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ROLE OF ABIOTIC FACTORS ON POPULATION BUILD UP OF ARTHROPOD FAUNA IN OKRA ECOSYSTEM UNDER GANGETIC ALLUVIAL PLAIN OF WEST BENGAL

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ABSTRACT
Investigations were carried out during spring-summer season of 2015 and 2016 (March-June) at Bidhan Chandra Krishi Viswavidyalaya located at Mohanpur, Nadia District, West Bengal to study the seasonal abundance and prevalence of tissue borers, foliage feeder and sucking pests of okra *vis.-a-vis*. the influence of weather parameters on their population build up. Jassids first appeared on 4^{th} WAS (9.11 ± 6.68) and their peak population was appeared when the crop was in active vegetative stage. Temperature (max.) has a profound influence on the population build up of whitefly like leafhopper. The minimum population of shoot and fruit borer was found in 4 WAS, attained peak during 9 WAS (18.15 ±6.21); afterwards a decline till 12 WAS (4.25 ±3.45). Similarly, highest population of *Helicoverpa armigera* was recorded on 9 WAS (5.25 ±3.32) whereas, leaf roller population was started to appear from the very beginning of observation. Coccinellids and spider population though presented in the field in varying number, recorded highest during 12^{th} WAS (0.93 ±0.21 and 0.78 ±0.30 respectively). Temperature (min.) and relative humidity have highly significant positive correlation whereas; sun shine hour has exhibited negative but significant correlation.

KEYWORDS: tissue borers, foliage feeder, sucking pests, okra.

INTRODUCTION
Okra (*Abelmoschus esculentus* (L.) Moench), frequently known as lady finger or bhendi belonging to family Malvaceae, is an important summer season vegetable crop with average production and productivity of 57.48 lakh tonnes and 11.75 tonnes per ha respectively in India (Jindal and Arora, 2010). It has occupied a prominent position among the export oriented vegetables because of its high nutritive value, palatability and good post-harvest life which accounts for 70 % of the export of fresh vegetables (Dhankar and Mishra, 2001). In West Bengal, okra is one of the most important spring-summer season vegetables which is vulnerable to attack by several sucking and chewing insect pests (Kumar *et al*., 2016), responsible to cause 48.97% reduction of pod yield (Kanwar and Ameta, 2007). Among the sap suckers, the cotton leafhopper, *Amrasca biguttula biguttula* (Ishida) is a serious pest (Dhandapani *et al*., 2003) causes cupping, yellowing and bronzing of leaves under severe attack while, whitefly, *Bemisia tabaci* (Gennadius) not only sucks the sap from leaves, but is also considered as the vector for Yellow Vein Mosaic Virus in okra. Lepidopteran pests like shoot and fruit borer *Earias vitella* (Fab.), gram pod borer *Helicoverpa armigera* (Hubn.) and leaf roller *Sylepta derogata* (Fab.) are also cause direct damage to this crop. The susceptibility of a crop to insect pests is greatly influenced by the prevailing climatic conditions, variety and season of cultivation. As okra is a warm and humid crop, it cannot tolerate very low and very high temperature with low humidity. Date of planting has tremendous effect on the growth, development and productivity of the crop as well as on the incidence of insect pests. The studies on monitoring of pest appearance, intensity of occurrence and influence of natural enemies on the pest population can be used for decision making in pest management. Pest behaviour and population dynamics in relation to weather parameter is an essential pre-requisite for formulation of an effective pest management programme (Yadav *et al*., 2007). Although, several studies have been carried out on various aspects of okra pests, but, very little information is available from Gangetic alluvial plain of West Bengal. Therefore, the present investigations were attempted to rule out the influence of abiotic parameters and their role in the oscillation of pest complex in okra.

MATERIALS & METHODS
The experiments were conducted during spring-summer season (March to June) of 2015 and 2016 at Students' Instructional Farm of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal (22° 95' N latitude, 88° 53' E longitude and 9.75 meter above mean sea level with average annual rainfall 1607.2 mm) with a popular cultivar "Shakti" in completely randomized block design. Crop was sown in 20 consecutive plots of $4 \times 3m^2$ with spacing 60 cm × 30 cm followed by recommended horticultural practices except any plant protection measures. Observations on incidence were made at weekly intervals throughout the crop growth on number of jassid (no./ 3 leaves), whitefly (no./ 3 leaves), shoot and fruit

borer (no. of bored shoot and fruit/ plant), gram pod borer (no. of larva/ plant), leaf roller (no. of larva/ plant) and predators (coccinelid predators *viz. Coccinella septempunctata*, *Coccinella transversalis*, *Cheilomenes sexmaculata*, *Micraspis discolor* and spiders *viz. Oxyopes sp*. and *Argiope sp*.) (no. of motile stages/ plant) from 3 randomly selected plants in each plot. From each plant, three different tires *viz*. top, middle and bottom leaves were considered for taking observation (Pal *et al*., 2013). Fresh infestations were considered to estimate the insect population. Shoot infestation was enumerated from the ratio of wilted shoots to the total number of shoots per plant while, percent fruit damage was calculated during each picking by sorting the infested fruit and fresh marketable fruits.

The meteorological data on different abiotic factors *viz*. temperature (maximum & minimum in °C), relative humidity (maximum & minimum in %), total rainfall (mm) wind speed (km/ hr) and bright sunshine hours (hr) during the period of investigation were collected from the Automated Weather Station, Department of Agro-meteorology and Physics, Bidhan Chandra Krishi Viswavidyalaya, located at Jaguli, Nadia, West Bengal.

Data subjected to analysis of variance by using SPSS (version 18.0: Inc., Chicago, IL, USA) software during different weeks after sowing at various growth stages of crop for statistical interpretation of the results.

RESULTS & DISCUSSION

The seasonal incidence of different sucking and chewing pests of okra and their predators were investigated during first fortnight of April till first fortnight of June. Data generated during 4 weeks after sowing (WAS), during the course of investigation has been depicted on Table 1.

TABLE 1: Seasonal incidence of chewing and sucking pests of okra and their predators during spring-summer season of 2015 and 2016

WAS	Mean population of sucking and chewing pests and natural enemies ± S.Em.						
	a	b	c	d	e	f	g
4 (2-8 April)	9.11±6.68	0.83±0.47	0.00±0.00	0.00±0.00	1.25±0.67	0.48±0.21	0.15±0.14
5 (9-15 April)	11.00±8.65	0.84±0.57	0.55±0.15	0.00±0.00	2.50±1.85	0.40±0.27	0.21±0.17
6 (16-22 April)	15.00±10.80	1.23±0.91	3.25±1.58	0.00±0.00	3.75±2.47	0.56±0.21	0.30±0.21
7 (23-29 April)	20.40±9.71	1.81±1.00	16.15±9.48	2.25±1.47	5.25±3.22	0.64±0.20	0.39±0.20
8 (30 April-6May)	27.01±11.37	2.50±1.31	12.25±7.38	3.50±2.43	5.00±3.48	0.80±0.18	0.47±0.14
9 (7-13 May)	28.53±11.32	2.48±0.87	18.15±6.21	5.25±3.32	4.00±2.59	0.80±0.24	0.59±0.24
10 (14-20 May)	33.54±13.36	2.83±1.65	14.25±5.29	2.25±2.15	2.75±3.41	0.82±0.31	0.67±0.31
11 (21-27 May)	27.27±15.46	2.93±1.65	10.13±8.25	1.75±0.86	2.25±1.75	0.82±0.42	0.69±0.40
12 (28 May-3 June)	30.36±15.03	3.85±1.70	4.25±3.45	0.00±0.00	2.15±2.17	0.93±0.21	0.78±0.30
CD (p=0.05)	0.15	0.03	0.24	0.19	0.05	0.18	0.33

WAS = Weeks after sowing; a = Leaf hopper; b = Whitefly; c = Fruit and shoot borer; d = Gram pod borer; e = Leaf roller; f = Coccinellids; g = Spiders

The population of leaf hopper was found to build up during 4 WAS (9.11 ± 6.68) with gradual increase till 12 WAS (28th May to 3rd June) (30.36 ±15.03). It is also clear from the abiotic parameter with respect to temperature that increase in leaf hopper population has direct influence on the rise in atmospheric temperature. Highest mean temperature (37.37 °C) recorded highest population of leaf hopper (30.36 ± 14.03). The work in the foregoing can be compared with the work of Gogoi and Dutta (2000), who recorded the maximum leaf hopper population during last week of May where, high temperature (30-36 °C) followed by RH (< 80%) and low rainfall coupled with bright sunshine favoured the development of leaf hopper population. So, these findings are in conformity with the findings of the present author. In case of whitefly, similar trend of gradual increment of population was recorded; lowest population (0.83 ±0.47) on 4 WAS and highest population (3.85 ± 1.70) during12 WAS. Here also temperature (max.) has a profound influence on the population buildup of whitefly like leaf hopper. Kumawat *et al*. (2000) observed that the whitefly infestation attained peak during the period of maximum temperature regime which varied significantly with the pest population. This statement is also in conformity with the finding of present authors. Hasan *et al*. (2008) recorded that peak population of whitefly was seen on 60 days old crop whereas, lowest at 30 days old crop. And the population density varied between 3.27 and 6.25 per leaf. This also lens further support with the finding of present authors.

TABLE 2: Correlation of chewing and sucking pests of okra and their predators with different abiotic parameters during spring-summer season of 2015 and 2016

Pests and natural enemies	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Sunshine hours (hr)	Wind speed (km/ hr)
	Max.	Min.	Max.	Min.			
a	0.267	0.765**	0.425*	0.893**	0.751**	-0.644**	-0.159
b	0.533**	0.566**	-0.223	0.392*	0.117	-0.083	0.179
c	0.326**	0.671**	-0.153	0.430*	0.108	-0.029	0.096
d	0.397*	0.612**	-0.016	0.572**	0.214	-0.346	0.085
e	0.465**	0.592**	-0.128	0.237	0.111	-0.170	0.025
f	0.343	0.792**	0.315	0.861**	0.662**	-0.581**	-0.057
g	0.357	0.701**	0.165	0.737**	0.371*	-0.514**	-0.008

a = Leaf hopper; b = Whitefly; c = Fruit and shoot borer; d = Gram pod borer; e = Leaf roller; f = Coccinellids; g = Spiders
** Correlation is significant at the 0.01%, * Correlation is significant at the 0.05%

Shoot and fruit borer incidence was recorded highest during 9 WAS (7th to 13th May) with population of 18.15 ±6.21. Here, the minimum population was found in 4 WAS with gradual increase till 7 WAS, attaining peak during 9 WAS, afterwards a decline till 12 WAS. Ahmed *et al*. (2000) found peak larval population of *Earias vitella* with temperature and RH combination of 29.9 ±2.9 °C and 84.0 ±5.1% and minimum population during 2nd fortnight of May. Hence this finding also lens further support to the present finding. In accordance to Naresh *et al.* (2003) the damage by fruit borer on okra occurred on 3 and 6 weeks old crop and two peaks of fruit borer, one each at vegetative stage and at reproductive stage further supports the present investigation. In case of *Helicoverpa armigera*, highest population was recorded at 9 WAS (5.25 ±3.32). Leaf roller population was also recorded highest (5.25 ±3.22) at 7 WAS. Interestingly, the leaf roller population was found from the very beginning of the experiment i.e. 4 WAS (1.25 ±0.67). Mean population leaf hopper, whitefly, shoot and fruit borer, gram pod borer and leaf roller along with natural enemies *i.e*. Coccinellids and spiders varied significantly among themselves. Coccinellid population though present in the field in varying number, recorded highest during 12 WAS (0.93 ±0.21) whereas, mean population (0.48 ±0.21) recorded during 4 WAS (2nd to 8th April). It is well known that spiders are almost prevalent in okra ecosystem. Highest number of spiders found at 12 WAS (28th March to 3rd June) (0.78 ± 0.30) with a minimum population (0.15 ±0.14) during 4 WAS.

Attempts were also made to study the interaction between sucking and chewing pests of okra and natural enemies in one hand along with abiotic factors on other through correlation studies followed by regression equation. It is evident from the Table 2 that temperature (min.) and relative humidity (RH) have highly significant positive correlation (0.765, 0.425 and 0.893 respectively) whereas, sunshine hours has exhibited negative but significant correlation (- 0.644) against leaf hopper population. Mandal *et al*. (2006) evaluated the effect of weather parameters on the incidence of leaf hopper and found that highest population was found with the increment of ambient temperature. He also found highly significant positive correlation with temperature maximum and minimum. This finding also gives further support to the finding of present author. Likewise, Iqbal *et al*. (2010) found that rainfall to be the most important factor contributing population fluctuation of leaf hopper on okra which is in parity of the present findings. In case of whitefly both temperature (max. and min.) and RH (min.) had a very good correlation (0.533, 0.566 and 0.392 respectively). Here, the regression equation for the best model has also been depicted in Table 3. In case of leaf roller, significant interaction was found in case of temperature maximum and minimum (0.465 and 0.592 respectively) and the computed R^2 value was 0.882. In case of Coccinellids and spiders, temperature (min.) and RH (min.) and total rainfall had significant and positive interaction (0.792, 0.861 and 0.662 respectively) whereas, sunshine hour had significant but negative (- 0.581) interaction. Here, the R^2 value in case of Coccinellids and spiders were calculated as 0.798 and 0.756 respectively. Sharma *et al*. (2010) recorded correlation between pests (borer) and weather parameter also negatively corrected with temperature and RH, but, non-significant and negatively correlated with rainfall. This is in contrary with the finding of the present author. Nath *et al*. (2011) studied that larvae of *Sylepta derogata* had non-significant and positive relationship with RH, rainfall and sunshine hour respectively and non-significant and negative correlation with temperature. This is also in contrary with the finding of present author. But, in West Bengal condition, Ghosh *et al*. (1999) found peak population of leaf roller during 2nd week of July under *Terai* region where okra sown is in delay with that of plains of South Bengal.

TABLE 3: Relation between major insect pests along with predatory fauna of okra and different abiotic parameters during spring-summer season of 2015 and 2016

Relationship	R^2	Adj. R^2	SE_{est}	Durbin-Watson
Leaf hopper population/ three leaves = – 5.72 Maximum temperature + 2.12 Minimum temperature** – 2.30 Maximum Relative Humidity* + 0.84 Minimum Relative Humidity** – 3.89 Rainfall** – 9.00 Sunshine hours** +17.19 Wind speed + 402.81	0.869	0.653	4.430	3.386
Whitefly population/ three leaves = – 1.64 Maximum temperature** + 0.587 Minimum temperature** – 0.491 Maximum Relative Humidity + 0.022 Minimum Relative Humidity* – 0.534 Rainfall – 1.203 Sunshine hours – 0.007 Wind speed + 100.40	0.793	0.543	0.247	3.386
Okra fruit and shoot borer population/ plant = 0.744 Maximum temperature** – 4.484 Minimum temperature** – 1.162 Maximum Relative Humidity + 0.88 Minimum Relative Humidity* – 2.476 Rainfall + 2.949 Sunshine hours – 0.051 Wind speed + 111.40	0.779	0.628	2.860	3.386
Gram pod borer population/ plant = 0.902 Maximum temperature* – 1.105 Minimum temperature** – 0.163 Maximum Relative Humidity + 0.475 Minimum Relative Humidity** – 0.623 Rainfall + 1.079 Sunshine hours + 0.902 Wind speed – 57.805	0.897	0.675	0.293	3.386
Leaf roller population/ plant = 4.152 Maximum temperature** – 1.607 Minimum temperature** + 0.514 Maximum Relative Humidity + 0.243 Minimum Relative Humidity + 0.811 Rainfall + 2.087 Sunshine hours + 7.060 Wind speed – 190.033	0.882	0.655	0.519	3.386
Coccinellids population/ plant = – 0.313 Maximum temperature + 0.080 Minimum temperature** – 0.095 Maximum Relative Humidity + 0.006 Minimum Relative Humidity** – 0.120 Rainfall** – 0.177 Sunshine hours** + 0.051 Wind speed + 19.660	0.798	0.680	0.025	3.386
Spiders population/ plant = – 0.263 Maximum temperature + 0.108 Minimum temperature** – 0.085 Maximum Relative Humidity + 0.007 Minimum Relative Humidity** – 0.103 Rainfall* – 0.283 Sunshine hours** + 0.127 Wind speed + 17.016	0.756	0.698	0.009	3.386

*Significant at $p_{0.05}$, **Significant at $p_{0.01}$

CONCLUSION
It can be concluded from the present experiment that abiotic factors like temperature, relative humidity and rainfall have a significant role in population dynamics of sucking and chewing pests of okra whereas, bright sunshine hours exhibited negative correlation with all the insect pests and their natural enemies also.

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REFERENCES
Ahmad, S., Gupta, S.C., Prakash, N. and Mandal, S.K. (2000) Weather factors and larval population of *Earias vittella* Fabr. in summer sown okra (*Abelmoschus esculentus* L.). J. Res. Birsa Agric. Univ., 12: 215-217.

Dhandapani, N., Shelkar, U.R. and Murugan, M. (2003) Bio-intensive pest management (BIPM) in major vegetable crops: an Indian perspective. Food Agric. Environ., 2: 333-339.

Dhankhar, B. S. and Mishra, J. P. (2001) Okra. In: “Textbook of Vegetables, Tuber Crops and Spices”. (Eds. S. Thamburaj and Narendra Singh), ICAR, New Delhi, pp. 222-237.

Ghosh, J., Ghosh, S.K., Chatterjee, H. and Senapati, S.K. (1999) Pest constraints of okra under Terai region of West Bengal. Ind. J. Entomol., 61: 362-371.

Gogoi, I. and Dutta, B.C. (2000) Seasonal abundance of cotton jassid, *Amrasca biguttula biguttula* (Ishida) on okra. J. Agric. Sci. Soc. North East India, 13: 22-26.

Hasan, W., Ansari, M.S. and Ali, H. (2008) Distribution pattern of white fly, *Bemisia tabaci* under natural condition on okra cultivars. Entomon., 33: 113-117.

Iqbal, J., Ashfaq, M., Hasan, M.U., Sagheer, M. and Nadeem, M. (2010) Influence of abiotic factors on population fluctuation of leaf hopper, *Amrasca biguttula biguttula* (Ishida) on okra. Pak. J. Zool., 42: 615-621.

Jindal, S.K. and Arora, D. (2010) Evaluation of okra genotypes for earliness and yield attributes under north Indian condition. Ind. J. Ecol., 37: 130-136.

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

Kumar, V., Dhankhar, S.K., Vilas, C.A., Kumar, S. and Yadav, N. (2016) Effect on spacing and fertilizers on seed quality of okra [*Abelmoschus esculentus* (L.) Moench]. Ind. J. Ecol., 43: 242-245.

Kumawat, R.L., Pareek, B.L. and Meena, B.L. (2000) Seasonal incidence of jassid and whitefly on okra and their correlation with abiotic factors. Ann. Biol., 16: 167-169.

Mandal, S.K., Sattar, A. and Gupta, S.C. (2006) Influence of meteorological parameters on the incidence of leaf hopper in okra at Pusa, Bihar. J. Agrometeorol., 8: 126-129.

Naresh, V., Biswas, A.K., Roy, K. and Reza, M.W. (2003) Relative susceptibility of different varieties of okra to the shoot and fruit borer, *Earias vittella* (Fabr.) and leaf roller, *Sylepta derogata* (Fabr.). Pest Manag. Econ. Zool., 11: 119-122.

Nath, L., Prasad, C.S., Tiwari, G.N. and Kumar, A. (2011) Impact of weather parameters on major insect pests of okra prevailing western Uttar Pradesh. Vegetos, 24: 152-156.

Pal, S., Maji, T.B. and Mondal, P. (2013) Incidence of insect pests on okra, *Abelmoschus esculentus* (L.) Moench in red lateritic zone of West Bengal. The J. Pl. Protec. Sci., 5: 59-64.

Sharma, R.P., Swaminathan, R. and Bhati, K.K. (2010) Seasonal incidence of fruit and shoot borer of okra along with climatic factors in Udaipur region of India. Asian J. Agric. Res., 4: 232-236.

Yadav, J.B., Singh, R.S. and Tripathi, R.A. (2007) Effect of weather parameters on incidence of pest complex of okra. Ann. Pl. Protec. Sci., 15: 447-478.