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INFLUENCE OF WEATHER PARAMETERS ON THE POPULATION DYNAMICS OF BLACK BUG, (*CAVELERIUS SWEETI* SLATER & MUGOMOTO) IN SUGARCANE IN HARYANA, INDIA

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ABSTRACT

In autumn planted, sugarcane, *(Saccharum officinarum)* crop the correlation coefficient showed non significant but positive trend with minimum and maximum temperature. The effect of minimum and maximum relative humidity with black bug population showed a negative correlation. In ratoon crop the highest black bug population 7.2/ tiller was recorded during the 4th week of May at minimum temperature, maximum temperature, minimum relative humidity, maximum relative humidity, 22.9°C 40.9°C 32.0% 46.0% and 9.4 sun shine hours respectively. The *Cavelerius sweeti* population was significant and positively correlated with minimum and maximum temperature. While minimum and maximum relative humidity was correlated negatively the population of black bug but it was positively correlated with sun shine hours. The regression coefficient for minimum and maximum temperature, minimum and maximum relative humidity and sun shine hours were 0.361, -0.162 , - 0.054, 0.029 and -0.867 in autumn planted crop and 0.014, 0.610, –0.075, 0.644 and -0.989 in ratoon crop of sugarcane, respectively. The ratoon crop of sugarcane was more vulnerable to *C. sweeti* attack in comparison to autumn planted sugarcane crop. The weather factors viz., minimum and maximum temperate, minimum and maximum relative humidity and sun shine hours were 22.9 °C, 40.9°C 32.0 per cent, 46.0 per cent and 9.4 respectively found optimum for the fast multiplication of the black bug population as well as infestation in ratoon crops.

Key words: Black bug, *Cavelerius sweeti*, Population dynamics, Sugarcane , Weather parameters.

INTRODUCTION

Amongst sucking insect pests, four species of black bugs, namely, *Cavelerious sweeti* Slater and Mogomoto, *Cavelerius excavatus* (Distant) and *Dimorphopterus gibbus* (Fabricius) are supposed to be associated with sugarcane crop in India but only one of them viz., *C. sweeti* has been studied in greater details as these are commonly found in different cane growing tracts of India (Chaudhary, 2008).

The most commonly occurring species of black bug of sugarcane, *Cavelerius sweeti* Slater and Mogomoto belongs to order-Hemiptera; sub order-Heteroptera; family-Lygaeidae and subfamily-Blissinae. Black bug species; *C. sweeti* is commonly found and damaging sugarcane crop in Punjab, Haryana, and Rajasthan, western parts of Uttar Pradesh and in some districts of Himachal Pradesh adjoining Haryana. The black bug was a minor pest till late seventies, have now attained, the status of major pest of sugarcane. It was assumed that it was a serious pest of young ratoon crop during pre-monsoon only and during rainy periods its incidence controlled naturally. As per a survey report of Haryana and Punjab, black bug is not a pest of ratoon crops only but it causes severe damage to the all types of crops viz., planted as well as ratoon crops (Pandey and Chhabra 2012). Both nymphs and adults varying from few to 200 per stool suck the leaf sap, due to which growth of plant is considerably retarded. The leaves of the infested plants become pale and individual leaves show deep

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brown spots. The tips and the margins of the leaves start drying up gradually. In severe cases the whole plant withers. The plant finally gives scorched appearance which can be spotted from a long distance (Yadav 2003). In the years of drought, the pest becomes serious even during September-October in grown up crops causing yellowing of leaves, giving sickly appearance and finally checking the growth. Since the damage of the pest occurs in the early stage of the crop growth, it is difficult to estimate the actual losses caused by it. However, in the severely infested crops, the quality of gur is adversity affected (Khan and Nath, 1939). Depending upon the degree of infestation and crop conditions, the fall in yield due to black bug attack varies from 1-5 tones per hectare (Pandey, 1975). The description of different stages of black bug have been described by Khan and Nath (1939), Kalra (1979) and Haque *et. al.* (1983). On the basis of descriptions given by above workers the adults are brownish black in colour and flat dorsatty. The wings are slightly smaller than the length or the abdomen. The mating takes place from end to end position. During summer eggs are laid in clusters on the inner surface of leaf sheath bases which are arranged in linear fashion in groups of 60-70. Individual egg of black bug is small, about 1.25 mm long, cigar shaped, creamy white or brownish when freshly laid but turns reddish 3-4 days after their deposition. Chorian is with five short micropylar processes. Eggs are laid in parallel rows, joining each other at their broadest point, severally in the middle. The number of eggs laid by a female varies from 55-475 in Punjab (Khan and Nath, 1939), 28-108 during summer in Bihar (Haque *et al.*, 1983) and 166 eggs at 33°C (Atwal and Singh, 1971). The longevity of adult varies from 20-40 days in Bihar (Haque *et al.*, 1983), but in Punjab longevity of male and female adults varies from 112 and 118 days in summer and 210 and 242 days in winter, respectively (Khan and Nath, 1939). The incubation period varies from 7-20 days in summer and 654-159 days during winter (Khan and Nath, 1939; Haque *et al.*, 1983). However, 30°C and 40-90 per cent relative humidity is found to be the optimum conditions, both for incubation and hatching of eggs as the average incubation period under these temperature and humidity condition was 12 days with per cent hatchability being 71 per cent (Atwal and Singh, 1971).

Keeping in view the severity of this sucking pest in sugarcane crop in Haryana, the present investigation "influence of weather parameters on the population dynamics of Black bug (*Cavelerius Sweeti* Slater & Mugomoto) in sugarcane in Haryana. These findings will help to manage the black bug properly in sugarcane.

MATERIALS AND METHODS

Field experiment was carried out at farmer's field under District- Sonepat (Haryana) which is situated at 28º N attitude and 97º E longitude and 219.85 meters above mean sea level (MSL). The total rainfall during study period April 2009 to June, 2009 was recorded 17.0 mm. the hottest months were March to July with maximum average temperature varies between 27.5 ºC to 42.9 ºC. The other climatic conditions such as rainfall and relative humidity prevailing around Sonepat provided ideal conditions for sugarcane cultivations. The arrangements were made through out the period of experiment for supplement irrigation as and when required through tube wells. The experimental area was medium in fertility status with 0.38 dS/m electrical conductivity and 0.60 per cent organic carbon with available N, P_2O_5 and K_2O as 267.7, 32.4 and 126.4 kg/ha respectively. The crop of CoH 119 was planted on 1st week of March at a row spacing of 60 cm. One forth of recommended dose of N in form of urea and full dose of P and K were applied as basal. The left over N was top dressed in two equal splits, depending upon crop growth stage. The cultural operations were followed as per needs for maintaining a good crop. Observations pertaining to pest damage was recorded at weekly intervals from third week of March, 2009 (11th standard week) to fourth week of June, 2009. (25th standard week). Total Number of tillers/ black bug effected tillers of two rows from each plot were recorded. Data thus, obtained were computed to work out the percentage infestation as per following formula.

$$\text{Infestation (\%)} = \frac{\text{No. of affected tillers in the sample}}{\text{Total No. of tillers in the sample}} \times 100$$

As for black bug population; five hills along with black bugs from each plot were up rooted and bugs population were recorded. The meteorological data during the study periods was also gathered from the district observatory, Sonepat for the

determination of correlation and regression coefficient between black bug population and weather factors. The weather factors and total population of black bugs (Y) and infested tillers (Y_1) were arranged as a weekly interval. Infested tillers and average metrological factors i.e. minimum temperature (X_1), maximum temperature (X_2), minimum relative humidity (X_3), maximum relative humidity (X_4) and sun shine hours (X_5).The interrelationship between the population and per cent infestation of *C. sweeti* and meteorological data to work out the correlation, regression and multiple regressions. The data obtained were analyzed statistically following the Fisher's method of analysis of variance as recommended by Cochran and Cox (1950). Simple and multiple regression analysis between percent infestation and weather conditions (X_1, X_2, X_3, X_4, X_5) were worked out by the methods out lined by Snedecor and Cochran (1967) and the data were processed on spectrum of computer regression as $Y= a+ b1X_1 + b2 X_2 + b3X_3 + b4X_4 + b5X_5$, Where b1 to b 5 are regression coefficient, X_1 to X_5 are the standard regression coefficient.

RESULTS AND DISCUSSION

In order to find out the impact of weather parameters like, temperature (maximum and minimum), relative humidity (maximum and minimum), and sun shine (hrs.) on the population fluctuation of *C. sweeti* in different cropping patterns namely autumn and ratoon crop of sugarcane was studied from April 2009 to June 2009 and presented in Table-1.

Population dynamics of *C. sweeti* in autumn planted sugarcane crop: The population of *C. sweeti* was recorded in autumn planted sugarcane crop started from 3rd week of March (11th standard week) to forth week of June (25th standard week). The data of population per cent due to *C. sweeti*, black bug are presented in Table 1. It is obvious from the table that *C. sweeti* population varied from 1.5 per tiller to 5.9 per tiller during the 11th standard week to 25th standard week. The minimum population was 1.5 per tiller at minimum temperature 24.5 ºC, maximum temperature 42.9 ºC, minimum relative humidity 19.0 per cent, maximum relative humidity 46.0 per cent and sunshine 8.5 hours. In 11th standard week the population of *C. sweeti* was recorded 1.9 per tiller at minimum temperature 14.5 ºC, maximum temperature 27.5 ºC, minimum relative humidity 35.0 per cent, maximum relative humidity 62.0 per cent and sun shine 7.0. The population slowly goes down to 1.6 per tiller during 12th standard week at 15.2 ºC minimum temperature, 28.0 ºC maximum temperature, 29.0 per cent minimum relative humidity, 60.0 per cent maximum relative humidity and 8.0 sun shine hours. In the 13th standard week population was slowly raised and peaked to 2.5 per tiller at minimum temperature 16.4º C, maximum temperature 30.8º C, minimum relative humidity 43.0 per cent.

Table 1: Population *of C. sweeti* in relation to abiotic parameters in autumn planted sugarcane crop

Months/week	Standard week	Population per tiller	Meteorological parameters					
			Temperature (°C)		Relative Humidity (%)		Sun shine hours	Rain fall (mm)
			Max.	Mini.	Max.	Min.		
March III	11th	1.9	27.5	14.5	62.0	35.0	7.0	-
IV	12th	1.6	28.0	15.2	60.0	29.0	8.0	-
April I	13th	2.5	30.8	16.4	70.0	43.0	8.5	-
II	14th	2.6	32.0	16.5	71.0	44.0	8.0	6.0
III	15th	2.9	37.8	19.5	45.0	21.0	10.6	-
IV	16th	4.2	41.2	22.9	33.0	15.0	10.0	-
May I	17th	4.8	37.2	21.6	36.0	18.0	7.6	2.0
II	18th	5.2	42.0	24.2	46.0	30.0	8.1	-
III	19th	5.3	42.8	25.9	52.0	22.0	9.2	-
IV	20th	5.9	40.9	22.9	46.0	32.0	9.4	-
V	21st	3.8	41.2	22.5	47.0	31.0	8.2	9.0
June I	22nd	2.5	40.9	24.0	52.0	29.0	8.1	-
II	23rd	2.4	41.9	23.8	49.0	24.0	10.6	-
III	24th	2.1	38.7	23.5	56.0	23.0	8.9	-
IV	25th	1.5	42.9	24.5	46.0	19.0	8.5	-

In the 15th standard week population was recorded 2.9 per tiller at minimum temperature 19.5 °C, maximum temperature 37.8 °C, minimum relative humidity 21.0 per cent, maximum relative humidity 45.0 per cent and sun shine 10.6 hours. The population during 17th standard week 4.8 per tiller at minimum temperature 21.6 °C, maximum temperature 37.2°C, minimum relative humidity 18.0 per cent, maximum relative humidity 36.0 per cent and sun shine 7.6 hours. During 18th standard week the population 5.2 per tiller was recorded. In the 19th standard week the population was constant at minimum temperature 25.9°C, maximum 42.8°C, minimum relative humidity 22.0 per cent, maximum relative humidity 52.0 per cent and sun shine 9.2 hours. During 20th standard week the population of *C. sweeti* was maximum 5.9 per tiller at minimum temperature 22.9°C and maximum temperature 40.9 °C, minimum relative humidity 32.0 per cent, maximum relative humidity 46.0 per cent and sun shine 9.4 hours. In the last week of June (25th standard week) the population was decreased 1.5 per tiller at minimum temperature 24.5 °C, maximum temperature 42.9 °C, relative humidity 19.0 per cent, maximum relative humidity 46.0 per cent and sun shine 8.5 hours.

The impact on influence of environmental factors on the population build-up of pest on sugarcane was studied using correlation coefficient (r) between the pest population and environmental factors prevailing during the period of investigation. The data pertaining to correlation coefficient (r) between population due to *C. sweeti* and environmental factors have been presented in (Table 2). The correlation coefficient showed positive trend with all the weather factors except the minimum relative humidity and maximum relative humidity. The effect of maximum temperature with population of black bug showed a positive correlation (r= 0.472) and minimum temperature showed positive trend (r= 0.486). The effect of relative humidity prevailing during the period of pest population was found non significant. The maximum relative humidity and minimum relative humidity showed negative correlation (r= - 0.500 and - 0.267). The effect of sun shine hours during the period of infestation also failed to establish any significant correlation but it was correlated positively (0.151). The combined quantitative effect of the observed abiotic factors *viz.*, maximum temperature, minimum temperature, maximum relative humidity, minimum relative humidity and sun shine hours on the population of C. *sweeti* was also worked out through co-efficient of determination factors (R^2) and regression equation (Table 3) the combined contribution of these weather factors was 31.5 per cent. Where; Y_2= Population in autumn planted crop of sugarcane, X_1= Minimum Temperature° C, X_2= Maximum Temperature °C, X_3= Minimum relative humidity (%), X_4= Maximum relative humidity (%) and X_5= Sun shine (hrs). The regression coefficients for minimum temperature, maximum temperature, minimum relative humidity, maximum relative humidity and sun shine hours were – 0.013, 0.123, - 0.057, 0.022 and – 0.299 respectively.

Population dynamics of *C. sweeti* in ratoon crop: The population of *C. sweeti was* recorded in ratoon crop of sugar cane started from 11th standard week till the 25th. The population due to *C. sweeti* is presented in Table 4. it is apparent from the data that the population varied from 1.9/tiller at minimum temperature 15.2°C, maximum temperature 28.0°C, minimum relative humidity 29.0 per cent, maximum relative humidity 60.0 per cent and 8.0 sun shine hours to 7.2 per cent at minimum temperature 22.9°C, maximum temperature 40.9°C, minimum relative humidity 32.0 per cent, maximum relative humidity 46.0 per

Table 2: Correlation coefficient (r) between population of *C. sweeti* and meteorological parameters

Meteorological parameters (X)		Population/ tiller (Y)
Minimum Temperature	(X1)	0.486
Maximum Temperature	(X2)	0.472
Minimum relative humidity	(X3)	-0.500
Maximum relative humidity	(X4)	-0.267
Sun shine hours	(X5)	0.151

TABLE 3: Regression equation showing quantitative relationship between mean per tiller of *C. sweeti* (Y2) and meteorological parameter

R^2	Regression equation
0.315	Y2 = 5.017 + 0.013 X1 + 0.123 X2 + - 0.057 X3 + 0.022 X4 + - 0.299X5

TABLE 4: Population dynamics of *C. sweeti* in ratoon crop of sugarcane

Months/week	Standard week	Population per tiller	Meteorological parameters					
			Av.Temperature (ºC)		Av. Relative Humidity (%)		Sun shine hours	Rain fall(mm)
			Max.	Mini.	Max.	Min.		
March III	11th	2.3	27.5	14.5	62.0	35.0	7.0	-
IV	12th	1.9	28.0	15.2	60.0	29.0	8.0	-
April I	13th	2.8	30.8	16.4	70.0	43.0	8.5	-
II	14th	2.9	32.0	16.5	71.0	44.0	8.0	6.0
III	15th	3.1	37.8	19.5	45.0	21.0	10.6	-
IV	16th	4.8	41.2	22.9	33.0	15.0	10.0	-
May I	17th	5.2	37.2	21.6	36.0	18.0	7.6	2.0
II	18th	6.5	42.0	24.2	46.0	30.0	8.1	-
III	19th	6.9	42.8	25.9	52.0	22.0	9.2	-
IV	20th	7.2	40.9	22.9	46.0	32.0	9.4	-
V	21st	5.2	41.2	22.5	47.0	31.0	8.2	9.0
June I	22nd	3.8	40.9	24.0	52.0	29.0	8.1	-
II	23rd	2.9	41.9	23.8	49.0	24.0	10.6	-
III	24th	2.2	38.7	23.5	56.0	23.0	8.9	-
IV	25th	2.0	42.9	24.5	46.0	19.0	8.5	-

cent and 9.4 sun shine hours. During initial stage of the crop at 11th standard week the population of *C. sweeti* was 2.3/tiller at minimum temperature 14.5ºC, maximum temperature 27.5ºC, minimum relative humidity 35.0 per cent, maximum relative humidity 62.0 per cent and 7.0 sun shine hours. In the 12th standard week being 1.9/tiller population at minimum temperature 15.2ºC, maximum temperature 28.0ºC, minimum relative humidity 29.0 per cent, maximum relative humidity 60.0 per cent and 8.0 sun shine hours.

The population was recorded 3.1/tiller at minimum temperature 19.5ºC, maximum temperature 37.8ºC, minimum relative humidity 15.0 per cent, maximum relative humidity 42.0 per cent and 10.6 sun shine hours during 15th standard week. In the 16th standard week the population started increased and goes to 4.8 per tiller at minimum temperature 22.9ºC, maximum temperature 41.02ºC, minimum relative humidity 15.0 per cent, maximum relative humidity 33.0 per cent and 10.0 sun shine hours. *C. sweeti* population was recorded 6.9/tiller during 19th standard week at minimum temperature 25.9ºC, maximum temperature 42.8ºC, minimum relative humidity 22.0 per cent, maximum relative humidity 32.0 per cent and 9.2 sun shine hours. During 20th standard week 7.2 per tiller maximum population was recorded at minimum temperature 22.9ºC, maximum temperature 40.9ºC, minimum relative humidity 32.0 per cent, maximum relative humidity 46.0 per cent and 9.4 sun shine hours. The population declined to 2.0/tiller during 25th standard week population was at minimum temperature 24.5ºC, maximum temperature 42.9ºC, minimum relative humidity 19.0 per cent, and maximum relative humidity 46.0 per cent and 8.5 sun shine hours. The correlation coefficient (r) between the (*C. sweeti)* population and weather factors (minimum temperature, maximum temperature, minimum relative humidity, maximum relative humidity and sun shine) are presented in Table5.

TABLE 5: Correlation coefficient (r) between population of *C. sweeti* and weather parameters

Meteorological parameters (X)		Population per tiller (Y)
Minimum temperature	(X1)	0.547*
Maximum temperature	(X2)	0.536*
Minimum relative humidity	(X3)	- 0.467
Maximum relative humidity	(X4)	- 0.281
Sun shine hours	(X5)	0.110

*- P value at 5%

The correlation coefficient showed significant positive trends between minimum temperature and maximum temperature (0.547 and 0.356). The correlation between maximum relative humidity and pest population was negatively (r= - 0.476 and - 0.281). The sun shine hours during the period with population of black bug revealed positive impact as evident from the value of 'r'(0.110). The combined and quantitative

TABLE 6: Regression equation showing quantitative relationship between mean population per tiller of *C. sweeti* (Y3) and meteorological parameters

R^2	Regression equation
0.366	Y3= 3.710 + 0.123X1 + 0.098 X2 – 0.504X3 + 0.024X4 + - 0.546X5

Where; Y3= Population per tiller in Ratoon crop of sugarcane, X1= Minimum temperature ºC, X2= Maximum temperature ºC, X3= Minimum relative humidity (%), X4= Maximum relative humidity (%), and X5= Sun shine (hrs)

effect of weather factors (minimum & maximum temperature, minimum and maximum relative humidity and sun shine hours) on population of *C. sweeti* was also worked out through coefficient of determination factor (R^2) and regression equation and the data are summarized in Table 6. The combined effect of weather factors was non significant (36.6%) on the population of *C. sweeti* in ratoon crop of sugarcane. The regression coefficients for (minimum temperature, maximum temperature, minimum relative humidity, maximum relative humidity and sun shine hours) were – 0.123, 0.098, - 0.504, 0.024 and – 0.546 respectively.

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