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Effect of Weather Parameters on the Incidence of Sorghum Stem Borer, *Chilo partellus* (Swinhoe)

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ABSTRACT

Sorghum (*Sorghum bicolor* L. Moench) is one of the world's most significant cereal crops. Sorghum stem borer, *Chilo partellus* (Swinhoe) has been known to be the most serious pest causing grain yield losses. An field experiment was conducted during *rabi*-2022 at Agriculture college farm, Naira to characterize relationship of various meteorological parameters with stem borer incidence in terms of dead heart and white ear heads. The peak incidence of sorghum stem borer was observed with 60.0% DH during 6th and 7th standard week. The correlation studies of (dead hearts) revealed that, there was no rainfall recorded during the period of study, maximum temperature (r = 0.237), minimum temperature (r = 0.248), morning and evening relative humidity (r = 0.170, r = 0.011) and showed non significant positive correlation whereas white ear heads in relation to abiotic factor showed that, there was no rainfall recorded during the period of study, maximum temperature (r = 0.239), minimum temperature (r = 0.419), evening relative humidity (r = 0.201) showed non significant positive correlation. Whereas the morning relative humidity (r = -0.305) showed non significant negative correlation, respectively.

Keywords: *Correlations, Dead hearts, Regression, Stem borer, Seasonal incidence, Weather parameters.*

Sorghum (*Sorghum bicolor* L. Moench) is one of the world's most significant cereal crops. In the sequence of wheat, maize and rice, sorghum ranks fourth among the world grains. Several species of stem borers attack sorghum in different regions (Nwanze *et al.* 1997). Among them, the spotted stem borer, *Chilo partellus* (Swinhoe), is predominant in Asia and eastern and southern Africa (Kumar *et al.,* 2006). It starts attacking sorghum two weeks after seedling emergence and lasts till harvest, affecting all plant components except the roots. The presence of shot holes generated by early instar feeding in the leaf whorls is the first symptom of its attack. The appearance of infested plants is ragged. The older larvae exit the whorl and burrow into the base of the stem. Stem boring by larvae affects the growth point in young plants (less than a month old), resulting in the creation of a dead heart. In view of the existing situation and importance of sorghum in India, there is a need for the development of economically viable and environmentally safe approach for successful management of stem borer. For this, the knowledge on population dynamics stem borer in sorghum is required but, the available of literature on seasonal incidence of stem borer in India is scanty. Hence, the present investigation was carried to know the influence of weather parameters on incidence of stem borer in sorghum.

MATERIAL AND METHODS

The present studies were undertaken on the seasonal occurrence of sorghum stem borer from

December - 2021 to March - 2022. The experiment was undertaken in field condition at college farm located at 84.63° East longitude and 14.26° North latitude, Agricultural college, Naira. A bulk plot of 200 m^2 was raised with sorghum cultivar CSH-16 duly following the agronomic practices recommended by Acharya N.G. Ranga Agricultural University. Crop was sown on 05-12-2021 at the depth of 3-4 cm following the spacing of 45 X 15 cm. To maintain the pest population during the entire crop period the bulk plot was kept under unprotected conditions. The crop was protected from diseases by blanket spraying of selective fungicides (carbendazim @ 500 g ha^{-1} and mancozeb 2 kg ha^{-1}) and was maintained without the application of insecticides to study the incidence of insect pests of sorghum. The weather data in relevance to rainfall, maximum and minimum temperatures, and relative humidity was correlated with pest incidence. The observations on damage caused by sorghum stem borer *i.e.* dead hearts (DH) during vegetative stage and white ear heads (WEH) during reproductive stage was recorded from 30 randomly selected plants. The per cent damage was calculated by using following formula:

% (Dead hearts/White ear heads) =

$$\frac{\text{Total no. of dead hearts / white ears/ whorls}}{\text{Total no. of tillers}} \times 100$$

Weather parameters that prevailed during crop period were correlated with biological observations (per cent dead hearts and per cent white ear heads). Multiple regression equation models were developed for the relationship. The statistical software XLSTAT was used for correlation and regression analysis (Version 2016.03.30882).

RESULTS AND DISCUSSION

Observations recorded on per cent dead hearts and per cent white ear heads during crop period are presented in Table 1. The incidence started during 4th standard week with 12.0% DH. The maximum and minimum temperatures on an average coinciding with the incidence of sorghum stem borer during 4th standard week were 36.0°C and 22.4°C, respectively, the average morning and evening relative humidity were 79.8 and 44.0 per cent respectively.

The peak incidence of sorghum stem borer was observed with a 60.0% DH during 6th and 7th standard week, during which maximum, minimum temperature of 35.4°C, 25.0°C and the average morning and evening relative humidity of 25.0 and 61.8 per cent and no rainfall was recorded.

The present findings were nearly in line with the findings of Divya *et al.* (2009) who observed that maximum number of plants (38%) was infested during 40th standard week followed by 39th standard week (32%) during *kharif* season. However in *rabi*-summer it was 20% (3rd and 8th standard week) followed by 18% (9th standard week) and 4% (32nd standard week). The peak infestation (27%) was observed during October while, it was minimum (7.5%) during August in *kharif* season. However, mean monthly percent incident of the pest was maximum (17%) during *kharif* while, it was minimum (9%) during March in *rabi*-summer.

The data presented in Table 2 relevance to correlation for the assessment of relationship between sorghum stem borer infestation (% dead hearts) and the abiotic factors. Among the five parameters correlated with per cent dead hearts revealed that, rainfall (r = 0.00) showed non significant correlation, maximum temperature (r = 0.237), minimum temperature (r = 0.248), morning and evening relative humidity (r = 0.170, r = 0.011) and showed non significant positive correlation. The results are mostly in line with the findings of (Patel and Purohit, 2012) who studied the population dynamics of *Chilo partellus* (Swinhoe) infesting sorghum and infereed

Table 1.Influence of abiotic factors on the incidence of sorghum *C. partellus* during *rabi,* 2021-2022.

S. No.	Standard week	Date & Month	Mean temperature (°C)		Mean relative humidity (%)		Per cent Dead hearts	Per cent white ears
			Max.	Min.	Mor.	Eve.		
1	49, 50	05Dec –10 Dec	29.8	18	77.8	52.8	0	0
2	50	11 Dec - 16 Dec	31.1	16.8	84.6	53.8	0	0
3	51	17 Dec - 22 Dec	31.3	18.2	77.4	53	0	0
4	51, 52	23 Dec - 28 Dec	30.9	18.4	74.4	61.6	0	0
5	52, 1	29 Dec - 03 Jan	32	17.3	80.6	46	0	0
6	1, 2	04 Jan - 09 Jan	33.2	22.4	85.4	56.2	0	0
7	2, 3	10 Jan - 15 Jan	32.6	20.8	82.6	51.6	0	0
8	3	16 Jan - 21 Jan	35.4	19.6	77.4	44.8	0	0
9	4	22 Jan - 27 Jan	36	22.4	79.8	44	12	0
10	4, 5	28 Jan – 02 Feb	37	19.8	73.4	37	22.5	0
11	5, 6	03 Feb - 08 Feb	35.8	23	81.2	47	52.5	0
12	6, 7	09 Feb -14 Feb	35.4	25	81.8	61.8	60	0
13	7, 8	15 Feb - 20 Feb	35.5	25.6	79.2	58.8	52.5	5
14	8, 9	21 Feb - 26 Feb	35.2	26.2	79	56.6	32.5	7.5
15	9	27 Feb - 04 Mar	35.9	25.8	79.8	56.4	7.5	12
16	10	05 Mar - 10Mar	35.8	26	76.6	57.6	0	35
17	10, 11	11Mar -16 Mar	37	26.8	71.6	54.2	0	17.5
18	11, 12	17 Mar -22 Mar	38.6	26.4	73.8	59.6	0	0
19	12, 13	23 Mar -28 Mar	37.7	27.4	79	60.8	0	0
20	13, 14	29 Mar -03 Apr	36.6	26.3	79.2	58.8	0	0
21	15	01 Apr- 09 Apr	35.6	25.3	79.3	54.7	0	0

Table 2. Simple correlation between abiotic factors and stem borer, *C. partellus* in sorghum crop during *rabi,* 2021-22.

Abiotic (Weather parameters)	Correlation coefficient (r) (Dead hearts)	Correlation coefficient (r) (White ear heads)
X_1 – Maximum temperature (°C)	0.237046	0.239008
X_2 – Minimum temperature (°C)	0.248276	0.419271
X_3– Morning relative humidity (%)	0.170335	-0.30503
X_4– Evening relative humidity (%)	0.011748	0.201025
X_5– Rain fall (mm)	-	-

***Significant at 5 % level**

Table 3. Multiple linear regression between abiotic factors and sorghum stem borer (Dead hearts and white ear heads) in crop during *rabi,* 2020-21

Multiple linear regression between abiotic factors and sorghum stem borer (Dead hearts)			
Variable	Partial regression coefficient (r)	Standard error	t- value
X_1 – Maximum temperature (°C)	0.803	4.998	0.160
X_2 – Minimum temperature (°C)	1.585	3.787	0.418
X_3 – Morning relative humidity (%)	1.501	1.459	1.028
X_4 – Evening relative humidity (%)	-0.460	1.217	-0.378
X_5– Rain fall (mm)	0.000	0.000	0.000
Regression equation	$Y= -146.04 + 0.803X_1 + 1.585X_2 + 1.501X_3 – 0.460X_4 +(0.00)X_5$		
Intercept (A)	-146.04		
R^2 value	0.137		
Adjusted R^2 value	-0.14		
Multiple linear regression between abiotic factors and sorghum stem borer (White ear heads)			
X_1 – Maximum temperature (°C)	-3.300	1.826	-1.807
X_2 – Minimum temperature (°C)	3.134	1.383	2.264
X_3 – Morning relative humidity (%)	-0.935	0.533	-1.753
X_4 – Evening relative humidity (%)	-0.533	0.444	-1.200
X_5– Rain fall (mm)	0.000	0.000	0.000
Regression equation	$Y= 149.17 - 3.300X_1 + 3.134X_2 – 0.935X_3 – 0.533X_4 +(0.000)X_5$		
Intercept (A)	149.17		
R^2 value	0.363		
Adjusted R^2 value	0.142		

that the stem borer population correlates positively with temperature, relative humidity, rainfall, rainy days and sunshine hour, and opined that the weather parameters had no or little effect on stem borer population. Whereas the correlation studies between sorghum stem borer (% white ear heads) and weather parameters revealed that there was no rainfall recorded, maximum temperature (r = 0.239), minimum temperature (r = 0.419), evening relative humidity (r = 0.201) showed non significant positive correlation. Whereas the morning relative humidity (r = -0.305) showed non significant negative correlation. The results given by Patel and Purohit (2016) mostly in line with present findings that the abiotic factors, maximum and minimum temperature had significant negative association, while, rainfall, rainy days and sunshine hours, wind velocity and evaporation had no significant association with *C. partellus* on *rabi* sorghum.

Similarly, The data on the Table 3. occurrence of sorghum stem borer (% dead hearts) was subjected

to multiple linear regression analysis and the following equation was arrived.

$Y= -146.04 + 0.803X_1 + 1.585X_2 + 1.501X_3 – 0.460X_4 + (0.00)X_5$

The analysis revealed that the abiotic factors were able to cause variation in the incidence of *C. partellus* to the extent of 13.71 per cent ($R^2 = 0.137$) out of which the maximum temperature (r = 0.803) showed significant positive correlation, whereas evening relative humidity (r = -0.460), showed significant negative correlation. Minimum temperature (r = 1.585), and morning relative humidity (r = 1.501) showed non significant positive correlation on the dead hearts incidence by *Chilo partellus*. The incidence of white ear heads was subjected to multiple linear regression analysis and the following equation was arrived.

$Y= 149.17 - 3.300X_1 + 3.134X_2 – 0.935X_3 – 0.533X_4 + (0.000)X_5$

The analysis revealed that the abiotic factors were able to cause variation in the incidence of sorghum stem borer (% white ear heads) to the extent of 36.3 per cent (R2 = 0.363) out of which the maximum temperature, morning and evening RH (r= -3.300, r = -0.935 and r = -0.533, respectively) showed significant negative effect, whereas minimum temperature (r = 3.134) showed showed significant positive correlation.

The results given by Rakesh *et al.* (2022) mostly in line with present findings where correlation studies revealed that morning and evening relative humidity showed a significant positive correlation (r = 0.631, 0.544 and 0.645, respectively) with *C. partellus* population. Further, minimum temperature showed a positive correlation (r = 0.280).

CONCLUSION

The crop sown during 49th and 50th standard week (December, 05-10) of *rabi*, showed a peak incidence of sorghum stem borer with a 60.0% DH during 6th and 7th standard week, during which maximum, minimum temperature of 35.4°C, 25.0°C and the average morning and evening relative humidity of 25.0 and 61.8 per cent and no rainfall was recorded. The multiple linear regression analysis it was observed that all the abiotic factors together accounted for 13.71 per cent variation in stem borer dead hearts incidence ($R^2 = 0.137$), whereas for per cent white ear heads it is accounted for 36.3 per cent (R2 = 0.363).

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