

Original Research Article

Population dynamics of spotted stem borer, *Chilopartellus* (Swinhoe) and pink stem borer, *Sesamiainferens* (Walker) on rabi sorghum

ABSTRACT

During the rabi season, the peak populations of *Chilopartellus* and *Sesamiainferens* were observed under specific weather conditions: no rainfall, maximum temperatures of 32.8°C and 31.9°C, minimum temperatures of 16.7°C and 16.2°C, morning relative humidity of 75.83% and 81.47%, afternoon relative humidity of 43.5% and 48.1%, and wind speeds of 20 km/h and 19.7 km/h, respectively. Correlation analysis revealed that the larval population of *C. partellus* infesting rabisorghum had a significantly positive correlation with morning relative humidity and a significantly negative correlation with wind speed. In contrast, the larval population of *S. inferens* showed a positive but non-significant correlation with rainfall, morning relative humidity, and afternoon relative humidity. By monitoring specific weather conditions, such as humidity and wind speed, and understanding their impact on pest populations, effective interventions can be designed to mitigate the damage caused by *C. partellus* and *S. inferens*. This knowledge is crucial for improving crop yields and ensuring sustainable agricultural practices.

Key words - Population, Significant, *C. partellus*, Correlation, *S. inferens*, Relative humidity

Introduction

Sorghum (*Sorghum bicolor* (L.) Moen.), a crop from the grass family Poaceae, is a warm-climate species originally domesticated in Africa. It was first cultivated in regions of Ethiopia or Chad over 5,000 years ago and later spread to India and other countries (Rosentrater and Evers, 2018). Known as “the sugarcane of the desert” or “the camel among crops,” sorghum is a C₄ plant capable of withstanding hot and drought-prone conditions, thriving under both rainfed and irrigated environments (SrinivasRao et al., 2013). In India, sorghum is cultivated over an area of 4.09 million hectares, yielding 3.47 million tonnes with an average productivity of 849 kg per hectare (FAOSTAT, 2020). Primarily grown under rainfed conditions, sorghum is cultivated during the kharif (rainy) and rabi (winter) seasons, predominantly in southern and central India [26-28]. Sorghum is susceptible to several insect pests, including the shoot fly (*Atherigona soccata* Rondani), stem borers (*Chilopartellus* Swinhoe and *Sesamiainferens* Walker), armyworms (*Mythimna separata* Walker and *Spodoptera frugiperda* J.E. Smith), aphids (*Melanaphis sacchari* Zehntner and

34 *Rhopalosiphum maidis* Fitch), midge (*Contarinia sorghicola* Coquillett), head caterpillars
35 (*Helicoverpa armigera* Hubner), hairy caterpillars (*Orgyia* sp., *Olenemendosa* Hubner, and
36 *Somenascintillans* Walker), shoot bugs (*Peregrinus maidis* Ashmead), and the green stink bug
37 (*Nezaraviridula* Linnaeus) in Maharashtra. In sorghum fields, insect pests account for over
38 35% of crop losses, estimated at \$580 million annually in India (Reddy and Zehr, 2004).
39 Among the most severe pests are the shoot fly and stem borers (*Chilopartellus* Swinhoe and
40 *Sesamia inferens* Walker), which pose significant threats in India (Mtiyet al., 2014).

41 **Material and Method**

42 A field experiment, consisting of forty-eight quadrats each measuring 2.70 x 3.00 m²,
43 was conducted to investigate the population dynamics of sorghum stem borers on
44 *rabisorghum*. The study took place at the Research Farm of the Department of Agricultural
45 Entomology, College of Agriculture, Latur (MS) during the rabi season of 2020-2021. The
46 popular sorghum variety Parbhani Moti was sown with a 45 x 15 cm spacing across 48
47 quadrats, following the recommended agronomic practices outlined by VNMKV, Parbhani
48 (Anonymous, 2018). The experiment was conducted under pesticide-free conditions. Data on
49 larval population fluctuations were recorded per quadrat. Larvae were collected from three
50 quadrats separately twice during each meteorological week, and the average number of larvae
51 per quadrat was calculated by dividing the total number of larvae by three. Due to low larval
52 counts, estimating the population per plant was impractical for statistical analysis. Statistical
53 analysis of the data, including simple correlation and multiple regression, was performed
54 using WASP 2.0 software developed by ICAR Research Complex, Goa, to examine the
55 relationship between the larval population of stem borers and weather parameters.

56 **Results and Discussion**

57 **1. Seasonal occurrence of *Chilopartellus* (Swinhoe)**

58 The first incidence of *Chilopartellus* on sorghum was recorded in the 52nd standard
59 meteorological week (SMW) with an average of 2.00 larvae per quadrat. The population
60 peaked at 5.66 larvae per quadrat during the 4th SMW. At this peak population level, the
61 prevailing weather conditions were as follows: no rainfall, a maximum temperature of
62 32.8°C, a minimum temperature of 16.7°C, a morning relative humidity of 75.83%, an
63 afternoon relative humidity of 43.5%, and a wind speed of 20 km/h (Table 1). The results of
64 this investigation align with previous studies. Singh *et al.* (2020) reported a maximum larval
65 population of *C. partellus* on maize during the 31st SMW, with an average of 3.8 larvae per
66 plant. Patel and Purohit (2016) observed that the incidence of *C. partellus* on sorghum began

67 in the fourth week of November (0.06 larvae per plant) and continued until the first week of
68 February, peaking in the second and fourth weeks of December (0.15 larvae per plant).
69 Divya *et al.* (2009) found that the highest number of *C. partellus* larvae were recorded during
70 the 40th SMW (30 larvae per 50 plants) in the kharif season and the 3rd SMW (19 larvae per
71 50 plants) in the rabi-summer season. Achiri *et al.* (2020) noted two major peaks in the larval
72 population of *C. partellus* on maize: one during the first growing season (March-June) and
73 another at the beginning of the second growing season (June-September). Suresh Kumar and
74 Arivudainambi (2018) reported that the peak larval population of *C. partellus* on maize
75 occurred in July during the kharif season, with a decline throughout the rabi season. Ram
76 Kumar *et al.* (2017) found that *C. partellus* on maize appeared in the 2nd week of August and
77 peaked at 2.4 larvae per plant in the 38th SMW (3rd week of September, 2016).

78 **Correlation between weather parameters and *C. partellus* infestation**

79 The results in respect of simple correlations between larval population of *C.*
80 *partellus* infesting sorghum and weather parameters during *rabi* season 2020-21 are presented
81 in (Table.2). The data revealed that before noon relative humidity ($r=0.533^*$) exhibited positively
82 significant correlation with larval population of *C. partellus* and wind speed ($r=-$
83 0.549^*) exhibited negatively significant correlation with larval population of *C. partellus*.
84 However, maximum temperature ($r= -0.185$) and minimum temperature ($r= -0.198$) were
85 negatively non-significant, while rainfall ($r= 0.009$) and afternoon relative humidity ($r= 0.294$)
86 showed positive but non-significant correlation with larval population of *C. partellus*. (Table.1).

87 The findings of the present investigation are consistent with those of Akshay Kumar
88 *et al.* (2020), who reported that maximum and minimum temperatures were negatively
89 correlated with the dead heart percentage of *Chilopartellus* on maize, while relative humidity
90 showed a positive correlation. Additionally, rainfall was positively correlated with dead heart
91 percentage during 2015. Arshad *et al.* (2021) noted that higher relative humidity caused
92 marked fluctuations in the population dynamics of *C. partellus* on maize. Achiri *et al.* (2020)
93 found that temperature and humidity did not significantly affect the mean number of *C.*
94 *partellus* larvae on maize during the first and second cropping seasons. Suresh Kumar and
95 Arivudainambi (2018) observed that the larval population of *C. partellus* was negatively
96 correlated with maximum temperature and had an insignificant relationship with minimum
97 temperature. They also found that increased relative humidity positively correlated with the
98 larval population. Rainfall showed a significant positive correlation with larval population in
99 Karimnagar, Medak, and Renga Reddy districts but was insignificant in Warangal district.

100 Ram Kumar *et al.* (2017) reported a significant negative correlation between *C. partellus*
101 larval population on maize and maximum temperature and sunshine. Minimum temperature
102 had a positive but non-significant effect, while relative humidity had a positive and highly
103 significant effect on the stem borer population. Lekhaet *al.* (2017) demonstrated a significant
104 negative correlation between *C. partellus* on sorghum and mean relative humidity ($r = -0.94$).
105 Patel and Purohit (2016) found that maximum, minimum, and average temperatures had a
106 significant negative association with *C. partellus* on rabi sorghum, while humidity, rainfall,
107 rainy days, sunshine hours, wind velocity, and evaporation showed no significant association.
108 Dindoret *al.* (2016) revealed that minimum temperature and wind velocity negatively
109 impacted *C. partellus* infestation on maize, affecting damaged plants and the leaf injury scale.
110 Zulfiqaret *al.* (2010) indicated that relative humidity and temperature significantly influenced
111 the population of *C. partellus* on maize. Ahadet *al.* (2008) found a positive correlation
112 between the adult population of *C. partellus* and relative humidity.

113 **Regression studies of *C. partellus* infestation on rabi sorghum**

114 Weather based multiple linear regression model was developed in respect of seasonal
115 incidence of *C. partellus* (Y) as a dependent variable and weather parameters (B1 to B6) as
116 independent variables and presented in (Table 2). The regression equation revealed that the
117 various weather
118 parameters had profound influence on seasonal incidence of *C. partellus* on sorghum. The coefficient
119 of determination (R^2) was 0.671 which indicated that different weather parameters contributed
120 67.1 per cent variability in larval population of *C. partellus*.

121 **2. Population dynamics of *Sesamia inferens* (Walker)**

122 The first incidence of *Sesamia inferens* on rabi sorghum was recorded in the 52nd
123 standard meteorological week (SMW), with an average of 1.33 larvae per quadrat. The
124 population reached its peak at 4.00 larvae per quadrat in the 3rd SMW. At this peak
125 population level, the prevailing weather conditions were: no rainfall, a maximum temperature
126 of 31.9°C, a minimum temperature of 16.2°C, a morning relative humidity of 81.47%, an
127 afternoon relative humidity of 48.1%, and a wind speed of 19.7 km/h (Table 1).

128 The findings of the present investigation align with those of Suresh Kumar and
129 Arivudainambi (2018), who reported that the larval population of *Sesamia inferens* on maize
130 was low during the kharif season and peaked in January during the rabi season, with larval
131 populations ranging from 0.80-4.12, 0.60-4.20, and 0.40-4.20 larvae per plant in Karimnagar,
132 Medak, and Warangal, respectively. Sharma *et al.* (2017) observed that the larval population
133 of *S. inferens* on maize increased after the 45th SMW, reached its maximum during the 49th

134 SMW, and then declined until the 7th SMW. Reuolin and Soundararajan (2019) recorded the
135 larval population of *S. inferens* on rice during the 11th SMW (first fortnight of March).
136 Umesh Kumar *et al.* (2018) noted peak larval populations of *S. inferens* on maize (6.17 and
137 6.93 larvae per plant) in the third week of August (34th SMW) during the *kharif* seasons of
138 2016 and 2017, respectively. Sanjay Kumar *et al.* (2017) found that the peak infestation
139 period of *S. inferens* on maize was observed at 70 days after sowing (DAS), with an average
140 of 22.38 pinholes per plant. Deole *et al.* (2017) reported that the larval population on maize
141 peaked at 13.81 and 18.56 larvae per plant in the 12th and 11th SMW during the spring
142 seasons of 2013-14 and 2014-15, respectively. Deole (2016) observed maximum activity of
143 *S. inferens* larvae and adults during the second and third weeks of March (11th and 12th
144 SMW). Singh and Kular (2015) revealed that the maximum incidence of *S. inferens* in a rice-
145 wheat cropping system occurred in September-October (2.76-4.17 per cent), with smaller
146 peaks observed in December and February.

147 **Correlation between weather parameters and *S. inferens* infestation**

148 The results in respect of simple correlations between larval population of *S.*
149 *inferens* infesting sorghum and weather parameters during *rabi* season 2020-21 are presented
150 in **table 1**. The data evidenced that the rainfall ($r= 0.054$), before noon relative humidity ($r=$
151 0.372) and afternoon relative humidity ($r= 0.139$) exhibited positive but non-significant
152 correlation with larval population of *S. inferens*. While, maximum temperature ($r= -0.107$),
153 minimum temperature ($r= -0.168$) and wind speed ($r= -0.401$) showed negative non-
154 significant correlation with *S. inferens* larval population.

155 **Regression studies of *S. inferens* infestation on *rabi* sorghum**

156 Weather based multiple linear regression model was developed in respect of seasonal
157 incidence of *S. inferens* (Y) as a dependent variable and weather parameters (B1 to B6) as
158 independent variables and presented in **table 2**. The regression equation revealed that the various
159 weather
160 parameters had profound influence on seasonal incidence of *S. inferens* on sorghum. The coefficient
161 of determination (R^2) was 0.433 which indicated that different
162 weather parameters contributed 43.3 percent variability in larval population of *S. inferens*.

163 **Conclusion**

164 The study investigated the relationship between weather conditions and the populations of
165 *Chilopartellus* and *Sesamia inferens* on *rabi* sorghum. *C. partellus* was significantly affected
166 by morning humidity (positively) and wind speed (negatively). *S. inferens* showed a positive
167 but non-significant correlation with rainfall and humidity. Understanding these correlations

168 helps predict pest outbreaks and plan effective interventions, improving crop yields and
169 promoting sustainable agriculture. This information is valuable for farmers, agricultural
170 services, researchers, and policymakers in developing precise pest management strategies.

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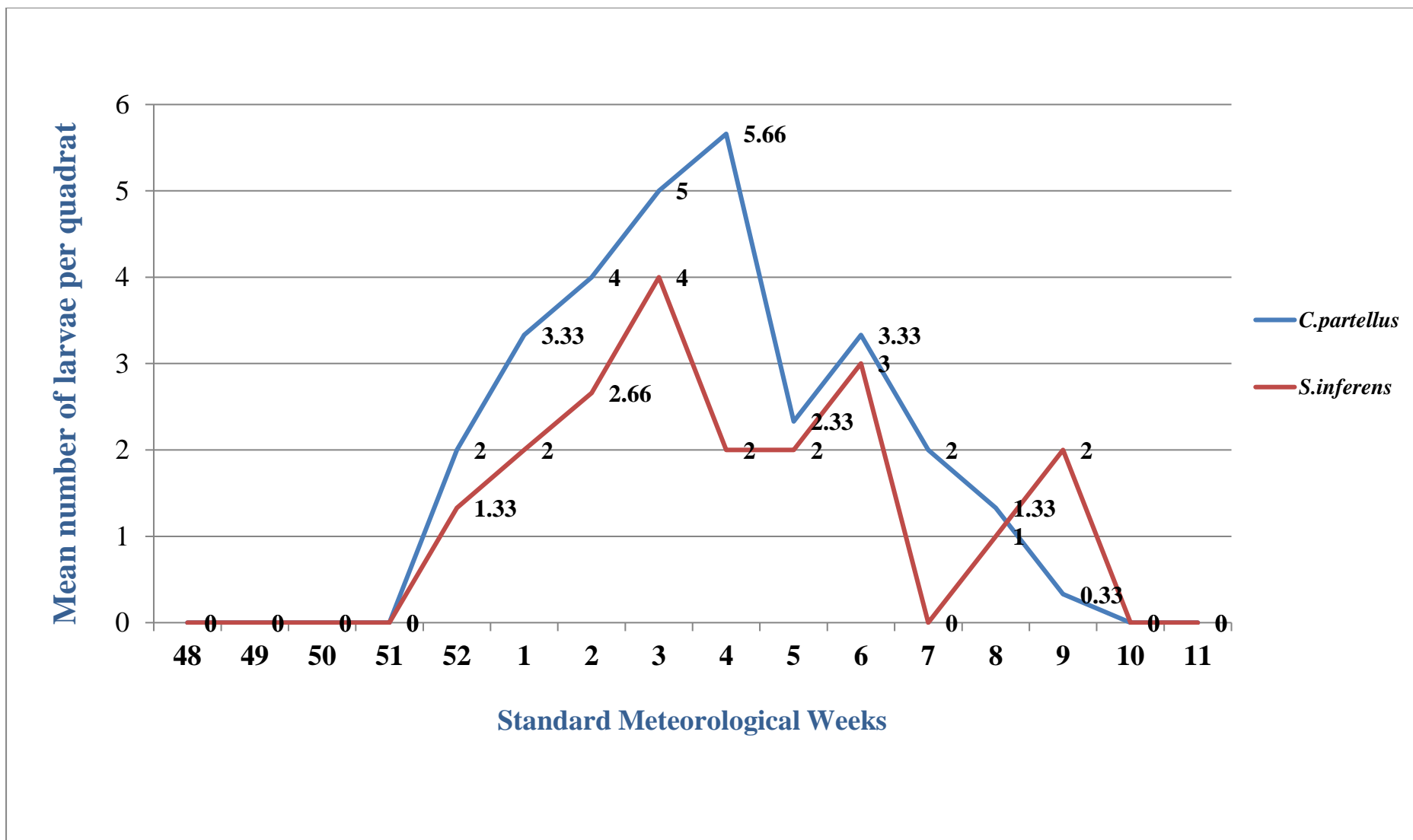
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Fig. 1: Population dynamics of *C. partellus* and *S. inferens* sorghum in relation to weather parameters during *rabi* season 2020-21

Table 1: Population dynamics of *C. partellus* and *S. inferens* on sorghum in relation to weather parameters during *rab* season 2020- 21

Month	Standard Meteorological Weeks	Rainfall (mm)	Temperature (°C)		Relative Humidity (%)		Wind speed (Km perh)	Mean number of larvae per quadrat	
			Min.	Max.	Before noon	After noon		<i>C. partellus</i>	<i>S. inferens</i>
November 2020	48	-	17.5	29.4	79.4	64.5	22.3	0	0
December 2020	49	-	13.1	31.3	67.4	39.5	21.6	0	0
	50	-	15.6	31.2	67.7	45.2	21.4	0	0
	51	-	12.2	29.5	74.4	42.4	20	0	0
	52	-	12.8	30.5	75.4	43.6	18.4	2.00	1.33
January 2021	1	-	16.5	30.4	91.2	53.4	18.7	3.33	2.00
	2	1.00	16.86	31.9	82.53	51.5	19.9	4.00	2.66
	3	-	16.2	31.9	81.47	48.1	19.7	5.00	4.00
	4	-	16.7	32.8	75.83	43.5	20	5.66	2.00
	5	1.25	15.39	31.6	76.99	37.7	23.1	2.33	2.00
February 2021	6	0.5	11.99	30.9	60.24	32.5	21.7	3.33	3.00
	7	-	15.44	32.9	65.86	36.3	24	2.00	0
	8	6.25	14.6	30.8	72.9	39.6	25.7	1.33	1.00
	9	-	18.49	36	48.81	24.8	26.1	0.33	2.00
March 2021	10	-	23.4	37	42.48	25.8	26.1	0	0
	11	-	19.1	36.7	42.31	22.3	27.8	0	0
'r' values of <i>C. partellus</i>		0.009	-0.185	-0.198	0.533*	0.294	-0.549*		
'r' values of <i>S. inferens</i>		0.054	-0.107	-0.168	0.372	0.139	-0.401		

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Table2:Multipleregressionsofweatherparameterswith*C.partellus*and
inferensonrabisorghum

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Multipleregressionsofweatherparameterswith<i>C.partellus</i>onrabisorghum				
Weatherparameters	Reg.coefficients (b)	SE (b)	Ttest	T table(0.05)
Rainfall(mm)(B1)	0.221	0.317	0.698	2.262
Maximumtemperature(°C)(B2)	1.315	0.707	1.860	2.262
Minimumtemperature(°C)(B3)	-0.375	0.408	-0.919	2.262
Beforenoonrelative humidity(%)(B4)	0.127	0.083	1.529	2.262
Afternoonrelativehumidity(%)(B5)	0.029	0.133	0.218	2.262
Windspeed(kmper h) (B6)	-0.400	0.331	-1.210	2.262
Intercept(a) =-35.694 Coefficientofdetermination(RSquare) =0.671 Multiple Correlation Coefficient (R) =0.819 StandardError = 1.440 Theregressiononequationworked outisasfollow. $Y = -35.694 + (0.221) \times B1 + (1.315) \times B2 + (-0.375) \times B3 + (0.127) \times B4 + (0.029) \times B5 + (-0.400) \times B6 + 1.440$				
Multipleregressionsofweatherparameterswith<i>S.inferensonrabisorghum</i>				
Weatherparameters	Reg.coefficients (b)	SE (b)	T test	T table(0.05)
Rainfall(mm)(B1)	0.141	0.281	0.500	2.262
Maximumtemperature(°C)(B2)	0.593	0.627	0.946	2.262
Minimumtemperature(°C)(B3)	-0.137	0.362	-0.378	2.262
Beforenoonrelative humidity(%)(B4)	0.075	0.073	1.019	2.262
Afternoonrelativehumidity(%)(B5)	-0.024	0.118	-0.206	2.262
Windspeed(kmper h) (B6)	-0.252	0.293	-0.859	2.262
Intercept(a) =-14.330 Coefficientofdetermination(RSquare) =0.433 Multiple Correlation Coefficient (R) =0.658 StandardError = 1.277 Theregressiononequationworked outisasfollow. $Y = -14.330 + (0.141) \times B1 + (0.593) \times B2 + (-0.137) \times B3 + (0.075) \times B4 + (-0.024) \times B5 + (-0.254) \times B6 + 1.277$				

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