



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(8): 240-242
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www.thepharmajournal.com
Received: 25-06-2022
Accepted: 29-07-2022

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Seasonal incidence of shoot fly and stem borer of pearl millet in relation to weather parameters

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Abstract

Investigations on “Seasonal incidence of shoot fly, *Atherigona approximata* (Malloch) and stem borer, *Chilo partellus* (Swinhoe) infesting pearl millet” were carried out under field condition during *Kharif-2021* at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat. Result showed that the infestation of shoot fly started in 33th standard meteorological week when temperature ranged between 32.9 °C (maximum) and 24.3 °C (minimum), average relative humidity 70.5 per cent, total rainfall 8.1 mm and 3.5 sunshine hours. The shoot fly infestation increased gradually to maximum (20.67%) on 37th standard meteorological week at 29.1 °C maximum temperature and 24.5 °C minimum temperature, 92 per cent average relative humidity, 0.9 sunshine hour and 393.4 mm total rainfall. Thereafter, the infestation of shoot fly declined. The infestation of stem borer started in 33th standard meteorological week when temperature ranged between 32.9 °C (maximum) and 24.3 °C (minimum), average relative humidity 70.5 per cent, total rainfall 8.1 mm and 3.5 sunshine hours. The stem borer infestation increased gradually and reached to maximum (16.67%) on 36th standard meteorological week at 30.1 °C maximum temperature and 23.7 °C minimum temperature, 88.5 per cent average relative humidity, 179.3 mm total rainfall and 1.4 sunshine hours. Thereafter, the infestation of stem borer declined

The relationship between shootfly and weather factor indicate a highly significant negative correlation with maximum temperature ($r = -0.877^{**}$) and a non-significant positive correlation with minimum temperature ($r = 0.375$), while a negative correlation with bright sunshine hours (-0.522) and highly significant positive correlation with morning relative humidity ($r = 0.802^{**}$), evening relative humidity ($r = 0.814^{**}$) and total rain fall ($r = 0.817^{**}$). In case of stem borer, highly significant negative correlation with maximum temperature ($r = -0.804^{**}$), while positive correlation with morning relative humidity ($r = 0.749^{**}$), evening relative humidity ($r = 0.764^{**}$) and non-significant positive correlation with minimum temperature ($r = 0.319$), while negative correlation with bright sunshine hours ($r = -0.421$) and significant positive correlation with total rainfall ($r = 0.681^{*}$).

Keywords: Pearl millet, seasonal incidence, shoot fly, stem borer

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is popularly known as “Bajra” and belongs to the family of *Poaceae*. This grain is basically originated from India or Africa. Pearl millet is one of the oldest cultivated crops since pre-historic times and ranks as the sixth most important grain in the world. Pearl millet is the staple food of the majority of the poor and small landholders, as well as feed and fodder for livestock in the rain-fed region of the country. It is a multipurpose crop, which is grown for food, feed, green and dried forages. The presence of all required nutrients in millets makes them suitable for large scale utilization in the manufacture of various food products. Pearl millet is one of the most extensively cultivated cereals in the world, after rice, wheat and sorghum.

Pearl millet excels all other cereals due to these features like C₄ plant with high photosynthesis efficiency and high dry matter production capacity. Pearl millet is a hardy crop and can grow in areas very hot and dry and on soils too poor for sorghum. Pearl millet is considered more efficient in the utilization of soil moisture and has a higher level of heat tolerance. It requires less input, matures in a short duration and is usually grown under the most adverse agro-climatic condition where other crops like sorghum and maize fail to produce economic yield.

Pearl millet occupies 6.93 million ha with an average production of 8.61 million tonnes and productivity of 1243 kg/ha during 2018-19 (Anon., 2020) [1]. It is one of the major crops of China, India, South-Eastern Asia, Sudan, Pakistan, Arabia, Russia & Nigeria. Pearl millet ranks first under the category of millets in India, in terms of area, production and productivity. The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and

Haryana which account for more than 90% of pearl millet acreage in the country. Most of the pearl millet in India is grown in the rainy season. It is also cultivated during the summer season in parts of Gujarat, Rajasthan and Uttar Pradesh; and during the post-rainy (*rabi*) season at a small scale in Maharashtra and Gujarat.

Over 100 species of insect pests have been reported to be associated with this crop (Balikai, 2010) [2]. Out of these, shoot fly, *Atherigona approximate* (Malloch) and stem borer, *Chilo partellus* (Swinhoe) are comparatively more serious pests attacking the crop. Kishore (1966) [4] reported about 23.3 to 36.5 per cent grain losses and 37.5 per cent fodder losses by shoot fly and 20-60 per cent yield losses due to stem borer have been reported. Looking to the concern with several facts, a research on this aspect was studied.

Materials and Methods

Methodology

The experiment was laid out in a Randomized Block Design with three replications during *Kharif*- 2021 at Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. Pearl millet variety "GHB 1231" was broadcasted in August, 2021. All agronomical practices were followed as per the scientific recommendations. The crop area was divided into 15 quadrates of size 1.2×1.0 m. Observations were recorded from 10 plants from each quadrate by counting dead hearts for shoot fly and parallel holes for stem borer, shoot fly dead heart percentage incidence was worked out at vegetative stage. At earhead stage showing shoot fly and stem borer (empty/ white ear head) damage was recorded separately and thus percentage ear head damage was worked out from ear heads of 10 plants of the net plot. The plot was kept unsprayed throughout the seasons. Infestations of shoot fly and stem borer of pearl millet were recorded at weekly intervals. The observations were continued till the harvest of the crop. Weekly meteorological data on temperature, relative humidity, bright sunshine hours and rainfall in the different standard weeks were collected from the meteorological observatory situated at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh.

Results and Discussions

Shoot fly

The data on the incidence of shoot fly infesting pearl millet variety "GHB 1231" during *kharif* 2021 are presented in Table 1. The initiation of shoot fly incidence was found in 33rd (SMW) (0.67%) and remained active throughout the crop season. The infestation of shoot fly gradually increased and reached to its peak in 37th standard meteorological weeks with 20.67 per cent plant infestation. Thereafter, the shoot fly infestation declined and disappeared after 41st standard meteorological week during the year.

The Table 1 indicated that during *kharif* 2021, the shoot fly infestation started in 33rd standard meteorological week when the temperature ranged between 32.9 °C (maximum) and 24.3 °C (minimum), average relative humidity 70.5 per cent, total rainfall 8.1 mm and 3.5 sunshine hours. The shoot fly infestation increased gradually to maximum (20.67%) on 37th standard meteorological week at 29.1 °C maximum

temperature and 24.5 °C minimum temperature, 92 per cent average relative humidity, 0.9 sunshine hours and 393.4 mm total rainfall. Thereafter, the infestation of shoot fly declined. Correlation matrix (Table 2) indicated a highly significant negative correlation with maximum temperature ($r = -0.877^{**}$) and non-significant positive correlation with minimum temperature ($r = 0.375$), while negative correlation with bright sunshine hours (-0.522) and highly significant positive correlation with morning relative humidity ($r = 0.802^{**}$), evening relative humidity ($r = 0.814^{**}$) and Total rain fall ($r = 0.817^{**}$).

Stem borer

The data on the incidence of stem borer infesting pearl millet variety "GHB 1231" during *kharif* 2021 are presented in Table 1 and it indicated that the initiation of stem borer incidence was found in 33rd SMW (1.34%) and the pest incidence increased up to 39th SMW and formed peak in 36th standard meteorological week of year, with 16.67 per cent plant infestation. Thereafter, the stem borer infestation declined and disappeared after 41st standard meteorological week during year.

Stem borer infestation started in 33rd standard meteorological week when temperature ranged between 32.9 °C (maximum) and 24.3 °C (minimum), average relative humidity 70.5 per cent, total rainfall 8.1 mm and 3.5 sunshine hours. The stem borer infestation increased gradually and reached to maximum (16.67%) on 36th standard meteorological week at 30.1 °C maximum temperature and 23.7 °C minimum temperature, 88.5 per cent average relative humidity, 179.3 mm total rainfall and 1.4 sunshine hours. The stem borer infestation decreased gradually for next two weeks and again form a peak (12.67%) on 39th standard meteorological week at 30.6 °C maximum temperature and 24.2 °C minimum temperature, 86 per cent average relative humidity, 156.6 mm total rainfall and 3.5 sunshine hours. Thereafter, stem borer infestation declined. The Correlation matrix indicated in Table 2 that a highly significant negative correlation with maximum temperature ($r = -0.804^{**}$), while a highly significant positive correlation with morning relative humidity ($r = 0.749^{**}$), evening relative humidity ($r = 0.764^{**}$) and a non-significant positive correlation with minimum temperature ($r = 0.319$), while negative correlation with bright sunshine hours ($r = -0.421$) and significant positive correlation with total rainfall ($r = 0.681^{*}$).

According to Patel and Purohit (2016) [5] Maximum temperature had a significant negative association with stem borer on sorghum while, sunshine hours had a non-significant association with *C. partellus* on *rabi* sorghum. Choudhary *et al.* (2018) [3] also reported that the infestation of shoot fly was recorded from 31st standard meteorological week (SMW) and remained throughout the crop season. The infestation of stem borer (*C. partellus*) was noticed in the 32nd SMW during both the years. The effect of abiotic factors on shoot fly (*A. approximata*) revealed non-significant negative correlation with maximum and minimum temperature and the effect of sunshine hours was found a non-significant negative correlation with shoot fly infestation in pearl millet crop.

Table 1: Weekly incidence of shoot fly and stem borer of pearl millet and weather parameters during *kharif* 2021

Weeks after sowing	Standard meteorological weeks	% Shoot fly infestation	% Stem borer infestation	Temperature °C		Relative Humidity (%)		BSS (hr/day)	Rain Fall (mm)
				Max.	Min.	Morning	Evening		
1	32	0.00	0.00	32.5	24.3	88	65	1.4	7.6
2	33	0.67	1.34	32.9	24.3	84	57	3.5	8.1
3	34	6.34	4.00	31.8	23.8	90	73	2.3	14.4
4	35	10.66	9.34	32.3	23.4	89	69	3.4	69.2
5	36	13.00	16.67	30.1	23.7	94	83	1.4	179.3
6	37	20.67	11.67	29.3	24.5	96	88	0.9	393.4
7	38	15.34	9.33	30.4	25.0	94	77	2.3	55.7
8	39	11.34	12.67	30.6	24.2	92	80	3.5	156.6
9	40	6.00	7.34	33.1	25.1	86	61	8.3	16.7
10	41	3.67	2.67	34.1	24.3	81	68	6.1	60.9
11	42	0.00	0.00	34.5	20.2	72	35	9.5	00
Mean		7.97	6.82						

Table 2: Correlation of co-efficient between shoot fly and stem borer of pearl millet with abiotic factors infesting pearl millet during *Kharif* 2021

Abiotic factors	% Infestation of shoot fly	% Infestation of stem borer
Maximum Temperature, °C (Max T.)	-0.877**	-0.804**
Minimum Temperature, °C (Min T.)	0.375	0.319
Morning Relative Humidity, % (RH ₁)	0.802**	0.749**
Evening Relative Humidity, % (RH ₂)	0.814**	0.764**
Rainfall, mm (R)	0.817**	0.681*
Bright Sunshine Hours, h/day (BSS)	-0.522	-0.421

Notes:

1. n= 11
2. Significant at P= 5% level (r = 0.602), P= 1% level (r = 0.734)
3. * = Significant
4. ** = Highly Significant

Conclusion

The infestation of shoot fly was recorded from 33rd standard meteorological week (SMW) and remained active throughout the crop season during the year and reached to its peak in 37th SMW of the year. Thereafter, the shoot fly infestation declined and disappeared after 41st SMW of the year. Stem borer infestation was noticed in the 33rd SMW during the year. The infestation increased with the advancement of the crop age. The infestation of stem borer reached to its peak in 39th SMW of the year. Thereafter, the stem borer infestation declined and disappeared after 41st SMW of the year. For shoot fly, the correlation matrix indicated a highly significant positive correlation with morning relative humidity, evening relative humidity and total rainfall. In case of stem borer, highly significant positive correlation with morning relative humidity and evening relative humidity.

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