



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 1751-1754
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www.thepharmajournal.com

Received: 02-01-2023

Accepted: 06-02-2023

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Incidence of early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factors

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Abstract

The field experiments were carried out at the Crop Research Centre, Chirrodi of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) during *Kharif* season of two consecutive years *i.e.* 2019 and 2020. To observed the incidence of early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factors, the ten plants were randomly selected from each replication of untreated plots of the fields. The incidence of early shoot borer, *C. infuscatellus* was recorded on sugarcane variety Co 0238 from 17th to 28th standard week with mean incidence ranged from 3.38 to 21.70 percent per ten plants during *Kharif*, 2019. The early shoot borer incidence *Kharif* during 2019 was first reported at 17th standard week (last week of April) with 3.38 percent per ten plants when mean maximum and temperature 34.36 °C and 28.84 °C, relative humidity at morning and evening 90.29 and 64.29 percent and rainfall were ranged from 0.00 to 0.00 mm, respectively. The pest activity increased from the third week of May and reached its peak at 23rd standard week (first week of June) with 21.70 percent incidence per ten plants when mean maximum and minimum temperature 42.29 °C and 23.73 °C, relative humidity at morning and evening 33.81 and 64.29 percent and rainfall was ranged from 0.00 to 2.10 mm, respectively. The incidence decline (15.70% per ten plants) during 26 standard weeks (last week of June) when the maximum and minimum temperature was 41.29 °C and 26.36 °C. The relative humidity recorded at morning and evening was 60.69 and 84.00 percent and rainfall 0.00 mm. During *Kharif*, 2020, the incidence of early shoot borer was observed from 17th to 28th standard week with mean incidence ranged from 4.73 to 23.93 percent per ten plants. The *C. infuscatellus* incidence during *Kharif* 2020 was first observed at 17th standard week (3rd week of April) with 4.73 percent per ten plants when mean maximum and temperature 36.34 °C and 17.93 °C, relative humidity at morning and evening 27.10 and 46.60 percent and rainfall were ranged from 6.10 to 30.30 mm, respectively. The pest activity increased from the second week of May and reached its peak at 23rd standard week (last week of May) with 21.40 percent incidence per ten plants when maximum and minimum temperature 38.54 °C and 21.40 °C, relative humidity at morning and evening 41.70 and 70.90 percent, respectively. Whereas, rainfall 42.10 mm was recorded. The incidence decline (13.39% per ten plants) during 27th standard weeks (fourth week of June) when the maximum and minimum temperature was 36.09 °C and 27.29 °C. The relative humidity recorded at morning and evening was 31.69 and 60.30 percent and rainfall 7.20 mm.

Keywords: Early shoot borer, incidence, temperature, relative humidity and rainfall

Introduction

Sugarcane (*Saccharum officinarum* L.) is one of the most important industrial and cash crops grown in all tropical and subtropical countries of the world and the world's most efficient living collector of solar energy, storing this energy in a huge quantity of biomass in the form of fiber and fermentable sugars. Besides sugar production, sugarcane produces numerous valuable by-products like alcohol, used by the pharmaceutical industry, ethanol used as a fuel, production of electric power and chipboard manufacturing and press mud used as a rich source of organic matter for crop production.

India is the second-largest producer of sugarcane occupies an area of 5.11 million ha with an annual production of 377.77 million tonnes and productivity of 77.4 tons per ha. In India, Uttar Pradesh has the largest area (21.51 MT) and production (173.8 MT) of sugarcane in the country. It is almost 50 percent of the cane area in the country, followed by Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Gujarat, Bihar, Haryana and Punjab. As per the estimates, sugar production in Uttar Pradesh is expected to increase to 12.30 million tons in 2018-19 from 10.51 million tons in the previous year (Anonymous, 2020)^[1].

Sugarcane is a long-duration crop of 10-18 months and normally crop is followed by one or two ratoon crops, grown over large areas for higher production of sugarcane per unit area. This provides a sort of mono-cropping stable agro-ecosystem for the multiplication of insect pests (Mann *et al*, 2006). Though the sugarcane agro-ecosystem is a stable one periodically it is affected by different abiotic and biotic changes in the environment. These changes along with difficulties in the application of chemicals in the closed canopy and limited control provided by various insect pest control tactics (*viz.* cultural, mechanical and biological).

Sugarcane is attacked by several pests during its development. Of these, the early shoot borer, *Chilo infuscatellus* is posing serious threat to sugarcane production all over India while stalk borer, *Chilo auricilius*, Gurdaspur borer, *Bissetia steniellus* and internode borer, *C. sacriphagous indicus* are major pest in India, respectively.

Early shoot borer, *Chilo infuscatellus* Snellen (Crambidae: Lepidoptera) is the major pests of sugarcane, infesting the crop during its early growth stages (*i.e.* prior to internode formation) (David and Nandagopal 1986)^[2]. Economic loss caused by this particular pests is due to a 16–65% reduction in sugarcane setts and mother shoots, resulting in 22– 33% losses in cane yield (Singh and Tomar 2003)^[3].

The *C. infuscatellus* eggs are white and flat, laid in batches on the under surface of the leaves by the side of the midrib in three or more rows, one overlapping the other. Eggs are laid on the leaf sheath also. A moth may lay more than 200 eggs at a time and in each cluster 8-60 eggs will be found. The oviposition periods are at peak during May in March-April planted crop. The eggs hatch in 3-4 days. The caterpillar bores into the growing stem and kills the young plant. The infestation start during germination kills the mother shoots and results in 'dead-hearts' during tillering. Although some tillering is initiated, the tillers become damaged and produce dead-hearts between March and June. Usually, *C. infuscatellus* infestations are high during the tillering phase, but decrease appreciably during the south-west monsoons that often begin in July (David and Nandgopal 1986)^[2].

Materials and Methods

The field experiments were carried out at the Crop Research Centre, Chirrodi of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) during *Kharif* season of two consecutive years *i.e.* 2019 and 2020. The insect pests and diseases-free healthy setts of sugarcane variety 'Co 0238' were manually planted at 10-15 cm deep with the help of labor on 7 March 2019 for the first year and 3 March 2020 for the second-year experiment with row to row and plant to plant spacing 70 x 75 cm, respectively. To observed the incidence of early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factors, the ten plants were randomly selected from each replication of untreated plots of the fields.

Results and Discussion

The incidence of early shoot borer, *C. infuscatellus* was recorded on sugarcane variety Co 0238 from 17th to 28th standard week with mean incidence ranged from 3.38 to 21.70 percent per ten plants during *Kharif*, 2019 (Table 1 and Fig.1). The early shoot borer incidence *Kharif* during 2019 was first reported at 17th standard week (last week of April) with 3.38 percent per ten plants when mean maximum and

temperature 34.36 °C and 28.84 °C, relative humidity at morning and evening 90.29 and 64.29 percent and rainfall were ranged from 0.00 to 0.00 mm, respectively. The pest activity increased from the third week of May and reached its peak at 23rd standard week (first week of June) with 21.70 percent incidence per ten plants when mean maximum and minimum temperature 42.29 °C and 23.73 °C, relative humidity at morning and evening 33.81 and 64.29 percent and rainfall was ranged from 0.00 to 2.10 mm, respectively. The incidence decline (15.70% per ten plants) during 26 standard weeks (last week of June) when the maximum and minimum temperature was 41.29 °C and 26.36 °C. The relative humidity recorded at morning and evening was 60.69 and 84.00 percent and rainfall 0.00 mm.

During *Kharif*, 2020, the incidence of early shoot borer was observed from 17th to 28th standard week with mean incidence ranged from 4.73 to 23.93 percent per ten plants. The *C. infuscatellus* incidence during *Kharif* 2020 was first observed at 17th standard week (3rd week of April) with 4.73 percent per ten plants when mean maximum and temperature 36.34 °C and 17.93 °C, relative humidity at morning and evening 27.10 and 46.60 percent and rainfall were ranged from 6.10 to 30.30 mm, respectively. The pest activity increased from the second week of May and reached its peak at 23rd standard week (last week of May) with 21.40 percent incidence per ten plants when maximum and minimum temperature 38.54 °C and 21.40 °C, relative humidity at morning and evening 41.70 and 70.90 percent, respectively. Whereas, rainfall 42.10 mm was recorded. The incidence decline (13.39% per ten plants) during 27th standard weeks (fourth week of June) when the maximum and minimum temperature was 36.09 °C and 27.29 °C. The relative humidity recorded at morning and evening was 31.69 and 60.30 percent and rainfall 7.20 mm (Table 2 and Fig. 2).

When the data of both the years were pooled, the incidence of early shoot borer recorded from 16th to 27th standard week with mean incidence ranged from 4.11 to 21.55 percent/ten plants during *Kharif* 2019 and 2020 (Table 3 and Fig. 3). The incidence of *C. infuscatellus* during both the years was first observed 16th standard week (third week of April) with 4.11 percent per ten plants when the mean maximum and minimum temperature 38.16 °C and 20.37 °C, relative humidity at morning and evening was 66.59 and 30.58 percent and rainfall 3.05 mm, respectively. The pest activity increased from the second week of May and attained its peak at 23rd standard week (first week of June) with 21.55 percent per ten plants when maximum and minimum temperature 37.94 °C and 25.46 °C, relative humidity at morning and evening was 77.35 and 56.80 percent, respectively and 3.95 mm rainfall was recorded. The incidence started declined (17.67% per ten plants) during 24th standard week *i.e.* second week of June when the maximum and minimum temperature 38.55 °C and 26.23 °C, relative humidity at morning and evening was 70.15 and 47.42 percent, respectively and 1.15 mm rainfall was recorded. The impact of weather factors on the incidence of early shoot borer was studied by work out correlation coefficient (*r*). The correlation coefficient showed that the maximum temperature had non-significant positive correlation (*r*= 0.497) in the year *Kharif* 2019 and non-significant positive correlation (*r*= 0.554) during *Kharif* 2020. The minimum temperature showed significant positive correlation (*r*= 0.864) during *Kharif* 2019 and minimum temperature showed non-significant positive correlation (*r*=

0.266) during *Kharif* 2020 with early shoot borer incidence. The mean relative humidity showed non-significant negative correlation ($r = -0.286$) during *Kharif* 2019 while in the second year crop season the mean relative humidity showed significant positive correlation ($r = -0.633$) with pest infestations. The rainfall showed non-significant negative correlation ($r = -0.039$) and positive correlation ($r = 0.079$) during *Kharif* 2019 and 2020, respectively. Pooled data revealed that all the weather parameters maximum temperature significant positive correlation ($r = 0.648$) while minimum temperature ($r = 0.0546$), relative humidity ($r = 0.401$) non-significant positive correlation and rainfall ($r = -0.032$) non-significant negative correlation with early shoot borer incidence.

The present findings are in accordance with Rao *et al.* (2013) [4] who reported that the incidence of *C. infuscatellus* Snellen in north coastal zone of Andhra Pradesh. This study assessed the impact of weather parameters on the on the infestation by

this pest on sugarcane. The finding suggested that the minimum temperature less than 23.8 °C and RH more than 77% favored the incidence. The present findings are in conformity with Pandey and Kumar (2014) [5] who reported that the highest incidence of *C. infuscatellus* during 21st standard week (8.8 percent) at 43.1 °C maximum temperature, 28.4 °C minimum temperature, 57.0 percent maximum relative humidity, 21.0 percent minimum relative humidity and 9.1 sun shine hours. The correlation coefficient showed significant and positive correlation with minimum temperature while it was highly significant and negatively correlated with minimum relative humidity with shoot infestation. The effect of maximum temperature with shoot infestation showed a negative correlation. The maximum relative humidity showed non-significant positive correlation where as it was positively correlated with minimum relative humidity and sun shine hours.

Table 1: Incidence of early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factors during *Kharif*, 2019

S.W.	Month & Date	Early shoot borer incidence (%)	Weather Parameters						Rainfall (mm)
			Temperature (°C)			Relative humidity (%)			
			Max.	Min.	Mean	Mor.	Even.	Mean	
17	April, 22-28	3.38	39.97	22.81	31.39	34.06	86.57	86.57	0.00
18	April, 29- May 4	5.02	39.13	21.99	30.56	40.37	84.33	84.33	3.40
19	May, 5-11	6.44	40.04	21.51	30.78	32.27	72.53	72.53	0.00
20	May, 12-18	7.71	36.83	20.84	28.84	36.29	77.19	77.19	4.60
21	May, 19-25	10.79	38.47	22.29	30.38	36.46	71.23	71.23	1.00
22	May, 26- June 1	16.09	42.79	23.73	33.26	33.81	64.29	64.29	0.00
23	June, 2-8	21.70	42.29	26.43	34.36	44.14	71.00	71.00	0.00
24	June, 9-15	19.05	41.29	26.71	34.00	60.69	84.00	84.00	0.00
25	June, 16-22	17.11	39.00	25.43	32.21	44.14	71.00	71.00	2.10
26	June, 23-29	15.70	41.29	26.36	33.82	60.69	84.00	84.00	0.00
27	June, 30-July 6	15.08	40.14	25.11	32.63	46.57	84.29	84.29	0.00
28	July, 7-13	12.23	36.14	24.2	30.17	69.29	90.29	90.29	92.30

Table 2: Incidence of early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factors during *Kharif*, 2020

S.W.	Month & Date	Early shoot borer incidence (%)	Weather Parameters						Rainfall (mm)
			Temperature (°C)			Relative humidity (%)			
			Max.	Min.	Mean	Mor.	Even.	Mean	
17	April, 16-22	4.73	36.34	17.93	27.14	27.1	46.60	46.59	6.10
18	April, 23-29	6.06	35.56	22.81	29.19	36.9	57.10	57.06	1.40
19	April, 30- May 5	9.62	35.30	21.99	28.64	38.8	53.00	52.97	6.90
20	May, 6-12	12.92	36.84	21.51	29.18	35.6	54.70	54.69	24.40
21	May, 13-19	16.29	36.83	20.84	28.84	36.3	77.20	77.19	0.10
22	May, 20-26	23.93	38.47	22.29	30.38	36.5	71.20	71.23	0.00
23	May, 26-June, 2	21.40	38.54	21.4	29.97	41.7	70.90	70.90	42.10
24	June, 2- 9	19.75	34.59	24.2	29.39	52.9	70.70	70.71	7.90
25	June, 10-16	18.46	38.09	27.03	32.56	50.7	69.30	69.29	0.20
26	June, 17-23	16.82	35.43	26.57	31.00	55.6	79.00	79.00	1.10
27	June, 24-30	13.39	36.09	27.29	31.69	60.3	73.90	73.86	7.20
28	June, 31-July, 6	10.86	35.37	26.09	30.73	66.1	78.70	78.71	30.30

Table 3: Pooled incidence of early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factor (*Kharif*, 2019 & 2020)

S.W.	Month & Date	Early shoot borer incidence (%)	Weather Parameters						Rainfall (mm)
			Temperature (°C)			Relative humidity (%)			
			Max.	Min.	Mean	Mor.	Even.	Mean	
16	April, 16-22	4.11	38.16	20.37	29.26	30.58	66.59	48.58	3.05
17	April, 23-29	6.33	37.35	22.4	29.87	38.64	70.72	54.68	2.40
18	April, 30- May 5	7.89	37.67	21.75	29.71	35.54	62.77	49.15	3.45
19	May, 6-12	10.44	36.84	21.18	29.01	35.95	65.95	50.95	14.50
20	May, 13-19	13.55	37.65	21.57	29.61	36.38	74.22	55.30	0.55
21	May, 20-26	18.00	40.63	23.01	31.82	35.16	67.75	51.45	0.00
22	May, 26-June, 2	21.11	40.42	23.92	32.17	42.92	70.95	56.94	21.05

23	June, 2- 9	21.55	37.94	25.46	31.70	56.80	77.35	67.07	3.95
24	June, 10-16	17.67	38.55	26.23	32.39	47.42	70.15	58.79	1.15
25	June, 17-23	16.22	38.36	26.47	32.41	58.15	81.50	69.82	0.55
26	June, 24-30	14.22	38.12	26.2	32.16	53.44	79.10	66.27	3.60
27	June, 31-July, 6	11.55	35.76	25.15	30.45	67.70	84.50	76.10	61.30

Table 4: Correlation between early shoot borer, *Chilo infuscatellus* (Snellen) in relation to weather factors

Weather Parameters	Correlation coefficient (r)		
	Early shoot borer		
	2019	2020	Pooled
Max. Temp. (°C)	0.497 (NS)	0.554 (NS)	0.648 (S)
Min. Temp. (°C)	0.864 (S)	0.266 (NS)	0.546 (NS)
Relative Humidity (%)	-0.286 (NS)	0.633 (S)	0.401 (NS)
Rainfall (mm)	-0.039 (NS)	0.079 (NS)	-0.032 (NS)

Acknowledgement

The authors are thankful to Dr. Gaje Singh, Professor, Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut and the entire faculty for providing the necessary facilities for conducting the present study.

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