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Seasonal incidence of termites and their correlation with meteorological parameters in chickpea crop

Shivani Choudhary, HL Deshwal and Manoj Kumar Gurjar

Abstract
The investigation was conducted at Agronomy Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University; Bikaner during two consecutive seasons *i.e. Rabi* 2021-22 and 2022-23 to study the seasonal incidence of termites in chickpea crops. The incidence of the termite in chickpea fields was observed throughout the crop season which ranged from 12.4 to 74.0 per stick. The maximum population of termites (72.02 to 74.0 per stick) was recorded in the last week of November to the first week of December during both the year of study. The initial damage of termites in chickpea crops cause seedling mortality and substantially tunneled the roots and stem. The correlation studies during both Years indicated that the population of termites had a significant positive correlation with both maximum (r= 0.821 & 0.833) and minimum temperatures (r= 0.602 & 0.742) whereas, a significant negative correlation with maximum (r= -0.686 & -0.633) and minimum relative humidity (r= -0.776 & -0.668).

Keywords: Seasonal incidence, termite, chickpea, correlation, and regression

Introduction
Chickpea, *Cicer arietinum* (L.) is one of the most important *Rabi* season pulse crops grown on about 9.0 million hectares worldwide, out of which about 70 percent is grown in India (Anonymous, 2019) [1]. It is considered as "king of pulses". In India, the area under Chickpeas is 9.99 million hectares with an annual production of about 11.91 million tones and productivity of 1192 kg/ ha. (Anonymous, 2020-21) [2]. In Rajasthan, chickpeas occupied 2.11 million hectares of area and an annual production of 2.26 million tones with a productivity of 1072 kg/ha (Anonymous, 2020-21) [2]. Chickpea is a rich source of protein (18-22%), carbohydrate (52-70%), fat (4-10%), mineral (calcium, phosphorus, iron), and vitamins B and C.
The chickpeas are attacked by more than 36 species of insect pests, out of them termite is the major significance of this crop. Termite damage the seedling by cutting just below or above the soil surface. In mature plants, it feeds on roots and inside the stem. Infested plants dry up and can be easily pulled out. Termites are regular pests in tropical and sub-tropical parts of India. In Rajasthan, the situation is more alarming as the termite inflict heavy damage to the crops in sandy loam soils. The yield is reduced drastically because the losses are inflicted at or near maturity and cannot be compensated (Verma and Kashyap, 1980) [13]. The yield loss due to termite damage is range from 50-100 percent. The chickpea roots and stem are tunneled by termites (*Odonto termes* spp.) inside which they feed remaining under the earthen galleries (Gaur *et al.,* 2010) [7]. The knowledge of the seasonal abundance of pests will certainly be helpful in formulating management strategies; hence, the present study was taken up to investigate the correlation between the termite population and meteorological parameters to deduce the most favorable conditions of the pest outbreak.

Materials and Methods
The present investigations were conducted at Agronomy Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University; Bikaner during two consecutive seasons *i.e. Rabi* 2021-22 and 2022-23 To study the seasonal incidence of termite chickpea variety, GNG-1958 was sown in the 30th October during *Rabi*, 2021 – 22 and 4th November during *Rabi* 2022- 23 in 9 X 10 m^2 size keeping row to row and plant to plant distance of 30 cm and 10 cm, respectively. The recommended agronomic package of practices was adopted for raising the crop excluding the plant protection measures. The crop has been allowed for natural infestation.

For recording observation on termites (seasonal incidence of workers), 25 wooden sticks of Eucalyptus (about 2 cm diameter, 1 m length) were installed at the time of sowing at the depth of 15 cm at different places in the plot. The termite counts were recorded by observing each wooden stick starting from 20 DAS till the maturity of the crop at ten days intervals and again reinstalling the stick. The whole experimental plot was kept free from pesticide application.

Results and Discussion

In the present study, during *Rabi*, 2021 – 22 and 2022- 23, on the chickpea crop (variety, GNG-1958) the incidence of the termites was observed throughout the crop season which was ranged from 12.4 to 74.0 per stick. The maximum population of termites (72.02 to 74.0 per stick) was recorded in the last week of November to the first week of December during both the year of study. The initial damage of termite in chickpea crops cause seedling mortality and substantially tunneled the roots and stem. The present study is conformity with that of Nautiyal, (2002) [11], Gour *et al.* (2010), Gadhiya (2013) [6], Prasad and Intodia, (2013) [12], Kumar *et al.* (2020) [9] and Meena *et al.* (2023) [10]. Kumar *et al.* (2017) [8] reported that the termites *Microtermes obesi* (Holmgren) and *Odonto termes obesus* (Rambur) is a major problem in wheat, chickpea, and maize crops, attacks throughout the crop growth by feeding on roots or the root zone, during seedling stage and near maturity. Channabasava and Borad (2019) [4] noticed the peak incidence (50.2 per stick) of termite in cotton crop in the last week of November also support the present finding. Avinash and Kumar (2019) [3] reported the maximum termite infestation to bait in the month of October. The termites are insect pests of regional importance particularly in Rajasthan and Haryana (DPPQ&S, 2001) corroborating the present finding.

The correlation studies during both years indicated that the population of termites had a significant positive correlation with both maximum (r= 0.821 & 0.833) and minimum temperatures (r= 0.602 & 0.742) whereas, a significant negative correlation with both maximum (r= -0.686 & -0.633) and minimum relative humidity (r= -0.776 & -0.668). However, rainfall showed a negative non-significant correlation (r=-0.462) during the first year and during the second year the rainfall not occurred. The multiple linear regression (MLR) analysis explained 78.80 and 85.40 percent variation in termite population due to the combined contribution of all-weather parameters. While, alone maximum temperature accounted for about 67.30 and 69.30 percent variation in termite population which was found to have the highest contribution in influencing the termite population among the other weather parameters during the first and second year, respectively. The results are in conformity with that of Channabasava and Borad (2019) [4] who reported a significant positive correlation of termite incidence with maximum temperature and negative with relative humidity. Avinash and Kumar (2019) [3] also reported a positive correlation between termites with minimum temperature and rainfall.

Table 1: Seasonal incidence of termites in chickpea crop and their correlation with meteorological parameters during *Rabi*, 2021-22

S. No.	Date of observations	Termite population/ stick	Temperature ºC		Relative Humidity (%)	
			Max.	Min.	Max.	Min.
1.	20.11.21	70.2	29.4	9.1	63.1	27.0
2.	30.11.21	74.0	29.95	9.15	66.8	23.1
3.	10.12.21	60.4	25.05	8.15	87.7	40.0
4.	20.12.21	42.2	22.75	3.6	75.5	23.4
5.	30.12.21	36.0	23.9	5.55	76.6	40.6
6.	09.01.22	20.6	20.05	7.5	83.7	56.6
7.	19.01.22	15.4	18.5	4.9	89.0	53.4
8.	29.01.22	12.4	20.6	6.35	84.2	47.1
9.	08.02.22	35.8	27.35	9.6	76.5	24.3
10.	18.02.22	55.2	29.35	11.15	73.8	22.6
11.	28.02.22	62.4	30.75	13.05	78.8	26.7
12.	10.03.22	68.6	39.65	18.5	73.7	16.3
Correlation coefficient			0.821**	0.608*	-0.686*	-0.776**

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed),

Table 2: Seasonal incidence of termites in chickpea crop and their correlation with meteorological parameters during *Rabi*, 2022-23

S. No.	Date of observations	Termite population/ stick	Temperature ºC		Relative Humidity (%)	
			Max.	Min.	Max.	Min.
1.	24.11.22	68.2	30.07	10.85	71.3	29.7
2.	04.12.22	70.2	29.38	6.55	66.6	26.7
3.	14.12.22	58.0	27.93	7.42	75.9	28.7
4.	24.12.22	48.2	26.81	5.29	80.5	28.5
5.	03.01.23	32.8	21.52	2.99	80.7	37.4
6.	13.01.23	18.6	21.15	1.38	84.3	35.7
7.	23.01.23	12.2	21.29	2.11	77.1	31.6
8.	02.02.23	11.4	20.56	3.68	82.3	40
9.	12.02.23	36.8	26.65	6.69	71.7	32.4
10.	22.02.23	45.4	30.86	8.98	62.4	23.5
11.	04.03.23	54.0	34.09	13.22	65.5	19.4
Correlation coefficient			0.833**	0.742**	-0.633*	-0.668*

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 3: Multiple regression models developed for termites during *Rabi*, 2021-23

Year	Regression equation	R^2
2021-22	$Y=-106.19^a+(7.17)T_{max}+ (-5.44)T_{min} + (-0.03) RH_{max}+ (0.39) RH_{min}$	0.788
	$Y=-35.10^a+ (3.07) T_{max}$	0.673
	$Y=16.53^a+ (3.33) T_{min}$	0.370
	$Y=195.65^a+ (-1.93) RH_{max}$	0.470
	$Y=88.55^a+ (-1.27) RH_{min}$	0.602
2022-23	$Y=-433.298^a+(13.49) T_{max}+(-6.19)T_{min}+ (0.72) RH_{max}+ (3.42) RH_{mor}$	0.854
	$Y=-57.99^a+ (3.77) T_{max}$	0.693
	$Y=15.05^a+ (4.20) T_{min}$	0.550
	$Y=175.17^a+ (-1.80) RH_{max}$	0.401
	$Y=111.93^a+ (-2.32) RH_{min}$	0.446

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