Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 555-558

Received: 11-08-2020
Accepted: 16-10-2020

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Effect of weather parameters on seasonal incidence of root borer, Emmalocera *depressella* (Swinhoe) in sugarcane under terai zone of Northern West Bengal

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Abstract
Study the effect of weather parameters on seasonal incidence of borer complex in sugarcane under Terai zone of Northern West Bengal was conducted during two consecutive years 2017-18 and 2018-19. During seasonal study, It was observed that maximum temperature with maximum relative humidity showed highly significant and significant positive correlation(r=8733** and r=6784*) with % incidence of root borer of sugarcane, respectively and the other parameter *i.e.* minimum temperature, minimum RH showed non significant positive correlation (r = 0.0758, r = 0.1619), respectively, while, the rainfall registered non significant negative relation (r= -0.1331). This is clear that maximum temperature was the influential weather elements for buildup of root borer incidence of sugarcane.

Keywords: sugarcane, root borer, seasonal incidence, weather parameter

Introduction
Sugarcane is a long duration crop of 10-18 months and therefore is liable to be attacked by a number of insect pests and diseases. Economical loss in sugarcane has been estimated to be 20 per cent in cane yield and 15 per cent in sugar recovery due to the ravages of the insect pests [1].Root borer, *Emmalocera deprecella* is unique among borers because it infes*t* underground portion of the canes and is therefore generally referred as root borer. In India, it infests sugarcane in the north Indian sugarcane belt, northern area of Gujrat, Maharashtra, Karnataka, and A.P. When its infestation occur during the early stage of crop growth dead heart are formed but in the grownup canes, no external symptom is discernible except yellowing of leaves and canes have to be dugout to detect its attack. Root borer have been observed to be active at high temperatures and moderate humidity levels and appears to be tolerant to rain to an extent of 45 cm after which population decline [2]. Generally, the ratoon is more infested than planted crop and increase in its acreage helps in the build-up of root borer population. Moreover, borer incidence and population are generally high in unirrigated field and in sandy or sandy loam soils [3]. Hence, keeping in view the pancity of knowledge on the sugarcane entomology under the Terai agro-climatic zone in particular and West Bengal in general, the present study has been undertaken with the objective to study the seasonal incidence of root borer of sugarcane and the role of various abiotic factors on the incidence of pest population.

Materials and Methods
Field trials were conducted on seasonal incidence of root borer of sugarcane and the role of various abiotic factors on the pest population dynamics in the Instructional Farms, Uttar Banga Krishi Viswavidyalaya at Pundibari, Cooch Behar, West Bengal, India during 2017-18 and 2018-19.The sugarcane variety (CoS767) was planted at 90 cm inter row spacing. The plot size was kept 6 × 5.4 m with total no of plots are 20. The crop was grown under normal recommended agronomical practices. The crop was kept free from insecticides to allow natural multiplication of population. Observations were taken at fortnightly interval after germination to till harvest of crop. Root borer % incidence was recorded by counting the healthy and infested canes in each clump to calculate the percentage incidence as follows:

$$\text{Per cent incidences of root borer} = \frac{\text{No of infected canes}}{\text{Total no of canes}} \times 100$$

Statistical analysis

The populations of insect with fortnightly meteorological data were correlated with average maximum, minimum temperature (°C), relative humidity (%) at max and min and total rainfall (mm) to observe the influence of abiotic factors on pest population. The meteorological data during crop season were recorded from Meteorological unit of UBKB.

Results and Discussion

The data on the mean infested shoot (%) during 2017-18 are presented in table 1 and Fig.1. The data reveal that the % incidence of root borer started to build up from the 2nd fortnight of March, 2017. There was steady increase in the % incidence during next two months i.e. March (2.1) and April (4.7 and 6.5). The data indicated that the peak was observed in the 1st fortnight of may (7.3), when the maximum and minimum temperatures (^{0}C) were 30.71^{0}C and 21.45^{0}C, respectively with relative humidity (%) maximum and minimum were 90 and 72, respectively during 2017.The rainfall (mm) was 7.60 mm during 1st fortnight of May, 2017. There after gradually decreasing trend was observed. The % incidence ranged from 0.33 to 7.3 during month March to July. The data of % incidence of root borer during crop season 2018-19 (table 2 and Fig.2), which showed similar trend as the crop season of 2017-18.The % incidence varied 1.3 to 6.4 from 2nd fortnight of March to 1st fortnight July and the peak was recorded 6.4 % in the 1st fortnight of may, when the maximum and minimum temperatures (^{0}C) were 30.01^{0}C and 19.97^{0}C, respectively with relative humidity (%) maximum and minimum were 82 and 70, respectively during 2018. The rainfall (mm) was 4.18 mm during 1stfortnight of May, 2018. The findings are agreement with Sardana [4], who reported that temperature ranging between 31– 34°C combined with high humidity create favourable conditions for this pest, while very low or very high temperatures combined with low humidity negatively impact on pest development. At Pusa, root borer was very active from the beginning of May to mid-June, a period when other borers were rendered almost inactive by the hot weather [5]

Correlation Coefficient

Simple correlation and multiple linear regression equation were worked out between weather factors % incidence of root borer during 2017-18 and presented in Table1a. It was observed that maximum temperature with maximum relative humidity showed highly significant and significant positive correlation(r=8733** and r=6784*) with % incidence of root borer of sugarcane, respectively and the other parameter *i.e.* minimum temperature, minimum RH showed non significant positive correlation (r = 0.0758, r = 0.1619), respectively, while, the rainfall registered non significant negative relation (r= -0.1331). Multiple linear regressions were worked by taking % incidence of root borer as dependant variable and climatic factors as independent variables (Table 1b), which revealed that coefficient of determination (R2 = 0.9123) was significantly high representing 91.23 per cent contribution of the overall abiotic factors on the pest infestation. The data of % incidence of root borer during crop season 2018-19 were observed (Table 2a and 2b) that maximum temperature showed highly significant positive correlation (r=7877**) with % incidence of root borer of sugarcane. The other parameter *i.e.* minimum temperature, maximum RH and minimum relative humidity showed non significant positive correlation (r = 0.4679, r = 0.4521, r = 0.1347), respectively. However, the rainfall showed non significant negative relation (r= -0.3849). This is clear that maximum temperature was the influential weather elements for buildup of root borer incidence of sugarcane. The present findings on root borer incidence were in similar trend with the result of Tanwar & Bajpai [6] who showed that Maximum temperature showed a significant positive correlation with the relative proportion of the borer. Light trap studies in Pakistan indicated that average maximum temperature of 34-37°C, minimum temperature of 20-27°C and RH of 52-70% were conducive to building up borer population levels [7].

Table 1: Seasonal incidence of Root borer, *Emmalocera depressella* (Swinhoe) on Sugarcane during crop season 2017-18

Months	Fortnightly interval	Mean infested shoot (%)	Temperature (^{0}C)		RH (%)		Rainfall(mm) (Av./day)
			Max.	Min.	Max.	Min.	
March, 2017	i	0	28.37	13.89	95.0	49.0	3.13
	ii	2.1	28.45	16.62	90.0	59.0	1.59
Apilr, 2017	i	4.7	30.08	19.24	89.0	59.0	1.53
	ii	6.5	30.51	20.79	92.0	71.0	10.95
May, 2017	i	7.3	30.71	21.45	90.0	72.0	7.60
	ii	3.7	32.78	23.18	91.0	72.0	17.35
June, 2017	i	2.6	33.35	24.68	92.0	73.0	6.31
	ii	2.3	32.25	24.63	92.0	78.0	29.14
July, 2017	i	1.9	31.05	25.23	92.0	80.0	20.23
	ii	0.33	33.11	25.74	90.0	77.0	6.85
August, 2017	i	0	30.96	25.34	97.6	86.26	57.15
	ii	0	33.38	25.91	96.37	75.25	7.63

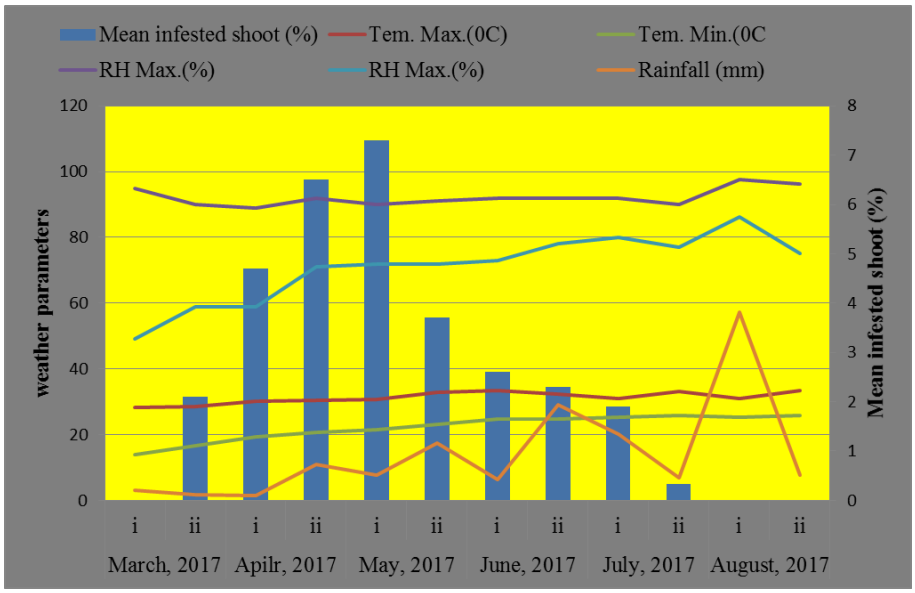

Fig 1: Seasonal incidence Emmalocera *depressella* (2017-18)

Table 1(a): Correlation matrix: Effect of weather parameters on *Emmalocera depressella* on Sugarcane during 2017-18

No. of observation	Effect of weather parameters on root borer	Temperature (^{0}C)		RH (%)		Rainfall (mm)
		Max.	Min.	Max.	Min.	
12	Mean infested shoot (%)	0.8733**	0.0758 NS	0.6784*	0.1619 NS	- 0.1331 NS

* Significant at 5% probability level
** Significant at 1% probability level

Table 1(b): Multiple linear regression models for weather parameters and Seasonal incidence on *Emmalocera depressella* on Sugarcane during 2017-18

No. of observation	Effect of weather parameters on root borer	Pure constant	Temperature (^{0}C)		RH (%)		Rainfall (mm) (X_5)	R^2
			Max. (X_1)	Min. (X_2)	Max. (X_3)	Max. (X_4)		
12	Mean infested shoot (%)	19.8469	0.8917 (1.9868)	0.0616 (0.0946)	-0.2031 (-1.2002)	0.0028 (0.0248)	0.1043 (0.1483)	0.9123
	Contribution	-	72.8363	0.1653	26.5811	0.0113	0.4059	

* Significant at 5% probability level.
** Significant at 1% probability level.
Figure in parenthesis indicate't' value.

Multiple linear regression equation

$$Y_1 = 19.6747+0.8917\ (X_1) + 0.0616\ (X_2) - 0.2031\ (X_3) + 0.0028(X_4) + 0.1043\ (X_5)$$

Table 2: Seasonal incidence of Root borer, *Emmalocera depressella* (Swinhoe) on Sugarcane during crop season 2018-19

Months	Fortnightly interval	Mean infested shoot (%)	Temperature (^{0}C)		RH (%)		Rainfall(mm) (Av./day)
			Max.	Min.	Max.	Min.	
Mar, 2018	i	0	29.38	16.24	72	50	0.43
	ii	1.7	31	17	71	49	5.93
Apr, 2018	i	2.5	31.03	19.01	75	60	10.63
	ii	4.3	29.63	20.20	79	69	3.61
May, 2018	i	6.4	30.01	19.97	82	70	4.18
	ii	5.8	31.78	22.04	86	70	10.90
Jun, 2018	i	3.1	34.03	23.99	82	70	6.06
	ii	2.4	31.24	23.79	91	79	16.24
Jul, 2018	i	1.3	31.2	24.8	92	83	32.6
	ii	0	33.8	26.2	86	75	8.3
Aug, 2018	i	0	33.1	24.1	90	76	20.4
	ii	0	33.90	26.30	86.00	75.00	4.00

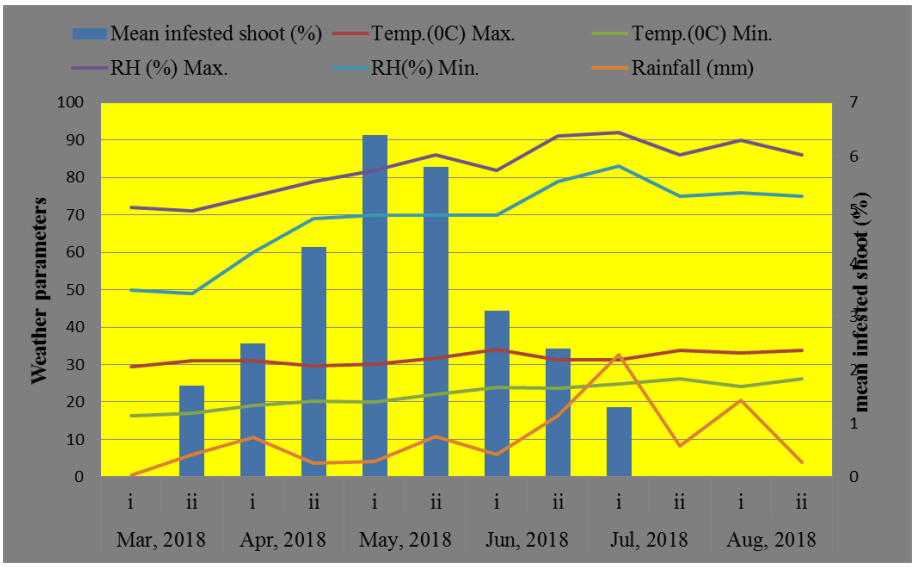

Fig 2: Seasonal incidence of Root borer, *Emmalocera depressella* (2018-19)

Table 2(a): Correlation matrix: Effect of weather parameters on *Emmalocera depressella* on Sugarcane during crop season 2018-19

No. of observation	Effect of weather parameters on root borer	Temperature (^{0}C)		RH (%)		Rainfall (mm)
		Max.	Min.	Max.	Min.	
12	Mean infested shoot (%)	0.7877**	0.4679 NS	0.4521	0.1347 NS	- 0.3849 NS

* Significant at 5% probability level
** Significant at 1% probability level

Table 2(b): Multiple linear regression models for weather parameters and Seasonal incidence on *Emmalocera depressella* on Sugarcane during crop season 2018-19

No. of observation	Effect of weather parameters on root borer	Pure constant	Temperature (^{0}C)		RH (%)		Rainfall (mm) (X_5)	R^2
			Max. (X_1)	Min. (X_2)	Max. (X_3)	Max. (X_4)		
12	Mean infested shoot (%)	23.5702	1.0567 (2.1795)	0.0311 (0.1337)	-0.2673 (-1.7174)	0.0311 (0.1684)	0.1750 (0.2375)	0.9341
	Contribution	-	60.8807	0.2293	37.8038	0.3634	0.7228	

* Significant at 5% probability level
** Significant at 1% probability level
Figure in parenthesis indicate't' value

Multiple linear regression equation

$$Y_1 = 23.5702 + 1.0567 (X_1) + 0.0311 (X_2) - 0.2673 (X_3) + 0.0311(X_4) + 0.1750 (X_5)$$

Conclusion

Study effect of weather parameters on seasonal incidence of root borer indicated that maximum temperature and RH maximum were the congenial weather elements for buildup of root borer incidence of sugarcane.

Acknowledgements

Authors are grateful to the Head, Department of Entomology, UBKV, Pundibari, Cooch Behar (W.B) for providing facilities to carry out the present research.

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