RESEARCH ARTICLE

SEASONAL INCIDENCE OF RED COTTON BUG (*DISDERCUS CINGULATUS*) AND FRUIT & SHOOT BORER (*EARIAS VITELLA*) OF OKRA AND THEIR CORRELATION WITH ABIOTIC FACTORS

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Abstract: The field experiment was conducted at the Horticulture farm, Rathindra Krishi Vigyan Kendra, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, at Sriniketan during the period of March 2010 to June 2010 and Okra variety "Parbhani Kranti" were sown in experimental site. The basic objective of the experiment was to find out the seasonal incidence of Red cotton bug (*Disdercus cingulatus*) and Fruit & shoot borer (*Earias vitella*) of okra and their correlation with abiotic factors. Experimental findings revealed that the Red cotton bug and Fruit & shoot borer observed to infest the crop at different growth stages and ecological factors played an important role in their fluctuation during the crop growing season as many weather parameters showed their significant effects on population abundances. The incidence of red cotton bug started from 18th standard week i.e. 1st week of May and the maximum population was recorded to the tune of 2.41/plant on 21st standard week during peak fruiting (4th week of May). The peak populations of fruit & shoot borer (6.97%/plant) were recorded on 1st week of June. Multiple regression analyses depicted that contribution of all the abiotic factors to the variations of red cotton bug population was 8.5% and for fruit & shoot borer it was 98.4%.

Keywords: Okra, Seasonal incidence, *Disdercus cingulatus*, *Earias vitella,* Abiotic factors

INTRODUCTION

Okra *Abelmoschus esculentus* L. (Moench), is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. (Tindall, 1983). It is a native crop of Africa, South East Asia and North Australia to the pacific (Boswell and Reed, 1962). This crop is suitable for cultivation as a garden crop as well as on large commercial farms. It is grown commercially in India, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malayasia, Brazil, Ghana, Ethiopian, Cyrpus and the Southern United States. India ranks first in the world with 3.5 million tonnes (70% of the total world production) of okra produced from over 0.35 million ha land (FAOSTAT 2008).

Okra is known by many local names in different parts of the world. It is called lady's finger in England, 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 varying moisture conditions. Even within India, different names have been given in different regional languages (Chauhan, 1972).

Okra is cultivated for its fibrous fruits or pods containing round, white seeds. The fruits are harvested when immature and eaten as a vegetable. Okra plays an important role in the human diet (Kahlon et al. 2007, Saifullah and Rabbani 2009). by supplying fats, proteins, carbohydrates,phosphorus, calcium, iron, sulphur, fibre, minerals and vitamins (Lamont 1999, Owolarafe and Shotonde 2004, Gopalan et al. 2007, Arapitsas 2008,). Okra is said to be very useful against genito-urinary disorders, spermatorrhoea and chronic dysentery (Nadkarni, 1927). Its medicinal value has also been reported in curing ulcers and relief from hemorrhoids (Adams, 1975).

Okra provides an important source of vitamins, calcium, potassium and other mineral matters which are often lacking in the diet of developing countries (IBPGR, 1990). The fully ripened fruits and stem containing crude fibers are used in paper industry, while roots and stem are used for purification of sugarcane juice in Jaggery (*Gur*) manufacture in India. In India, okra has occupied a prominent position among the export oriented vegetables. It is cultivated in 51.8 mha with 12.1 mt/ha productivity (National Horticulture Database, 2012).

Insect pests are the main constraint in the successful cultivation of okra. The okra crop is attacked by number of insect pests right from germination to harvesting of the crop *viz.;* jassid *(Amrasca biguttula biguttula* Ishida*);* whitefly *(Bemisiatabaci* Genn.*);* aphid *(Aphis gossypii* Glover*);* shoot and fruit borer *(Earias insulana* Boised and *E. vitella* Fab.*);* leaf roller *(Sylepta derogate* Fab.*);* red cotton bug *(Dysdercu skoenigii* Fab.*);* mite *(Tetrantchus telarius* Linn.*);* green plant bug *(Nezara viridula* Linn.*)* and green semilooper *(Anomis flava* Fab.*)*. Among the insect pests jassid *(A.biguttula biguttula* Ishida*);* whitefly *(B.tabaci* Genn.*)* and shoot and fruit borer *(E.insulana* Boised and *E. vittella* Fab.*)* are considered as major pests.

The larvae of shoot and fruit borer bore into the growing shoots, flower buds, flowers and fruits of

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okra, thereby killing the plants or causing heavy shedding of flower buds. The infested fruits become distorted and rendered unfit for human consumption and procurement of seeds. The borers have been reported to cause 24.16 to 26.00 per cent damage to okra shoots and 40 to 100 per cent loss to fruits in India. (meena et al. 2009).

MATERIAL AND METHOD

In order to study the seasonal incidence of red cotton bug (*Disdercus cingulatus*) *and fruit & shoot borer* (*Earias vitella*) of okra and correlation with abiotic factors , the experiment was laid out in a Randomized Block Design (RBD) with three replications. The soil condition of the plot was loamy sand (utisol) in texture with acidic in nature. The range of weekly maximum and minimum temperature during the crop growing season was 34.11°C to 41.68°C and 23.35°C to 27.15°C, respectively.

The maximum and minimum temperatures during the crop season were almost similar to the normal temperatures. The morning relative humidity during the crop growing period varied from 83.85 to 91.14 per cent while the afternoon relative humidity varied from 24.14 to 56.57 per cent. Total rain fall received during the crop season was nearly 31.00 mm and the mean wind velocity was ranged from 4.18 to 7.31 kph/day.

The experimental plots were measured about of 2.7 × 3.6 sq m in which plant-to-plant and row-to-row spacing were of 45 cm and 60 cm, respectively. All recommended package of practices were followed during for raising a healthy crop.

Details of data collection

Seven different sizes of sample viz., two, four, five, six and seven, eight and sixteen plants were used for estimation of insect populations of okra. Each sample size was considered as a treatment. Therefore, there were seven treatments for the present investigation in which two samples per plot represents T_1 while four, five, six, seven, eight and sixteen samples per plot represent T_2, T_3, T_4, T_5, T_6 and T_7, respectively. These treatments were randomly allocated in seven plots in each replication. In each plot, the plants for respective sample size were selected randomly from whole population leaving the border plants in the following manner.

For sample size two, from 1-16 plants two plants were randomly chosen for estimation of insect population. The crop was kept under constant observation for appearance of pests. Observations were recorded in each standard week from 6 a.m. to 10 a.m. However, observations for different insect populations were taken in separate days in each standard week. The observations were continued till last harvesting of fruits.

The population of red cotton bug was recorded from whole plant and the data were expressed as mean number of insect per plant while the level of fruit infestation by the lepidopteran borer was ascertained by picking fruits from whole plot and subsequent sorting of infested and healthy fruits have been done for estimation of percent fruit damaged out of total fruits for each treatment.

Statistical analyses

For finding out the effect of abiotic factors on insect-pests population correlation and regression analyses were carried out while to compare the population abundances in different growth stages of the crop analysis of variance was done in randomized block design. (Gomez and Gomez, 1984).

Meteorological data

Weekly data of atmospheric temperature (maximum and minimum), relative humidity and total rainfall were obtained from meteorological observatory, Palli Siksha Bhavana, (Institute of Agriculture) Visva-Bharati, Sriniketan.

RESULT AND DISCUSSION

Incedence of Red cotton bug and Shoot & Fruit borer at different stages of okra during the growing seasons

The population of red cotton bug didn't found during the early growth stage of the crop. The Table 1 depicted that, initiation of this hemipteran bug occurred during 18th standard week i.e. on 1st week of May and the maximum population was recorded to the tune of 2.41/plant on 21st standard week during peak fruiting (4th week of May) when the maximum & minimum temperatures, morning & afternoon r.h., rain fall and wind velocity were 34.78^{0}c, 24.58^{0}c, 83.85%, 50.28%, 4.83 mm and 5.22 kph, respectively. Thereafter, the population gradually decreased. Interestingly, during this period the insect was observed to infest mostly on the fruits. Higher populations at this stage also reported by Srivastava (1993).

Seasonal incidence of shoot and fruit borer as recorded in Table 1 substantiated that its infestation was not observed in the initial growth phase. However, the population was observed from 16th standard week i.e. 3rd week of April. This insect is considered to be the most notorious pest in this region and hardly any variety could be found free from any blemishes of its infestation. Initiation of this pest was manifested by the presence of wilted shoot and then shifted to green fruits and noticed to feed the internal content. This peculiarity in damage also recorded in the present investigation. After initiation, the population increased sharply and attained maximum level (6.97%/plant) at 1st week of June (22nd standard week). After which, the population gradually decreased but caused considerable damage to the fruits till the maturity of the crop. This observation also in accordance with the findings of Zala *et. al*. (1999).

Role of weather parameters on the population fluctuations of insect- pests of okra

Population density of red cotton bug during the experimental period was below the threshold level estimated in this lateritic zone and it was observed that the population was some what lower than the average of past few years' data. Hence, in the present investigation correlation between the bug population and other weather factors recorded very low except morning r.h. (r= -0.416 ns) and wind speed (r= 0.340 ns) (Table 1 & 2).

The upward population of shoot and fruit borer was recorded with increased fruiting as well as rise of temperatures and wind speed. Rain fall, minimum and maximum relative humidity non-significant but negative correlatation with the fruit and shoot borer population. More or less strong positive correlations were recorded between the borer population (%fruit damage) and maximum temperature (r= 0.355ns), minimum temperature (r= 0.537ns) and wind speed (r= 0.507ns) (Table 1 & 2). Therefore, it was apparent from the results that the insect had immense potentiality to cause continuous damage to the crop during congenial weather conditions. Ahmad *et al.*(2000) reported that the larval population of *E. vitella* in fruits of Parbhani Kranti was correlated with weather factors. The analysis revealed the existence of significant positive relationship with the minimum temperature (r= 0.578) and negative correlation with the maximum temperature (r = -0.747) as well as positive correlation with both the r.h. at 7 h (r= 0.774) and 14 h (r= 0.800), respectively. Rainfall too had significant impact on the larval population as the coefficient of correlation (r= 0.410) was significant.

Multiple interactions of ecological parameters with insect population

Multiple regression analyses were worked out to find out the combined effect of all the abiotic factors on population abundance of the insect on the crop. For this purpose, coefficient of determination (R^2) was computed. Besides this, percentage of contribution of different independent variables viz. maximum and minimum temperatures, maximum and minimum relative humidity, rain fall and wind speed to the variations of dependent variable (insect population) was also calculated from the standardized partial regression coefficients (β's) and the results regarding these findings are presented in Tables 3 & 4.

Table 3 revealed that coefficient of determination (R^2) between and independent variables was 0.771 while adjusted R^2 was computed as 0.085 which indicated that 8.5 per cent variation in insect population was caused due to the abiotic factors. Based on calculation the major contribution was made by maximum temperature (45.71%) followed by minimum temperature (25.47%) and afternoon relative humidity (12.94%). Rainfall, wind speed, morning relative humidity had little countribution on the fluctuation of the insect population.

Okra fruit and shoot borer is one of the most important insect-pest of this crop. The insect has an immense potentiality to damage the crop in favorable weather conditions. Earlier reports on this aspect revealed that many a time the crop suffered from havoc yield loss caused by this insect. Therefore, an attempt has been made to study the combined effect of weather factors on the variation of population build up of this insect in the crop. For borer population, Coefficient of determination (R^2) between and independent variables was 0.997 while adjusted R^2 was computed as 0.984 which indicated that 98.4 percent variation in insect population was caused due to the abiotic factors (Table 4). Contribution of each abiotic factor was also computed separately to find out the individual effect of those independent variables to the population fluctuation of the fruit borer. In nature, this was not generally happened exactly because those weather parameters were more or less correlated to each other and none of these parameters remained constant for a long period. However, the information regarding the above findings gave an idea on the individual effect of independent variables on the population fluctuation of the insect. From the Table 4 it was appeared that the major contribution was made by maximum temperature (41.98%) followed by minimum temperature (34.87%). Afternoon relative humidity (9.71%), wind speed (7.46%) and rain fall (5.96%) showed little contribution on the fluctuation of the insect population. Ahmad *et al.*(2000) reported that larval population peak of *E. vittella* in fruits of okra cv. Parbhani Kranti remained confined during 1st fortnight of July at 29.9±2.9 ^{0}C, 84.0±5.1 percent r.h. and 61.4 mm precipitation while the population was minimum during 2nd fortnight of May when the temperature (31.6±7.7 ^{0}C) was comparatively higher and r.h. was 54±2.1 per cent. Multiple regression analysis revealed that with one unit increase in maximum and minimum temperature there were 7.9 per cent decrease and 10.2 per cent increase in larval population, respectively. Similarly, with one unit increase in the rainfall, there was 0.8 per cent decrease in the larval population.

Table 1. Incidence of Red cotton bug and Fruit & shoot borer at different growth stages of okra

Standard weeks	Plant growth stages	Insect Populations #	
		Red cotton bug (No./ plant)	Fruit & shoot borer (%/plant)
15	3-4 leaves	0	0
16	Initiation of branching with 6-7 leaves	0	0
17	1-2 branching with 9-10 leaves	0	0
18	Initiation of flowering	0.17	1.39
19	Peak flowering & initiation of fruiting	0.47	2.64
20	Fruiting	1.07	4.73
21	Peak fruiting	2.41	6.67
22	Post peak fruiting	1.99	6.97
23	Fruiting but initiation of senescence	1.01	5.27
# Population of insects estimated on the basis of 16 samples/ plot (44.44% plant population)			

Table 2. Correlation between different weather parameters and mean insect population

Weather parameters	**Red cotton bug**	**fruit & shoot borer**
Maximum temperature (^{O}C)	.025ns	.355ns
Miniimum temperature (^{O}C)	.228ns	.537ns
Maximum relative humidity (%)	-.416ns	-.262ns
Miniimum relative humidity (%)	-.016ns	-.161ns
Rainfall (mm)	-.083ns	-.234ns
Wind speed (Km/h)	.340ns	.507ns

** Correlation is significant at p= 0.01
* Correlation is significant at p= 0.05

Table 3. Regression coefficients between abiotic factors and red cotton bug population on okra

Weather Parameters	**Partial regression coefficient (b)**	**Standard partial regression coefficient (β)**	**Student"t" value**	**% contribution #**
Maximum temperature (X_1)	-1.928	-3.369	NS	45.72
Miniimum temperature (X_2)	1.639	2.515	NS	25.47
Maximum relative humidity (X_3)	-0.0013	-0.005	NS	0.01
Miniimum relative humidity (X_4)	-0.307	-1.793	NS	12.94
Rainfall (X_5)	0.395	1.247	NS	6.26
Wind speed (X_6)	1.379	1.544	NS	9.60

The prediction equation for insect population: $Y= 35.604 -1.928X1 + 1.639X2 – 0.0013X3 – 0.307X4 + 0.395X5 + 1.379X6$
Coefficient of determination (R^2) = 0.771
Adjusted R^2 =0.085

Per cent contribution of all the abiotic factors on insect population = 8.5
* t value significant at p = 0.05 ** t value significant at p = 0.01 NS: F test non- significant
# Contribution of different independent variables (abiotic actors) to variation in the dependent variable (*D. cingulatus*) on okra

Table 4. Regression coefficients between abiotic factors and fruit & shoot borer population on okra

Weather Parameters	Partial regression coefficient (b)	Standard partial regression coefficient (β)	Student"t" value	% contribution #
Maximum temperature (X_1)	-4.310	-2.561	*	41.98
Miniimum temperature (X_2)	4.475	2.334	*	34.87
Maximum relative humidity (X_3)	-	-	-	-
Miniimum relative humidity (X_4)	-0.620	-1.232	*	9.71
Rainfall (X_5)	0.898	0.965	*	5.98
Wind speed (X_6)	2.838	1.080	*	7.46

The prediction equation for insect population: Y= 58.528 – 4.310X1 + 4.475X2 – 0.620 X4 + 0.898X5 + 2.838X6
Coefficient of determination (R^2) = 0.997
Adjusted R^2 =0.984
Per cent contribution of all the abiotic factors on insect population = 98.4
* t value significant at p = 0.05 ** t value significant at p = 0.01 NS: t- test non- significant
# Contribution of different independent variables (abiotic actors) to variation in the dependent variable (*E. vittella*) on okra

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