.70		67.6		66.10		69.50
R value			0.796		0.835		0.822		0.813		0.834

*Significant at 5%, **Significant at 1%, Regression coefficients are mentioned on the basis of significant variables in stepwise analysis up to 13 WAG (22nd SMW) reaching to its peak (3.07 and 3.61/ leaf) at 11 WAG (20th SMW) while, it was lowest (0.62 and 0.87/leaf) during 5 WAG (14nd SMW) in both the farming systems. The result also showed that okra crop grown in organic farming system had lower whiteflies (1.03/leaf) as compared to conventional plots (1.29) (Table 1).

Correlation between whitefly population and maximum temperature ('r= 0.377 in organic farm), average temperature ('r' = 0.465 and 0.419) and bright sunshine ('r' = 0.596 and 0.576) was significantly positive which implies that with increase in unit values of these variables, there was corresponding increase in pest population and vice-versa (Table 2 & 3).

Ahmad *et al.* (2010), Mohansundaram and Sharma (2011), Pal and Mandal (2013) and Pankaj Kumar *et al.* (2017) reported activity of whitefly in okra throughout the crop season. Physical factors prevailing during the crop season did not support the pest activity as correlation was found non-significant with most of the factors except bright sunshine.

In the present investigation, the whitefly population commenced from the early crop stage which is in confirmation to the findings of Pankaj Kumar *et al.* (2017) who observed initiation of whitefly incidence from second week after sowing which reached peak at ninth week after sowing.

Red spider mite

Red spider mite population was recorded from 9 WAG (18th SMW) to14 WAG (23th SMW) when the crop was in fruiting stage in both the farming systems and attained peak (23.69/2 cm^2 leaf area) during 13 WAG (22nd SMW) at organic farm and 27.52 per 2 cm^2 leaf area during 11 WAG (20th SMW) at conventional farm. The lowest mite population (6.53 and 8.24) was observed at 9 WAG (18th SMW) in both the farming systems. Lower mites were observed in organic plots (7.67) than in conventional plots (8.88) (Table 1).

Red spider mite population exhibited significant positive association with minimum temperature ('r' = 0.822 and 0.834), average temperature ('r' = 0.731 and 0.742), evening relative humidity ('r' = 0.733 and 0.750), average relative humidity ('r' = 0.609 and 0.622) and wind velocity ('r' = 0.757 and 0.767) implying that with increase in unit values of temperature (minimum, average), relative humidity (evening and average) and wind velocity, there was corresponding increase in pest population and vice-versa (Table 2 and 3).

In the present investigation, overall mite activity was observed at crop maturity. Mohansundaram and Sharma (2011) also reported higher incidence of mite at the end of the *kharif* season which is more or less is in conformity with the present findings. The present finding on late occurrence of pest is in conformity with the finding of Nath *et al*. (2011) who reported highest activity of mite during 39th SMW in 2006. It was highest during 42nd SMW during *kharif*, 2014 under present investigation. Further, maximum temperature showed non-significant negative association which is in agreement with the finding of Nath *et al*. (2011). The present results are in close conformity with Siddartha *et al.* (2017) who reported that two spotted spider mite, *T. urticae* dominated in the mid and late crop growth stages resulting in substantial loss in the yield. They further reported that maximum and average temperature had significant but negative on mites. In the present investigation, maximum temperature had negative impact on mite population, although it was non-significant, thus confirms the present investigation.

Overall, it can be summarized that leaf hopper, whitefly and red spider populations were lower in organic (5.47, 1.03 and 7.67/plant, respectively) than conventional farming system (6.37, 1.29 and 8.88/plant). However, there was not much difference in population of fruit borer and its damage in both the farming systems.

REFERENCES

Ahmad, S., Bhagat, R. M., Ishtiyaqahad, and Kumar, A. 2010. Pest complex & their succession on okra *Abelmoschus esculentus* L. Moench. *Haryana Journal of Horticultural Science*, **39** (1-2): 169-171.

Dabhi, M. V. 2008. Succession, population dynamics and management of major insect pests of okra [*Abelmoschus esculentus* (L.) Moench]. Ph.D thesis submitted to Gujarat Agricultural University (unpublished).

Dave, P. P. and Pandya, H. V. 2017. Fruit damage caused by okra shoot and fruit borer, *Earias vittella* (Fabricius) in relation to various abiotic factors in Gujarat. *Journal of Entomology and Zoology Studies*, **5** (6): 2152-2159.

Jayasimha, G. T., Rachana, R. R., Manjunatha, M. and Rajkumar, V. B. 2012. Biology and seasonal incidence of leafhopper, *Amrasca biguttula biguttula* (Ishida) (Hemitpera: Cicadellidae) on okra. *Pest Management in Horticultural Ecosystems*, **18** (2):149-153.

Kanwar, N. and Ameta, O. P. 2007. Assessment of loss caused by insect pests of okra, *Abelmoschus esculentus* (L.) Moench. *Pestology*, **31** (5): 45-47.

Mohansundaram, A. and Sharma, R. K. 2011. Abundance of pest complex of okra in relation to abiotic and biotic factors. *Annals of Plant Protection Sciences*, **19** (2): 286-290.

Nath, L., Prasad C. S., Tiwari, G. N. and Kumar, A. 2011. Impact of weather parameters on major insect pests of okra prevailing in western Uttar Pradesh. *Vegetos – An International Journal of Plant Research,* **24** (2): 152-156.

Pal, S., Maji, T. B. and Mondal, P. 2013. Incidence of insect pest on okra *Abelmoschus esculentus* (L) Moench. in red lateritic zone of West Bengal. *Journal of Plant Protection Sciences*, **5**(1): 59-64.

Pankaj Kumar, Singh, D. V. and Sachan, S. K. 2017. Succession of important insect pests of okra (*Abelmoschus esculantous*) under western Uttar Pradesh climate conditions. *International Journal of Engineering and Management Sciences*, **8** (1): 72-74

Pathan, N., Berani, N. K. and Bharpoda, T. M. 2018. Impact of abiotic factors on the incidence of major insect pests in okra, *Abelmoschus esculentus* (L.) Moench. *International Journal of Current Microbiology and Applied Sciences,* **7**(01): 1225-1236.

Sheedi, M. A. 1980. Arthropods associated with okra *Hibiscus esculentus L.* crop (Doctoral dissertation, M.Sc. Thesis, Sindh Agriculture University, Tandojam).

Siddartha, D., Kotikal, Y. K., Venkateshalu and Sanjiv D. 2017. Seasonal incidence of sucking pests on okra. *Global Journal of Bioscience and Biotechnology*, **6** (2): 245-250.

Srinivas, R. and Rajendran, R. 2003. Joint action potential of neem with other plant extracts against the leaf hopper *Amrasca devastans* (Distant) on okra. *Pest Management and Economic Zoology,* **10**: 31- 136.

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