Short Comminucation

Influence of weather parameters on incidence of maize stem borer, *Chilo partellus* (Swinhoe) in summer maize in Punjab, India

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Maize, *Zea mays* (L.) is one of the most important cereal crop, whose demand is expected to touch 42 million tonnes by 2025 (Anonymous, 2011). The average productivity of maize in India (29.67 q ha^{-1}) and in Punjab (39 q ha^{-1}) are low as compared to world's average productivity of 51.85 q ha^{-1} (FAO, 2016). One of the serious limitation in full manifestation of maize yield is the attack of insect pests during different seasons. Maize stem borer, *Chilo partellus* (Swinhoe) is the key pest of summer maize in India causing 26.7 to 80.4 per cent losses in different parts of India (Panwar 2005). Furthermore, it has been reported that the degree of incidence of *C. partellus* varies with alteration in its sowing time (Goyal and Kanta, 2007). Singh *et al.* (2012) had identified weather conditions conducive for incidence of various insect pests of rice in Punjab. The present study was planned to determine the relationship of incidence of *C. partellus* with different weather parameters in Punjab.

The field experiments were conducted at Entomological Research Farm, PAU, Ludhiana and Farmer's field in District Jalandhar of Punjab during summer 2013 and 2014. The maize single cross hybrid (PMH 1) was sown on three dates i.e. last week of May, 10th of June and 25th June following PAU recommendations (Anonymous, 2013). Each treatment plot (3.6 m x 4 m) consisted of 6 rows of 4 m row length with row to row and plant to plant spacing of 60 x 20 cm. The deadhearts incidence of *C. partellus* in the unprotected maize plots was recorded at 7, 14, 21 and 28 days after germination. The meteorological data of Ludhiana and Jalandhar locations for the study period was obtained from School of Climate Change and Agricultural Meteorology, PAU, Ludhiana and Krishi Vigyan Kendra, Jalandhar, respectively. The correlation coefficients between deadhearts incidence caused by *C. partellus* in unprotected maize plots and weather parameters were calculated to examine the extent of linear relationship between these two variables. The deadhearts incidence in maize was modeled with five independent variables such as maximum temperature (T_{max}), minimum temperature (T_{min}), morning relative humidity (RH I), evening relative humidity (RH II) and rainfall (Rain) using stepwise regression technique. The software SAS 9.3 was used for the statistical analysis of the data.

The correlation coefficients obtained between weather parameters and the deadhearts incidence caused by maize stem borer, *Chilo partellus* in unprotected summer maize planted at three different times (pooled over both the locations and both the years) are presented in Table 1. The deadhearts incidence caused by *C. partelllus* was negatively correlated with maximum temperature and it was significant in maize planted on 10th June (r = - 0.55; p=0.02). This deadhearts incidence was found to be positively correlated with minimum temperature and evening relative humidity. This positive correlation of deadhearts incidence in maize sown on 25th June with minimum temperature (r = 0.44; p = 0.09); maize sown on 10th June and 25th June with evening relative humidity (r = 0.49; p = 0.06 and r = 0.45; p= 0.08) was significant at less than 10 per cent level of significance.

The stepwise regression analysis between deadhearts incidence as dependent variable and weather parameters, viz. temperature, relative humidity and rainfall as independent variables are presented in Table 2. The results revealed that maximum temperature and rainfall accounted for 41 per cent variation (R^2=41.1 %) in deadhearts incidence in maize sown during last week of May. It was found that decrease of 1 °C maximum temperature and 1 mm rainfall resulted in 1.89 and 0.10 per cent increase in deadhearts incidence in maize sown during last week of May, respectively. The deadhearts incidence in maize sown on 10th June showed high variation as indicated by R^2 value (68.3 %). It was revealed that the deadhearts incidence in maize sown on 10th June was increased by 5.50, 1.00 and 0.16 per cent with decrease in 1°C maximum temperature, 1 per cent morning relative humidity and 1 mm rainfall, respectively. However, deadhearts

Table 1: Correlation between deadhearts incidence caused by maize stem borer, *Chio partellus* in summer maize planted at three different times and abiotic factors (Pooled over two locations and two years)

Abiotic factors	Last week of May		Maize planted on 10th June		Maize planted on 25th June	
	Correlation	P value	Correlation coefficient (r)	P value	Correlation coefficient (r)	P value
Max. temp (T_{max})	-0.18	0.49	-0.55*	0.02	-0.29	0.28
Min. temp (T_{min})	0.39	0.13	-0.11	0.68	0.44**	0.09
Rainfall (Rain)	-0.19	0.45	-0.01	0.96	0.11	0.70
Relative humidity (morning) (RH I)	0.32	0.22	0.30	0.26	0.26	0.33
Relative humidity (evening) (RH II)	0.26	0.34	0.49**	0.06	0.45**	0.08

P d" ± Significant at ± % level of significance, *Significant at Pd"0.05, ** Significant at Pd"0.10

Table 2: Stepwise regression model of deadhearts incidence on maize (planted at different times) caused by maize stem borer, *Chilo partellus* against abiotic factors

Time of planting	Variable	Parameter estimate	Standard error	t-value	Pr > |t|	Variance Inflation	R^2 (%)	Pr > F	Adj R^2 (%)	MAE
Last week of May	Intercept	85.67	26.97	3.18	0.0073	0	41.14	0.0319	32.09	4.70
	T_{max}	-1.894	0.661	-2.86	0.0133	3.047				
	Rain	-0.10	0.036	-2.89	0.0128	3.047				
10th June	Intercept	287.33	64.38	4.46	0.0008	0	68.34	0.0025	60.43	3.06
	T_{max}	-5.505	1.174	-4.69	0.0005	6.504				
	RH I	-1.003	0.297	-3.37	0.0056	5.990				
	Rain	-0.164	0.075	-2.17	0.0506	1.243				
25th June	Intercept	-77.47	41.94	-1.85	0.0876	0	33.48	0.0706	23.25	2.93
	T_{min}	2.479	1.532	1.62	0.1297	1.029				
	RH II	0.226	0.134	1.68	0.1171	1.029				
Pooled	Intercept	-31.96	25.67	-1.24	0.2196	0	7.69	0.1653	3.59	5.43
	T_{min}	1.252	0.931	1.34	0.1856	1.000				
	RH II	0.080	0.058	1.38	0.1753	1.000				

incidence in maize sown on 25th June decreased by 2.48 and 0.23 per cent with decrease in 1°C minimum temperature and 1 per cent evening relative humidity, respectively. The variation in deadhearts incidence in maize sown on 25th June was about 33 per cent (R^2=33.4%). The pooled analysis of incidence of *C. partellus* in maize at both the locations during both the years revealed that the deadhearts incidence caused by it decreased by 1.25 and 0.08 per cent with decrease in 1°C minimum temperature and 1 per cent evening relative humidity, respectively. This variation in deadhearts incidence was found to be only 7 per cent (R^2=7.69).

The results of the present study revealed that different weather parameters have different influence on the incidence of *C. partellus* in summer maize planted at different times. The present findings are in conformity with that of Mahadevan and Chelliah (1986) who had reported that minimum temperature is positively correlated with the deadhearts incidence in maize as they had observed that 1°C decrease in minimum temperature resulted in 1.69 per cent decrease in *C. partellus* damage. Similarly, Ahad *et al*. (2008) had reported that the adult population of *C. partellus* had positive correlation with minimum temperature and relative humidity; however this population of *C. partellus* was also found to be positively correlated with maximum temperature. On the contrary side, Kandalkar *et al*. (2002)

had reported that the correlation of minimum temperature and *C. partellus* infestation was negatively significant (r = -0.734).

The contradiction in present findings with other workers may be due to different crop season and agroecological conditions in that region as compared to region of this study. The results of the present study concludes that the decrease in maximum temperature, rainfall, morning relative humidity and increase in minimum temperature, evening relative humidity led to increase in the damage caused by *C. partellus* in summer maize.

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