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Effect of the abiotic factors on major insect pests in Okra (*Abelmoschus esculentus*) under Chhattisgarh Plain

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Abstract
A field experiment was conducted on Rabi season 2014 at the experimental field of Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India to the effect of abiotic factor viz., Maximum temperature, Minimum temperature, Morning Relative humidity, Evening Relative humidity, Wind velocity and Sunshine hours on major insect on okra cultivar Parbhani kranti. Five insect species viz shoot and fruit borer (*Earias vittella*), aphid (*Aphis gossypii*), jassid (*Amrasca biguttula biguttula*), whitefly (*Bemisia tabaci*) and red cotton bug (*Dysdercus koenigii*) were observed as the major insect pests. The period of maximum activity of shoot and fruit borer (18.36 fruit borers per plant) were noticed during first week of January. The density of aphid (17.94 per three leaves) and jassid (17.12 per three leaves) were observed during first, second week of December respectively whereas whitefly (13.23 per three leaves) were observed during fourth week of November. The density of red cotton bug (3.16, 2.94 and 2.89 per plant) was observed during second and fourth week of December and fourth week of January. The aphid, jassid, whitefly and red cotton bug population had significant positive correlation with maximum temperature while shoot and fruit borer had positive correlation with maximum temperature.

Keywords: Abiotic factor, okra, population dynamics, insect pests

1. Introduction

Okra (*Abelmoschus esculentus*) popularly known as bhindi, ladysfinger etc., is an annual vegetable crop grown in tropical and subtropical regions in the country it possess an area of about 231 hectare with a total production of 6350 million tones. (Annonymus 2013) [1]. Vegetables are an indispensable part of our diet, supplying vitamins, carbohydrates and minerals needed for a balanced diet. Vegetables are important especially in developing countries like India, where malnutrition abounds (Randhawa, 1974 and Masood Khan *et al.*, 2001) [13, 6]. Okra dry seed contains good edible oil (13-22%) and protein (20-24%). The oil is used in soap, cosmetic industry and as vanaspati while protein is used for fortified feed preparations. High iodine content of fruits helps to control goitre while leaves are used in inflammation and dysentery (Mishra 2001) [8]. India ranks first in the world with an area of 4, 52,500 ha with a production of 48, 03,300 mt of okra fruits with a productivity of 10.6 mt. /ha. In Chhattisgarh, the crop is grown in an area of 25,233 ha with production of 2, 49048 mt. of okra fruits and productivity is 9.86 t /ha (Anonymous, 2012) [2]. The crop has been reported to be attacked and infested by an array of insect causing injuries to their seedling, vegetative, flowering, shoot formation and fruit maturity stages. Thus, among the various constraints for low productivity in okra crop, the infestation of insect pest is the main contributor. Pests are dynamic in nature and succession of pest occur with the nature of the agro-ecosystem and many reports are available on the succession of the insect pest of okra from different part of the country. [Boopathi *et al*., (2011), Sabyasachi and Mondal (2013) and Netam *et al.*,(2007)] [3, 14, 11].

In the plain plateau of Chhattisgarh, there is paucity of information on the dynamic of insect pest on okra. Therefore, this information will help in designing a successful pest management strategy in okra fields of the plain plateau region. The effects of different meterological factors on the insect pest population in okra were studied in the prevailing agroclimatic condition of Raipur.

2. Materials and Methods

Field study was carried out in the experimental field of Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh (C.G.) during kharif 2014-15. The research field located in the south eastern part of Chattisgarh and lies at 21-16ºN latitude and 81.36ºE longitude with an altitude of 298 meter above mean sea level. The experiment was laid out in a randomized block design (RBD) with three replications having a plot size 4.0m x 3.0m each with 0.5 meter pathway between plots. The regular observations were recorded starting immediately after seed germination and continued up to harvest. The crop was kept unprotected for this purpose. Observations on different insect pests and their natural enemies were recorded on 10 tagged plants, once in a standard week on the okra. The meteorological data were obtained from the observatory of I.G.K.V. Raipur. For the ease of analysis and findings, meterlolgical data were also pooled out at weekly interval. The data on infestation of various insect pests were correlated with prevailing abiotic factors viz, temperature, relative humidity, sunshine hours and wind velocity. The correlation study was worked out by using formula as given below:

$$r = \frac{\sum XY - nxy}{\sqrt{\sum X^2 - nX^2} \text{ x } \sqrt{\sum Y^2 - nY^2}}$$

Where,
X = Mean of first factor
Y = Mean of second factor
n = Total no. of observations
r = Correlation coefficient

After correlating significant and non-significant findings, t-test value n-2 degrees of freedom were calculated on the following formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \sim t \text{ with } (N-2)\ d.f.$$

3. Results and Discussion:

Five insect species viz shoot and fruit borer (*Earias vittella*), aphid (*Aphis gossypii*), jassid(*Amrasca biguttula biguttula*), whitefly (*Bemisia tabaci*) and red cotton bug (*Dysdercus koenigii*) were observed as the major insects pests on okra variety Parbhani kranti causing damage at vegetative, flowering and at maturation stages of crop. The period of maximum activity of shoot and fruit borer (18.36 fruit borers per plant) was noticed during fourth week of January, during this period maximum (28.9 ^{0}C) and minimum (13.5 ^{0}C) temperature, morning (88%) and evening (37%) relative humidity, wind velocity (2.1 km/h) and bright sunshine hours (7.4 hours/day) prevailed and seasonal mean was 11.23 per plant (Table 3, 1). The larval population of shoot and fruit borer showed non-significant positive correlation with maximum temperature (r = 0.55), minimum temperature (r =0.37), morning vapour pressure (r = 0.27), evening vapour pressure (r = 0.24) and evaporation (r = 0.16). There was morning relative humidity (r = -0.07), evening relative humidity (r = -0.02), wind speed (r = -0.10) and sunshine hours (r = -0.07) showed negative correlation with larval population (Table 2). The larval population of *Earias vittella* showed positive association with maximum and minimum temperature, evaporation and sunshine hours with shoot and fruit damage. A negative correlation between insect population and relative humidity was observed (Muthukumar and Kalyanasunduram 2003) [9]. Selvaraj (2010) [16] reported significant positive correlation with maximum temperature and dewfall. The peak activity of *Earias vittella* occurred during the second week of November with 1.08 larvae/ plant. (Netam, P.K. 2003) [10]. The highest population 17.94 per three leaves of aphid was recorded in first week of December with the seasonal mean of 10.81 per three leaves (Table 1). During peak period, maximum (28.9 ^{0}C) and minimum (10.8^0 C) temperature, morning (90%) and evening (28%) relative humidity, wind velocity (2.2 km/h) and bright sunshine hours (9.0 hours/day) prevailed (Table 3). The aphid showed high significant positive correlation with maximum temperature (r = 0.70**). The non-significant positive correlation was with minimum temperature (r= 0.42). There was morning relative humidity (r = -0.21), evening relative humidity (r = -0.03), wind speed (r= -0.30) and sunshine hours (r= -0.13) showed negative correlation with nymph and adult population (Table 2). The nymph and adult population of aphid were also showed significant positive correlation with maximum temperature and wind speed while negative correlation with morning and evening relative humidity and dewfall (Selvaraj, 2010) [16]. Singh *et al*., 2005 [17] showed temperature, relative humidity and total rainfall were negatively correlation with aphid population. Vishwanathrao 2002 showed significant negative correlation with wind velocity and positive with sunshine hours. The peak activity of aphid occurred during second week of November with 19.58 aphids/plant (Netam, P.K. 2003) [10]. The jassid population peak activity (17.12 per three leaves) was noticed on second week of December with the seasonal mean 8.94 per three leaves (Table 1). During this period, maximum (28.6 ^{0}C) and minimum (15.8 ^{0}C) temperature, morning (89%) and evening (49% 0 relative humidity, wind velocity (2.3 km/h) and bright sunshine hours (3.0 hours/day) prevailed (Table 3). The nymph and adult population of jassid showed high significant positively correlation with maximum temperature (r = 0.70**) while non-significant positive correlation with minimum temperature (r = 0.47) and evening relative humidity (r = 0.14). There was negative correlation with morning relative humidity (r = -0.20), wind speed (r = - 0.25) and sunshine hours (r = -0.35) (Table 2). The jassid population showed significant positive correlation with maximum temperature (Prashad and Logiswaran, 1997) [12]. Mahmood 2002 [7] reported that jassid showed positive and significant correlation with maximum and minimum temperature while relative humidity was negatively and non-significantly correlated with population fluctuation. The peak activity of jassid occurred during second week of December with a population of 5.45 jassid/plant and minimum population was recorded in third week of December (Netam, P.K. 2003) [10]. Choudhary and Dhadesh (1989) [4] reported on intensity of 4.78/leaf. The density of whitefly increased gradually with peak population of 13.23 per three leaves in the fourth week of November, during this period, maximum (30.2 ^{0}C) and minimum (12.5 ^{0}C) temperature, morning (90%) and evening (26%) relative humidity, wind velocity (1.9 km/h and bright sunshine hours (8.6 hours/day) prevailed (Table 1,3). The maximum activity of whitefly was recorded during fourth week of November. The nymph and adult of whitefly population showed significant positive correlation with maximum temperature (r = 0.76*). There was minimum temperature (r = 0.30), morning relative humidity (r = 0.53) and sunshine hours (r = 0.10) showed non-significant positive correlation whereas evening relative humidity (r = -0.30) and wind speed (r = -0.40) showed non-significant negative correlation. The seasonal mean of nymph and adult population of whiteflies 8.23 per three leaves (Table 2, 1). The nymph and adult population of whiteflies showed significant positive correlation with maximum temperature, relative humidity and a negative with minimum temperature (Prasad and logiswaran 1997) [12]. Vishwanthrao 2002 noticed that the whitefly showed significant negative correlation with wind velocity and positive with sunshine hours. The peak activity of whitefly occurred during second week of October to last week of October with 2.7 per plant. (Netam, P.K., 2003) [10]. The highest population 3.16 per plant of red cotton bug was recorded during second week of December with the seasonal mean of 2.08 per plant (Table 1). During peak period, maximum (28.6 ^{0}C), minimum (15.8 ^{0}C) temperature, morning (89%) and evening (49%) relative humidity, wind velocity (2.3 km/h) and bright sunshine hours (3.0 hours/day) prevailed (Table 3). The population of red cotton bug showed significant positive correlation with maximum temperature (r = 0.65*). There was minimum temperature (r = 0.47) and evening relative humidity (r = 0.13) showed non-significant positive correlation were as morning relative humidity (r = -0.41), wind speed (r = -0.30) and bright sunshine hours (r = -0.20) showed non-significant negative correlation with red cotton bug population (Table 2). The population of red cotton bug were active from the third week of November to last week of December with a peak population of (0.19/plant) (Netam, P.K. 2003) [10].

The study showed that the five insects species viz., shoot and fruit borer (*Earias vittella*), aphid (*Aphis gossypii*), jassid (*Amrasca biguttula biguttula*), whitefly (*Bemisia tabaci*) and red cotton bug (*Dysdercus koenigii*) were observed as the major insect pests infesting okra. The majority of the insect pests were showed positive correlation with maximum temperature and minimum temperature.

Table 1: Major insect pests infesting okra during different crop growth period (*Rabi*, 2014-15)

Insect pest/natural enemies	Date of observation mean/plant														
	13/11/14	**20/11/14**	**27/11/14**	**04/12/14**	**11/12/14**	**18/12/14**	**25/12/14**	**01/01/15**	**08/01/15**	**15/01/15**	**22/01/15**	**29/01/15**	**05/02/15**	**12/02/15**	**Over all mean**
Aphid	0.00	9.88	14.94	17.94	15.72	11.32	9.21	7.18	6.47	4.67	0.00	0.00	0.00	0.00	10.81
Jassid	0.00	7.86	11.94	13.76	17.12	12.27	6.12	5.24	4.09	2.13	0.00	0.00	0.00	0.00	8.94
Whitefly	7.94	11.83	13.23	9.12	8.34	4.07	3.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.23
Shoot & fruit borer	0.00	0.00	0.00	0.00	0.00	3.48 (S)	7.76 (S)	10.27 (S)	11.54(S)	13.27 (S)	18.36 (F)	14.32 (F)	12.38 (F)	9.76 (F)	11.23
Red cotton bug	0.00	0.00	0.00	2.35	3.16	1.09	2.94	1.23	1.36	1.08	2.89	2.83	1.92	0.0	2.08

Table 2: Correlation coefficients among major insect pests of okra and weather parameters

Weather factors	Aphid		Jassid		Whitefly		Shoot & fruit borer		Red cotton bug	
	R	**byx**	**r**	**byx**	**r**	**byx**	**r**	**byx**	**r**	**byx**
Max. temperature ^{0}C	0.70**		0.55**		0.76**		0.55	-	0.65*	
Min. temperature ^{0}C	0.42	-	0.47	-	0.30	-	0.37	-	0.47	-
Morning RH (%)	-0.21	-	-0.20	-	0.53	-	-0.07	-	-0.41	-
Evening RH (%)	-0.03	-	0.14	-	-0.30	-	-0.02	-	0.13	-
Wind speed (Km/hr)	-0.30	-	-0.25	-	-0.40	-	-0.10	-	-0.30	-
Sunshine (Hrs)	-0.13	-	-0.35	-	0.10	-	-0.07	-	-0.20	-

Table 3: Meterlological data during the crop growth period of Rabi 2014-2015.

SMW	Date	Temperature ^{0}C		Relative humidity (%)		Wind velocity (Km/h	Sunshine (hr/day)
		Maximum	**Minimum**	**Morning**	**Evening**		
46	14/11/14	31.4	19.3	84	35	2.8	6.8
47	21/11/14	29.3	11.9	91	28	1.9	8.5
48	28/11/14	30.2	12.5	90	26	1.9	8.6
49	05/12/14	28.9	10.8	90	28	2.2	9.0
50	12/12/14	28.6	15.8	89	49	2.3	3.0
51	19/12/14	25.0	8.3	89	31	2.2	7.8
52	26/12/14	26.0	9.9	86	34	2.2	8.3
1	02/01/15	25.0	14.8	95	52	4.4	4.5
2	09/01/15	25.8	8.0	90	29	2.2	9.2
3	16/01/15	26.0	8.3	90	29	2.2	8.3
4	23/01/15	28.9	13.5	88	37	2.1	7.4
5	30/01/15	28.3	11.7	88	29	2.6	7.6
6	06/01/15	29.9	14.0	83	36	2.5	5.7
7	13/01/15	29.3	13.6	88	39	3.2	8.2

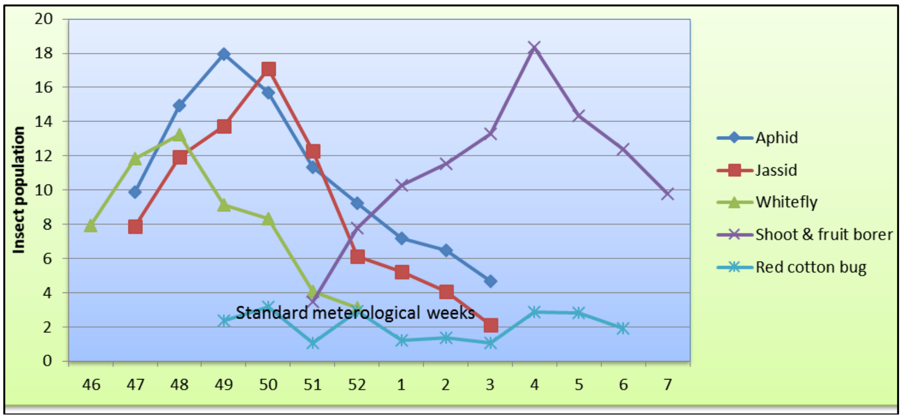

Fig 1: Seasonal incidences of Aphid, Jassid, Whitefly, Shoot & fruit borer and Red cotton bug on okra at weekly interval, during the crop growth period.

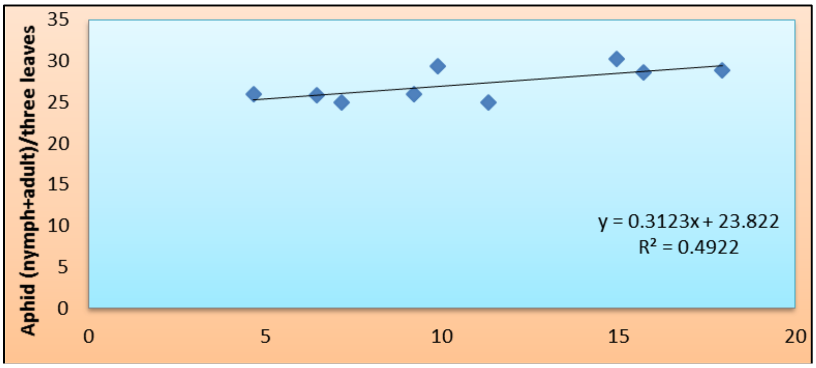

Fig 2: Regression of maximum temperature on aphid infesting okra

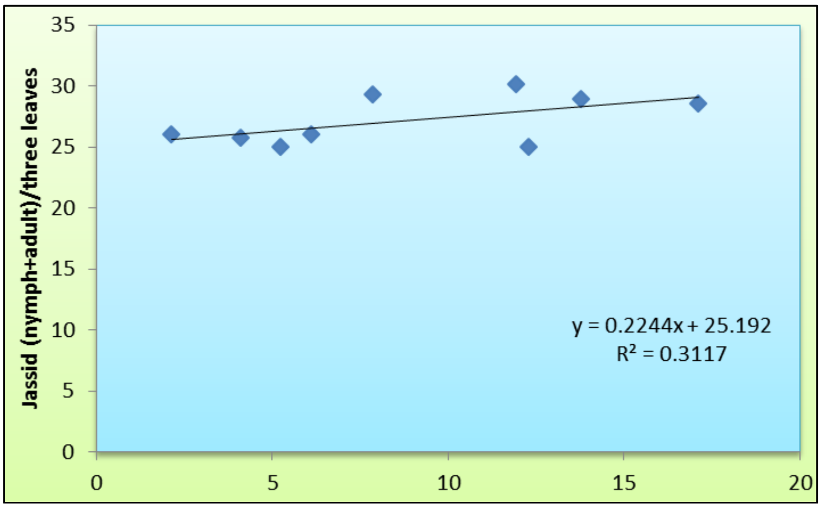

Fig 3: Regression of maximum temperature on jassid infesting okra

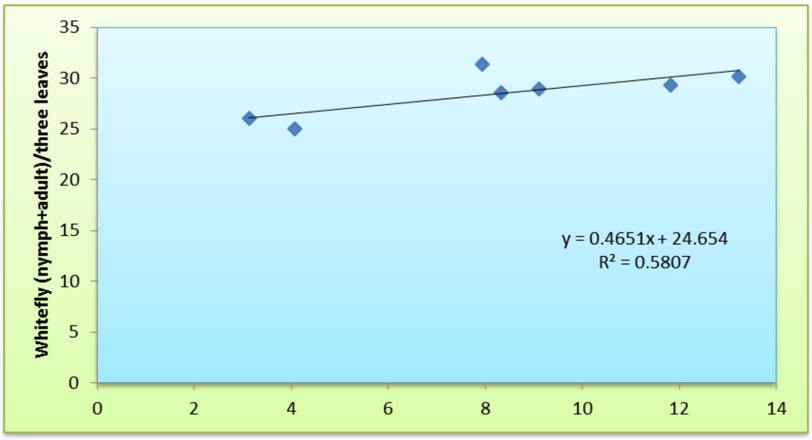

Fig 4: Regression of maximum temperature on whitefly infesting okra

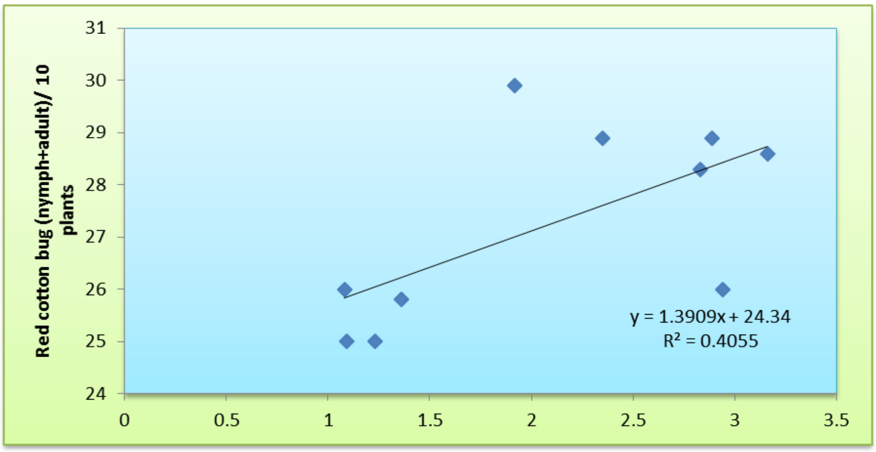

Fig 5: Regression of maximum temperature on red cotton bug infesting okra

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