Research Article

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Influence of Climatic Factors on the Incidence of Stem Borer Infesting Sorghum

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ABSTRACT

The study was undertaken to evaluate the effect of abiotic factors on the incidence of Chilo partellus during summer, kharif and rabi seasons of 2024-25 in the hot semi-arid zone of Banaskantha district, Gujarat. The highest mean stem borer infestation was recorded in summer season (11.80% dead hearts), followed by kharif (9.48% dead hearts) and rabi (7.95% dead hearts). Peak dead heart incidence was observed during 19th SMW i.e., second week of May (36.67%) in summer, 34th SMW i.e., 4th week of August (30.00%) in kharif and 1st SMW i.e., 1st week of January (26.67%) in rabi, with a single population peak recorded in each season. Correlation analysis indicated that bright sunshine hours exhibited a significant positive association with stem borer incidence during summer, whereas maximum temperature showed a significant negative association during both kharif and rabi. In kharif season, higher maximum relative humidity was associated with increased stem borer incidence. Multiple regression analysis revealed that the selected weather parameters accounted for 36.00%, 78.00% and 59.00% of the variation in stem borer incidence during all seasons, respectively. Overall, the study emphasizes the crucial contribution of abiotic factors to the seasonal dynamics of C. partellus populations in sorghum.

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth most widely cultivated cereal crop globally, following wheat, rice, maize, and barley. In Gujarat, the crop is predominantly cultivated during the *kharif* (including late *kharif*) and *rabi* seasons. According to Anon. (2025), sorghum occupied an area of 42,660 ha in Gujarat during 2024, producing 66,130 tonnes with an average productivity of 1,550 kg ha^{-1}. About 150 insect species have been recorded on sorghum, including both field and stored conditions. Stem borer is sporadic in nature and highly influenced by the environment (Khadioli *et al.*, 2014). Spotted stem borer, *Chilo partellus* (Crambidae: Lepidoptera), is one of the *Chilo* species that feeds on a wide range of cereals in the tropical regions (Achiri *et al.*, 2022). In India, *C. partellus* is one of the serious insect pests causing 24.3 to 36.3% yield loss (Kaur *et al*., 2020). The weather factors play a key role in determining the incidence and dominance of a pest or pest complex (Meena *et al*., 2013). Understanding the relationship between weather parameters and pest incidence is essential for predicting outbreaks, identifying critical periods of infestation and implementing timely and effective integrated pest management strategies. Therefore, studying the population dynamics of *C. partellus* in relation to abiotic factors provides valuable information for developing location-specific pest forecasting models and sustainable management practices, ultimately contributing to enhanced sorghum productivity.

MATERIALS AND METHODS

Experimental site and crop

The present study was carried out during three consecutive cropping seasons, *i.e*., summer, *kharif* (2024) and *rabi* (2024-25) seasons at the Agronomy Instructional Farm, Sardarkrushinagar, Dantiwada, Gujarat, (India) under open-field conditions. The experimental site is located at 26.47° N latitude and 72.12° E longitude. Sorghum (variety GJ-43) crop was raised following package of practices as recommended by SDAU except the plant protection measures. The weather data was obtained from the Agro-Meteorological Laboratory, C. P. College of Agriculture, Sardarkrushinagar.

Observations recorded

Thirty plants from five quadrats were randomly selected from the field in a zig-zag manner and observations on percent dead hearts were recorded at weekly intervals starting from emergence. The percent dead hearts due to stem borer were calculated based on the total number of plants per plot and the number of plants exhibiting dead heart symptoms.

Statistical analysis

The percent dead hearts with weather parameters were subjected to correlation and regression analysis

using OPSTAT software, whereas data organization and basic computations were carried out using Microsoft Excel (Sheoran *et al*., 1998).

RESULTS AND DISCUSSION

The study revealed that infestation of stem borer prevailed from mid vegetative stage to late reproductive stage. In summer 2024, stem borer was first observed during 16th SMW (Standard Meteorological Week) (3.33% dead hearts). The dead heart percentage caused by larvae increased gradually and attained its peak during 19th SMW (36.67% dead hearts) *i.e*., five WAS (weeks after sowing) and then declined thereafter until the 23rd SMW. In *kharif* 2024, incidence of stem borer was noticed first during 30th SMW (6.67% dead hearts), *i.e*., four weeks after sowing. The dead heart percentage increased gradually and attained maximum (30.00% dead hearts) during 34th SMW. These followed a decreasing trend subsequently until 37th SMW (6.67% dead hearts). In *rabi* 2024-25, first incidence was observed during 50th SMW (6.67% dead hearts) and peak was attained during the 1st SMW (26.67% dead hearts) *i.e*., five weeks after sowing and later incidence decreased gradually and recorded low infestation during 4th SMW (3.33% dead hearts). Throughout the study seasons, only a single peak in pest incidence was observed. Stem borer infestation was first observed during the 5th (WAS) in both summer and *rabi* seasons, whereas its incidence commenced earlier, during the 4th WAS, in *kharif* season. Among the three seasons, the summer crop experienced the highest average infestation, which may be attributed to the prevalence of favourable environmental conditions, particularly warm temperatures and prolonged sunshine hours, which accelerate larval development, enhance survival and facilitate rapid population build-up by recording 11.80% dead hearts, indicating comparatively greater pest pressure in this season.

The present findings are in close agreement with those of Meena and Bhamare (2024), who reported that the first incidence of C. partellus on rabi sorghum was at the 52nd SMW and reached its peak at the 4th SMW. Similarly, Rakesh et al. (2022) observed that the initiation of stem borer infestation occurred during the 33rd SMW, with maximum infestation during the 37th SMW. Sonawane *et al*. (2022) also reported that dead heart symptoms first appeared during the 31st SMW and attained a peak during 43rd SMW, recording 11.42 per cent dead hearts. On maize, Kumar *et al*. (2017) observed the appearance of *C. partellus* during the second week of August, with peak population during 38th SMW (third week of September), while Patel and Purohit (2016) reported that stem borer infestation on *rabi* sorghum commenced during the 48th SMW and reached its maximum during the 50th SMW, corroborating the current findings. Likewise, Suresh Kumar and Arivudainambi (2018) recorded highest larval population during July in the *kharif* season, followed by a gradual decline during the *rabi* season. Divya et al. (2010) also reported greater larval abundance during October (0.4 larvae plant^{-1}) in the kharif season than during the rabi-summer period (0.3 larvae plant^{-1} in February), in agreement with the present study.

The correlation and regression analysis (Table 2) demonstrated that the influence of weather parameters on stem borer incidence varied considerably across the three cropping seasons. In summer 2024, among the six weather variables studied, only bright sunshine hours exhibited a significant positive correlation with stem borer incidence (r = 0.556), whereas maximum temperature, minimum temperature, wind speed and maximum and minimum relative humidity showed non-significant associations. The positive association with sunshine hours suggests that prolonged solar radiation and warmer daytime conditions may favour the development, survival and activity of *Chilo partellus* larvae, thereby promoting higher dead heart incidence. Multiple regression analysis indicated that the combined effect of the weather variables explained 36.00% of the variation in stem borer incidence ($R^2 = 0.36$).

During the *kharif* season of 2024, maximum temperature showed a significant negative correlation (r = -0.556) with stem borer incidence, whereas maximum relative humidity exhibited a significant positive correlation (r = 0.569). No significant relationship was observed between stem borer incidence and the other weather parameters. The negative relationship with maximum temperature indicates that excessively high temperatures prevailing during the *kharif* season may adversely affect egg viability, larval survival or adult activity, thereby suppressing population development. In contrast, higher relative humidity is likely to provide a favourable microclimate for egg hatchability and larval establishment resulting in increased infestation. Regression analysis revealed that the selected weather variables collectively accounted for 78.00% of the variation in stem borer incidence ($R^2 = 0.78$), indicating that climatic factors played a dominant role in regulating seasonal population fluctuations during the *kharif* season.

Table 1: Occurrence of stem borer in sorghum during various seasons

Summer 2024				***Kharif* 2024**				***Rabi* 2024-25**			
Month	**WAS**	**SMW**	**Stem borer Dead heart (%)**	**Month**	**WAS**	**SMW**	**Stem borer Dead heart (%)**	**Month**	**WAS**	**SMW**	**Stem borer Dead heart (%)**
March	1	12	0.00	**July**	1	27	0.00	**November**	1	46	0.00
	2	13	0.00		2	28	0.00		2	47	0.00
April	3	14	0.00		3	29	0.00		3	48	0.00
	4	15	0.00		4	30	6.67	**December**	4	49	0.00
	5	16	3.33	**August**	5	31	10.00		5	50	6.67
	6	17	13.33		6	32	16.67		6	51	13.33
May	7	18	30.00		7	33	23.33		7	52	20.00
	8	19	36.67		8	34	30.00	**January**	8	1	26.67
	9	20	26.67	**September**	9	35	20.00		9	2	23.33
	10	21	20.00		10	36	10.00		10	3	10.00
	11	22	16.67		11	37	6.67		11	4	3.33
June	12	23	6.67		12	38	0.00	**February**	12	5	0.00
	13	24	0.00		13	39	0.00		13	6	0.00
Mean			**11.80**		**Mean**		**9.48**		**Mean**		**7.95**

WAS: Weeks After Sowing, SMW: Standard Meteorological Weeks

In *rabi* 2024-25, both maximum temperature (r = -0.617) and minimum temperature (r = -0.602) exhibited significant negative correlations with stem borer incidence, while all other weather parameters remained non-significant. These results suggest that fluctuations in temperature exerted a major influence on stem borer population during the *rabi* season. The negative correlations may indicate that increasing temperatures during the latter part of the season reduced pest survival and development. In contrast, the relatively cooler conditions prevailing during the early stages of crop growth were conducive to stem borer infestation. Regression analysis showed that the weather variables explained 59.00% of the variation in stem borer incidence ($R^2 = 0.59$), indicating a moderate influence of abiotic factors on pest population dynamics during *rabi*.

The findings of the present study are consistent with those reported by Dindor *et al.* (2022), who found that minimum temperature and wind velocity were negatively associated with *C. partellus* infestation on maize, resulting in reduced plant damage and leaf injury. Similarly, Rakesh *et al.* (2022) reported a highly significant positive association of maximum relative humidity and rainfall, along with a significant positive correlation of minimum relative humidity, with stem borer incidence. Likewise, Sonawane *et al.* (2022) recorded significant positive correlations between stem borer incidence and bright sunshine hours, maximum relative humidity, minimum relative humidity and a highly significant association with minimum temperature. The findings of Patel and Purohit (2016) similarly revealed significant negative correlations between both maximum and minimum temperatures and stem borer incidence, whereas the remaining weather parameters exhibited non-significant relationships, corroborating with current findings. Also, Ahad *et al.* (2010) reported a positive relationship between adult populations of *C. partellus* and relative humidity, while Zulfiqar *et al.* (2008) demonstrated that temperature and relative humidity were the principal meteorological variables governing seasonal fluctuations of *C. partellus* on maize.

The differences in the timing and magnitude of stem borer incidence among seasons and across studies are likely attributable to variations in agro-climatic conditions, sowing dates, crop phenology, host genotype and regional environmental factors. The relatively high coefficient of determination obtained during the *kharif* season indicates that weather variables predominantly governed stem borer population dynamics during this period, whereas the comparatively lower R^2 values recorded during summer and *rabi* suggest that additional factors, including host plant resistance, natural enemy activity and crop management practices, also contributed substantially to seasonal pest fluctuations. These findings highlight the importance of integrating weather-based forecasting with field surveillance for timely implementation of Integrated Pest Management (IPM) strategies against *Chilo partellus* in sorghum.

Table 2: Correlation and regression - weather parameters vs incidence of stem borer on sorghum

Summer 2024

Pest		Abiotic factors					
		Bright sunshine hours (X_1)	Wind speed (km/h) (X_2)	Temperature °C		Relative humidity (%)	
				Max (X_3)	Min (X_4)	Max (X_5)	Min (X_6)
Dead heart (%)	Stem borer	0.556*	0.149NS	0.291NS	0.229NS	0.093NS	-0.319NS
		$Y = -103.25 + 4.12X_1 - 0.82X_2 + 1.66X_3 - 0.79X_4 + 0.50X_5 - 0.26X_6$ $R^2 = 0.36$					

***Kharif* 2024**

Pest		Bright sunshine hours (X_1)	Rainfall (X_2)	Wind speed (km/h) (X_3)	Temperature °C		Relative humidity (%)	
					Max (X_4)	Min (X_5)	Max (X_6)	Min (X_7)
Dead heart (%)	Stem borer	-0.496NS	0.141NS	0.153NS	-0.556*	-0.200NS	0.569*	0.438NS
		$Y = -199.70 - 4.90X_1 + 0.02X_2 + 2.69X_3 + 5.96X_4 - 5.51X_5 + 2.35X_6 - 0.66X_7$ $R^2 = 0.78$						

***Rabi* 2024-25**

Pest		Bright sunshine hours (X_1)	Wind speed (km/h) (X_2)	Temperature °C		Relative humidity (%)	
				Max (X_3)	Min (X_4)	Max (X_5)	Min (X_6)
Dead heart (%)	Stem borer	-0.232NS	0.283NS	-0.617*	-0.602*	0.350NS	0.149NS
		$Y = 59.80 - 0.53X_1 - 3.45X_2 - 1.13X_3 - 1.94X_4 + 0.19X_5 - 0.22X_6$ $R^2 = 0.59$					

NS non-significant; * significant at $p = 0.05$; ** significant at $p = 0.01$; Y = mean number of dead hearts per plant

CONCLUSIONS

The study demonstrated that the seasonal incidence of *Chilo partellus* in sorghum was strongly influenced by prevailing weather conditions, with the highest infestation recorded during the summer season, which was favoured by bright sunshine hours, whereas maximum temperature negatively influenced infestation during *kharif* and *rabi*, while maximum relative humidity promoted pest incidence in *kharif*. These findings provide a scientific basis for weather-based forecasting and timely implementation of integrated pest management strategies.

REFERENCES

Achiri, T. D., Atakan, E., & Pehlivan, S. (2022). Invasive maize spotted stem borer *Chilo partellus* Swinhoe 1885 (Lepidoptera: Crambidae) is the dominant pest in maize agro-system in the Mediterranean Region of Turkey. *Journal of Asia-Pacific Entomology, 25*(4), 101972. https://doi.org/10.1016/j.aspen.2022.101972

Ahad, I., Bhagat, R. M., Ahmad, H., & Monobrullah, M. (2008). Population dynamics of maize stem borer, *Chilo partellus* Swinhoe in Upper Himalayas of Jammu region. *Journal of Bioscience, 16*, 137–138.

Anonymous. (2025). *India stat*. Retrieved February 2025, from http://www.indiastatagri.com/table/agriculture/selected-state-season-wise-area-production-product/1348073

Dindor, M. U., Bharpoda, T. M., Patel, B. H., Chaudhary, R. I., & Patel, R. J. (2020). Population dynamics and influence of weather factors on stem borer, *Chilo partellus* (Swinhoe) infesting maize. *Ecology, Environment and Conservation, 22*(4), 1983–1986.

Divya, K., Marulasiddesha, K. N., Krupanidhi, K., & Sankar, M. (2009). Population dynamics of spotted stem borer, *Chilo partellus* (Swinhoe) and its interaction with natural enemies in sorghum. *Indian Journal of Science and Technology, 3*(1), 70–74.

Kaur, J., Kumar, P., Suby, S. B., Sekhar, J. C., Upadhyaya, A., Bana, J. K., & Yadav, S. R. (2020). Incidence of egg and larval parasitoids of *Chilo partellus* on kharif maize. *Journal of Biological Control, 34*(1), 37–42. https://doi.org/10.18311/jbc/2020/23014

Khadioli, N., Tonnang, Z. E. H., Muchugu, E., Ong'Amo, G., Achia, T., Kipchirchir, I., Kroschel, J., & Le Ru, B. (2014). Effect of temperature on the phenology of *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae): Simulation and visualization of the potential future distribution of *C. partellus* in Africa under warmer temperatures through the development of life-table parameters. *Bulletin of Entomological Research, 104*(6), 809–822. https://doi.org/10.1017/S0007485314000601

Meena, R. S., Ameta, O. P., & Meena, B. L. (2013). Population dynamics of sucking pests and their correlation with weather parameters in chilli, *Capsicum annum* L. crop. *The Bioscan, 8*(1), 177–180.

Meena, S. K., & Bhamare, V. K. (2024). Population dynamics of spotted stem borer, *Chilo partellus* (Swinhoe) and pink stem borer, *Sesamia inferens* (Walker) on rabi sorghum. *Journal of Advances in Biology & Biotechnology, 27*(7), 471–479.

Patel, D. R., & Purohit, M. S. (2016). Effect of different weather parameters on population of stem borer, *Chilo partellus* Swinhoe infesting rabi sorghum. *International Journal of Economic Plants, 3*(1), 001–003.

Patil, S., & Varma, B. (2023). Studies on succession and population dynamics of various insect pests in established sorghum varieties. *Biological Forum—An International Journal, 15*(10), 1419–1422.

Rakesh, S., Singh, U. C., Naveen, Kanchan, B., & Neeraj Kumar. (2022). Seasonal incidence of major insect pests complex of sorghum [*Sorghum bicolor* L. (Moench)]. *The Pharma Innovation Journal, SP-11*(4), 1670–1673.

Ram Kumar, Alam, T., & Mukherjee, U. (2017). Studies on seasonal incidence of *Chilo partellus* (Swinhoe) on maize with relation to abiotic factors. *Journal of Experimental Zoology, 20*(2), 1075–1078.

Sheoran, O. P., Tonk, D. S., Kaushik, L. S., Hasija, R. C., & Pannu, R. S. (1998). Statistical software package for agricultural research workers. In D. S. Hooda & R. C. Hasija (Eds.), *Recent advances in information theory, statistics and computer applications* (pp. 139–143). Department of Mathematics Statistics, CCS HAU.

Sonawane, C. K., Somvanshi, V. L., Khating, S. M., & Ilyas, M. (2022). Population dynamics of major pests of kharif sorghum and their natural enemies and correlation with weather parameters. *The Pharma Innovation Journal, 11*(12), 4601–4605.

Suresh Kumar, R. S., & Arivudainambi, S. (2018). Population dynamics of insect pest on popular maize hybrids. *Life Science Archives, 4*(4), 1417–1422.

Zulfikar, M. A., Sabari, M. A., Raza, M. A., Hamza, A., Hayat, A., & Khan, A. (2010). Effect of temperature and relative humidity on the population dynamics of some insect pests of maize. *Pakistan Journal of Life and Social Sciences, 8*(1), 16–18.

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