Biological Forum – An International Journal **15(5a): 165-170(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of different Sowing Dates on Occurrence of Maize Stem Borer [*Chilo partellus* (Swinhoe)] in *Kharif* Maize

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(Received: 03 April 2023; Revised: 27 April 2023; Accepted: 03 May 2023; Published: 15 May 2023)
(Published by Research Trend)

ABSTRACT: The present investigation was conducted on Agronomy Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during *Kharif* 2018 with the objective of seasonal incidence of maize stem borer, effect of different sowing dates on its incidence and their correlations with the environmental factors. During the crop season in *Kharif* 2018, the maximum leaf injury (8.30 mean LIR) by *Chilo partellus* was recorded in the second week of August at 30th days after sowing. The dead heart incidence first appeared during last week of July and reached to its peak (3.00 per cent) during second week of August at 30th days after sowing. The pest showed significant negative correlation with mean relative humidity but non-significant with mean atmospheric temperature and total rainfall. During crop season, the effect of six dates of sowing was observed on the basis of seasonal mean the maximum larval population was recorded in the second date of sowing (6th August), while minimum larval was found in the last date of sowing (3rd September) in both varieties. However, in the first date of sowing *C. partellus* larval population showed a significant positive correlation with mean atmospheric temperature in both the varieties. In the last date of sowing *C. partellus* larval population showed a significant positive correlation with total rainfall in maize variety Pratap Hybrid Maize-3. While, in the first and last date of sowing *C. partellus* larval population showed a significant positive correlation with total rainfall in maize variety Pratap QPM. *C. partellus* larval population showed a significant positive correlation in different dates of sowing. The overall results indicate that the per cent infestation of maize stem borer can be minimized by sowing the crop in mid-July. It would be a cumbersome work to uproot and dissected the infested plants on every observation. This study will be helpful in the facilitating to scientific community as well as farmers regarding the occurrence of *C. partellus* in maize crop.

Keywords: *Chilo partellus,* environmental factors, incidence, *Kharif* maize.

INTRODUCTION

Maize (*Zea mays* L.) is an important cereal crop belonging to the family, Poaceae and is an originated South America. Maize is cultivated for various purposes including grain, fodder, green cobs, sweet corn and baby corn. It is the third most important cereal crop in India after Wheat and Rice. It has the highest genetic yield potential among the cereal crops and accounts for 9 per cent of total food grain in the country. In India; Karnataka, Rajasthan, Andhra Pradesh, Maharashtra, and Uttar Pradesh, are the major maize producing states. Maize contains about 10.5 per cent protein, 4.0 per cent oil, 70 per cent carbohydrates, 2.3 per cent crude fibers, 10.4 per cent albuminoids, 1.4 per cent ash (Khan *et al*., 2014). It has significant quantities of vitamin A, nicotinic acid, riboflavin and vitamin E. Maize is low in calcium, fairly high in phosphorus. It can be used for manufacturing starch, alcohol, acetic acid, lactic acid, syrup, vinegar, resin powder, fuel for torpedoes, artificial leather, boot polish etc. The green cobs are roasted and consumed by the people with great interest. Maize grains are milled into broken grits for making grovel for human consumption. Maize is globally cultivated on an area of 178.55 mha with production of 872.8 MT and productivity of 4888 kg/ ha (Anon., 2016) and in India during 2016-17, maize occupied 8.69 million hectares of areas with an estimated production of 21.80 MT and productivity of 2509 kg/ha. In Rajasthan, the area under cultivation during *Kharif* was highest compared to other maize growing states. It is grown in Udaipur, Rajsamand, Bhilwara, Chittorgarh, Ajmer, Sirohi, Banswara and Dungarpur districts mainly during *Kharif* season during 2016-17. Maize occupied 0.88 million hectares area with an estimated production of about 1.14 MT and productivity was 1318 kg/ha (Anon., 2016). The average productivity in Rajasthan is much below the national average. It is one of the most adapted crops for the agro-climatic condition of the semiarid tropics of

southern Rajasthan (Zone IV) and can be successfully grown in *Kharif*, *Rabi* and *Zaid*. The multiple pest complex of maize crops poses serious limitations in the maize production in different agro-climatic regions of India. As many as 141 insect pests cause varying degrees of damage to maize crops, right from sowing till the harvest (Reddy and Trivedi 2008). Amongst the maize stem borer, is one of the serious insect pests *Chilo partellus* (Swinhoe). The loss due to *C. partellus*, varied from 26.7 to 80.4 per cent in different agro-climatic regions of India (Chatterji *et al*., 1969). The principal aim of the management of pest population is to hold pest below the economic injury level which has more relevance in relatively short duration crops like maize. Several insecticidal recommendations have been made from time to time by various workers for the control of this pest. As the return per unit area is very low, many farmers avoid using costly pesticides; hence the exact time of this pest's incidence and the different environmental factors play crucial role in its management. Keeping this view, the seasonal incidence and the effect of different sowing dates in the management of maize stem borer was studied in the present investigation.

MATERIALS AND METHODS

Site and location of the experiment. The present investigation was carried out at the Agronomy farm, Rajasthan College of Agriculture, Udaipur, during *Kharif*, 2018. Udaipur is located at 23.4°N longitudes and 75°E latitude at an elevation of 579.5 MSL (Mean Sea Level) in the state of Rajasthan.

Climatic condition of the location. The zone has a typical sub-tropical climatic condition characterized by mild winters and moderate summers associated with high humidity especially during the months of July to September. The average annual rainfall of this tract ranges between 450-650 mm, which is contributed by Southwest monsoons from July to September and occasional rain during the winter season. During summer, the temperatures may go as high as 42°C, while in winter it may fall to as low as 4.5°C. This region provides a safe and long growing season for most of the crops.

Meteorological data. The weekly meteorological data of abiotic factors *viz*., temperature (maximum and minimum), relative humidity (morning and evening) and total rainfall were obtained from Meteorological Observatoryof Agronomy farm, Rajasthan College of Agriculture, Udaipur.

Seasonal incidence of insect pests in maize ecosystem. The experiment for seasonal incidence of maize stem borer conducted in three plots, each with size of 4.5 m × 3.0 m with row to row and plant to plant spacing of 75 cm × 20 cm, respectively. The incidence of maize stem borer was recorded on variety Pratap M-9 from 7 days after germination till harvest of the crop at weekly intervals.

Observations. The incidences of maize stem borer infestation were studied in terms of number of plants showing leaf injury symptoms and number of plants with dead hearts. The observations were recorded till 30 DAS from central two rows (each row comprising of 15 plants) of each plot at weekly intervals. Ten randomly selected and tagged plants at weekly intervals during morning hours between 6:30 a.m. to 8:00 a.m. when most of the larvae were less active.

Incidence of *C. partellus* on different sowing dates. The effect of different sowing dates on *C. partellus* was evaluated on two different varieties of maize in a field trail that containing at least 6 sowing of each variety. There are total 12 plots and the row to row and plant to plant spacing is and 75 cm × 20 cm respectively.

Observations. The crop was sown from the start of crop season and at least 6 sowings were done at weekly intervals. The observations were start after one week of germination and continued up to 60 day of the crop. Infested plants were uprooted and dissected to record the *C. partellus* larvae as number/each observation.

Statistical Analysis. Population data of maize stem borer obtained was subjected to statistical analysis to find out the coefficient of correlation with average temperature, relative humidity and rainfall, which was obtained from the Meteorological Observatory, Rajasthan College of Agriculture, Udaipur. Simple correlations were worked out between the population of insect pests and abiotic factors by using Karl Pearson's coefficient of correlation (Steel and Torry 1980).

RESULTS

Maize stem borer seasonal incidence

Leaf injury rating. Perusal of presented data (Table 1), on the occurrence of *C. partellus* larvae revealed that the leaf injury first appeared during third week of July with 1.50 leaf injury rating and reached to its peak 8.30 leaf injury rating during second week of August under the prevalence of mean atmospheric temperature (26.01°C), mean relative humidity (79.50 per cent) and total rainfall (27.20 mm) at 30th days after sowing of maize in the experimental field during, 2018. Coefficient of correlation between leaf injury from *C. partellus* and weather parameters revealed that the leaf injury rating showed non-significant correlation with mean atmospheric temperature, mean relative humidity and total rainfall.

Per cent dead hearts. It is evident from the data (Table 1) on the occurrence of *C. partellus* on maize crop revealed that the dead heart incidence (1.60 per cent) first appeared during last week of July and reached to its peak (3.00 per cent) during second week of August at 30th days after sowing of maize in the experimental field during, 2018. During this period, mean atmospheric temperature (26.59°C), mean relative humidity (67.07 per cent) and total rainfall (0.00 mm). The pest showed significant negative correlation with mean relative humidity (r = -0.771) but non-significant with mean atmospheric temperature and total rainfall during the cropping season 2018.

Incidence of *C. partellus* on different sowing dates

Maize variety (Pratap Hybrid Maize-3). The data recorded on the incidence of *C. partellus* on maize variety (Pratap Hybrid Maize-3) during six different

sowing dates is presented in Table 2. The effect of six dates of sowing *viz.*, 30th July, 6th August, 13th August, 20th August, 27th August and 3rd September, 2018 were evaluated on the incidence of *C. partellus* in maize. In each case incidence of *C. partellus* started after seven days of germination. The initial population of *C. partellus* in different sowing plots varies from 0.75 to 1.75 *C. partellus* per ten plants. The maximum (1.00 to 2.00 *C. partellus* per ten plants) larvae of *C. partellus* were recorded in the second week of observations in all dates of sowing and thereafter declined continuously as the crop matured. On the basis of seasonal mean the maximum larval population (1.21) was recorded in the second date of sowing (6th August), while minimum larval population (0.63) was found in the last date of sowing (3rd September). However, the *C. partellus* larval population in different dates of sowing did not show any significant correlation with mean atmospheric temperature except first date of sowing (30th July). In the first date of sowing *C. partellus* larval population showed a significant positive correlation (r = 0.849) with mean atmospheric temperature. Same trend was also recorded for rainfall excluding the last date of sowing (3rd September). In the last date of sowing *C. partellus* larval population showed a significant positive correlation (r = 0.859) with total rainfall. While *C. partellus* larval population showed a significant positive correlation in different dates of sowing *viz.*, 6th August (r = 0.845), 13th August (r = 0.958), 27th August (r = 0.961) and 3rd September (r = 0.835) with mean relative humidity except two dates of sowing 30th July and 20th August.

Maize variety (Pratap QPM). The data recorded on the incidence of *C. partellus* on maize variety (Pratap QPM) during different six sowing dates is presented in Table 3. The effect of six dates of sowing *viz.*, 30th July, 6th August, 13th August, 20th August, 27th August and 3rd September, 2018 were evaluated on the incidence of *C. partellus* in maize. The incidence of *C. partellus* in all dates of sowing in maize crop started seven days after germination. The initial population of *C. partellus* in different sowing plots varies from 0.75 to 2.50 *C. partellus* per ten plants. The maximum (1.00 to 3.25 *C. partellus* per ten plants) larvae of *C. partellus* were recorded in the second week of observations in all dates of sowing and thereafter declined as the crop matured. *C. partellus* incidence on the basis of seasonal mean the maximum larval population (2.08) was recorded in the second date of sowing (6th August), while the minimum larval population (0.63) was found in the last date of sowing (3rd September). However, the *C. partellus* larval population in different dates of sowing did not show any significant correlation with mean atmospheric temperature except first date of sowing (30th July). In the first date of sowing *C. partellus* larval population showed a significant positive correlation (r = 0.926) with mean atmospheric temperature. Same trends also recorded for rainfall excluding first (30th July) and last date of sowing (3rd September). In the first and last date of sowing *C. partellus* larval population showed a significant positive correlation (r = 0.945 and r = 0.932, respectively) with total rainfall. While *C. partellus* larval population showed a significant positive correlation in two dates of sowing *viz.*, 13th August (r = 0.915) and 27th August (r = 0.930) with mean relative humidity.

DISCUSSIONS

A. Maize stem borer seasonal incidence

During the crop season, leaf injury by *C. partellus* first appeared during third week of July to continuous first week of September and reached to its peak 8.30 leaf injury rating during second week of August at 30th days after sowing of maize in the experimental field during, 2018. Coefficient of correlation between leaf injury from *C. partellus* and weather parameters showed non-significant. The occurrence of *C. partellus* on maize crop revealed that the dead heart incidence first appeared during last week of July and reached to its peak (3 %) during second week of August at 30th days after sowing of maize in the experimental field during, 2018. The pest showed significant negative correlation with mean relative humidity but non-significant with mean atmospheric temperature and total rainfall. Similar findings have been made by many earlier workers. Kandalkar *et al*. (2002) observed that only minimum temperature showed significant and negative correlation with stem borer leaf injury and also reported that maximum temperature, morning and evening RH, and rainfall did not influence stem borer incidence significantly and the highest infestation of stem borers was recorded in the month of August followed by July and September months. Relatively more infestation (11.54 to 15.41 per cent) was observed during early stages of the crop growth (20-70 days). Raiger *et al*. (2002) reported that the incidence in terms of leaf injury was started in third week of August and dead hearts were formed a week later. Bhagat *et al.* (2008) reported that mean infestation (dead heart + leaf infestation) of stem borer ranged from 0 to 23.16 per cent during *Kharif* season. Biradar *et al.* (2011) conducted an experiment to study the seasonal incidence of insect pests and their natural enemies on maize. The higher number of pin holes due to stem borer infestation were noticed during the months of August and lower during the months of December and June. Similarly, maximum dead hearts due to stem borer infestation were noticed during the month of July (62 per cent) and minimum during the month of June, December and January (32 per cent). A survey on the incidence of stem borers in maize was carried out during 2010-11 and 2011-12 by Mallapur *et al.* (2012) the data indicated that the incidence of stem borers in maize varied from 28.07 to 60.15 and 32.60 to 61.15 per cent during *Kharif* 2010-11 and 2011-12, respectively. Relatively more infestation (33.34 per cent) was observed during early stages of crop growth (36-45 days). Sahito *et al.* (2012) reported that the population of stem borer was positively (0.1908NS) and non-significantly correlated with temperature and insect population increased with increasing temperature whereas borer population was significantly (-0.4030)

correlated with relative humidity in negative direction, suggested that the stem borer population was decreased with increasing relative humidity. Kumar *et al.,* (2017) record the seasonal incidence of *C. partellus* (Swinhoe) on maize with relation to abiotic factors. Incidence of maize stem borer started from 2nd week of August and continued up to 4th week of October with peak incidence in 38th SMW. The larval population with maximum temperature and sunshine showed significant negative correlation, (r = -0.670 and -0.643) respectively.

B. Incidence of Chilo partellus Swinhoe on different sowing dates

During crop season, the effect of six dates of sowing *viz.*, 30th July, 6th August, 13th August, 20th August, 27th August and 3rd September, 2018 on incidence of pest population. In each case incidence of *C. partellus* started after seven days of germination in both the varieties. On the basis of seasonal mean the maximum larval population (1.21 in Pratap Hybrid Maize-3 and 2.08 in Pratap QPM) was recorded in the second date of sowing (6th August), while minimum larval population (0.63 in Pratap Hybrid Maize-3 and 0.63 in Pratap QPM) was found in the last date of sowing (3rd September). However, the *C. partellus* larval population in different dates of sowing did not show any significant correlation with mean atmospheric temperature except first date of sowing (30th July). In the first date of sowing *C. partellus* larval population showed a significant positive correlation with mean atmospheric temperature in both the varieties of maize during crop season 2018. Same trend was also recorded for rainfall excluding the last date of sowing (3rd September). In the last date of sowing *C. partellus* larval population showed a significant positive correlation with total rainfall in maize variety Pratap Hybrid Maize-3. While, in the first and last date of sowing *C. partellus* larval population showed a significant positive correlation with total rainfall in maize variety Pratap QPM. *C. partellus* larval population showed a significant positive correlation in different dates of sowing *viz.*, 6th August, 13th August, 27th August and 3rd September with mean relative humidity in maize variety Pratap Hybrid Maize-3. While *C. partellus* larval population showed a significant positive correlation in two dates of sowing *viz.*, 13th August and 27th August with mean relative humidity. Earlier workers reported that the early sown crop was highly infested by the maize stem borer *viz., C. partellus* as compared to late sown crop (Chev, 1976). The Cobs weight data show that maximum yield was recorded in plots sown on 20th June with cobs weight of 0.297 while the minimum yield was recorded in plots sown in the last week of June and July. These results are in comparison with the work of Imholte and Carter (1987) where they planted corn on three sowing dates ranging from 26th April to 6th June. The early planting resulted in delayed emergence, silking and increased harvest grain moisture. Highest grain yields were generally obtained when planting was completed by early May, while yield declined as planting was delayed. Allessi and Power (1975) reported that the effect of planting date and population in maize grain yield in 1971 and 1972 was significant. Effect of these variables was independent and interaction was generally non-significant. Delay in planting date after June affected grain much more than dry matter and grain production highly. Widstrom *et al*. (1984) studied the effect of different planting dates on the forage yield of seven experimental hybrids planted from 1st June to 1st August. They concluded that June 1st planting gave the maximum yield. Farmanullah *et al.* (2010) studied the effect of different planting dates of maize against the infestation of *C. partellus* and observed that minimum percent infestation (1.39) was recorded in plots sown in the 3rd week of July while the highest (4.82) was recorded in the plots sown in 2nd week of July. The moderate infestation was recorded in the plots of 3rd and last weeks of June. The overall results indicate that the per cent infestation of maize stem borer can be minimized by sowing the crop in mid-July.

Table 1: Seasonal incidence of *Chilo partellus* in maize during *Kharif* 2018.

Date of observations	Mean Atm. Temp. (°C)	Mean RH (%)	Total rainfall (mm)	*C. partellus*	
				Mean LIR (30th DAS)	Per cent dead hearts (30th DAS)
July 23, 2018	26.56	85.93	98.20	1.50	0.00
July 30, 2018	25.56	78.36	2.40	4.90	1.62
August 06, 2018	26.59	67.07	0.00	6.90	3.00
August 13, 2018	26.01	79.50	27.20	8.30	2.56
August 20, 2018	26.86	77.43	67.60	5.40	1.50
August 27, 2018	25.55	80.43	33.60	2.60	0.80
September 03, 2018	25.55	78.93	17.40	1.40	0.27
Seasonal mean	**26.10**	**78.24**	**35.20**	**4.43**	**1.39**
Coefficient of correlation (r) b/w insect pests and mean Atm. Temp.				0.292	0.248
Coefficient of correlation (r) b/w insect pests and mean RH				-0.572	-0.771*
Coefficient of correlation (r) b/w insect pests and total rainfall				-0.397	-0.566

* Significant at 5 per cent level of significance

Table 2: Incidence of *Chilo partellus* on maize variety (Pratap Hybrid Maize-3) in different sowing dates during *Kharif* 2018.

Date of observations	Mean Atm. Temp.(C)	Mean RH (%)	Total Rainfall (mm)	Dates of Sowing					
				30/07/2018	06/08/2018	13/08/2018	20/08/2018	27/08/2018	03/09/2018
				C. partellus/10 plants					
13, August 2018	26.01	79.50	27.20	1.25	-	-	-	-	-
20, August 2018	26.86	77.43	67.60	1.00	1.00	-	-	-	-
27, August 2018	25.55	80.43	33.60	0.75	1.75	1.75	-	-	-
03, September 2018	25.55	78.93	17.40	0.50	1.50	2.00	1.00	-	-
10, September 2018	24.66	75.43	11.00	0.25	1.25	1.75	1.25	1.25	-
17, September 2018	24.42	74.21	8.80	0.25	1.00	1.50	0.50	1.50	0.75
24, September 2018	25.95	66.86	28.80	-	0.75	1.25	0.75	0.75	1.00
01, October 2018	24.71	60.43	25.80	-	--	0.75	0.50	0.50	0.75
08, October 2018	25.76	57.93	0.00	-	-	-	0.25	0.50	0.50
15, October 2018	25.70	53.29	0.00	-	-	-	-	0.25	0.50
22, October 2018	24.51	43.93	0.00	-	-	-	-	-	0.25
29, October 2018	23.60	41.86	0.00	-	-	-	-	-	-
05, November 2018	22.30	47.36	0.00	-	-	-	-	-	-
Seasonal Mean	**25.51**	**75.55**	**20.90**	**0.67**	**1.21**	**1.50**	**0.71**	**0.79**	**0.63**
Coefficient of correlation (r) b/w *C. partellus* and mean Atm. Temp.				0.849*	-0.158	0.222	-0.126	-0.687	0.271
Coefficient of correlation (r) b/w *C. partellus* and mean RH				0.681	0.845*	0.958*	0.765	0.961*	0.835*
Coefficient of correlation (r) b/w *C. partellus* and total rainfall				0.676	-0.134	-0.298	0.251	0.085	0.859*

* Significant at 5 per cent level of significance

Table 3: Incidence of *Chilo partellus* on maize variety (Pratap QPM) in different sowing dates during *Kharif* 2018.

Date of observations	Mean Atm. Temp.(C)	Mean RH (%)	Total Rainfall (mm)	Dates of Sowing					
				30/07/2018	06/08/2018	13/08/2018	20/08/2018	27/08/2018	03/09/2018
				C. partellus/10 plants					
13, August 2018	26.01	79.50	27.20	2.00	-	-	-	-	--
20, August 2018	26.86	77.43	67.60	2.75	2.50	-	-	-	-
27, August 2018	25.55	80.43	33.60	2.25	3.25	2.25	-	-	-
03, September 2018	25.55	78.93	17.40	1.50	2.00	2.50	1.50	-	-
10, September 2018	24.66	75.43	11.00	1.25	1.75	1.75	2.00	1.25	-
17, September 2018	24.42	74.21	8.80	1.00	1.50	1.50	1.25	2.00	0.75
24, September 2018	25.95	66.86	28.80	-	1.50	1.25	1.00	1.00	1.00
01, October 2018	24.71	60.43	25.80	-	-	1.00	1.00	0.75	1.00
08, October 2018	25.76	57.93	0.00	-	-	-	0.75	0.50	0.50
15, October 2018	25.70	53.29	0.00	-	-	-	-	0.25	0.25
22, October 2018	24.51	43.93	0.00	-	-	-	-	-	0.25
29, October 2018	23.60	41.86	0.00	-	-	-	-	-	-
05, November 2018	22.30	47.36	0.00	-	-	-	-	-	-
Seasonal Mean	**25.51**	**75.55**	**20.90**	**1.79**	**2.08**	**1.71**	**1.25**	**0.96**	**0.63**
Coefficient of correlation (r) b/w *C. partellus* and mean Atm. Temp.				0.926*	0.419	0.339	-0.453	-0.693	0.001
Coefficient of correlation (r) b/w *C. partellus* and mean RH				0.623	0.734	0.915*	0.809	0.903*	0.733
Coefficient of correlation (r) b/w *C. partellus* and total rainfall				0.945*	0.542	-0.030	-0.043	0.213	0.932*

* Significant at 5% level of significance

CONCLUSIONS

During the crop season in *Kharif* 2018, the maximum leaf injury (8.30 mean LIR) by *Chilo partellus* was recorded in the second week of August at 30th days after sowing. The dead heart incidence first appeared during last week of July and reached to its peak (3.00 per cent) during second week of August at 30th days after sowing. The pest showed significant negative correlation with mean relative humidity but non-significant with mean atmospheric temperature and total rainfall. During crop season, the effect of six dates of sowing was observed on the basis of seasonal mean the maximum larval population and found that *C. partellus* larval population showed a significant positive correlation in different dates of sowing. The overall results indicate that the per cent infestation of maize stem borer can be minimized by sowing the crop in mid-July during *Kharif* season.

FUTURE SCOPE

This study will be helpful in the facilitating to scientific community as well as farmers regarding the occurrence of *C. partellus* in maize crop.

Acknowledgement. The authors sincerely thanks Dr. M. K. Mahla, Professor and Head, Department of Entomology for constant help during the whole course of studies in completing the research experiments and Department of Entomology, Rajasthan College of Agriculture, MPUAT,

Udaipur for providing the necessary facilities to conduct the investigations.
Conflict of Interest. None.

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How to cite this article: Gagandeep Singh, M.K. Mahla, N.L. Dangi, Kuldeep Sharma, Vijay Kumar and Sarita (2023). Effect of different Sowing Dates on Occurrence of Maize Stem Borer [*Chilo partellus* (Swinhoe)] in *Kharif* Maize. *Biological Forum – An International Journal*, *15*(5a): 165-170.