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Seasonal incidence of shoot fly and stem borer-pests of pearl millet [*Pennisetum glaucum* (L.) R. Br.] in Semi-Arid region of Rajasthan

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Abstract

The present investigation was conducted to study the seasonal incidence of shoot fly and Stem borer-Pests of Pearl millet [*Pennisetum glaucum* (L.) R. Br.] in Semi-Arid Region of Rajasthan. The study results revealed that the infestation of shoot fly was recorded from 31st standard meteorological week (SMW) and remained throughout the crop season in both years and the peak of first and second years in 33rd and 34th SMW, respectively. The infestation of stem bore (*Chilo partellus* Swinhoe) (Lepidoptera: Pyralidae) was noticed in the 32nd SMW during both the years and respective peak of 2014 and 2015 during both the years. The effect of abiotic factors on shoot fly (*Atherigona Approximata*) revealed non significant negative correlation with maximum and minimum temperature, total rainfall and sunshine hours with shoot fly (*A. Approximata*) infestation. However, non significant positive correlation existed with average relative humidity during 2014. During 2015, the non significant negative correlation with maximum temperature, total rainfall and sunshine hours with shoot fly infestation, however, non significant positive correlation existed with minimum temperature and average relative humidity.

Keywords: Sunshine, abiotic, correlation, shoot fly (*A. Approximata*), Stem borer (*C. partellus* Swinhoe)

1. Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a staple food for millions of poor people living in the semi-arid tropical regions of Africa and Asia. It is multipurpose crop, which is grown for food, feed, green and dried (Karvi) forages. The presence of all required nutrients in millets make them suitable for large scale utilization in the manufacture of various food products such as traditional meals, baby foods, snack foods, dietary foods in both grain and flour form. The use of pearl millet is also increasing in traditional foods and snacks like porridge, chapatti, *khichri*, *laddoo*, *mathi* etc; bak [7, 8]. Shoot fly, (*A. Approximata*) Mallocho (Anthomyiidae: Diptera) as a pest of bajra in Rajasthan [8].

Earhead products like cake, *nan khatai*, biscuits etc; Whereas, in Rajasthan state cover total area 4.07 million hectares, production 4.45 million tones and its productivity 1093 kg/ha of Pearl millet [6]. Out of these, shoot fly (*A. Approximata*) and white grub are the major insect-pests of pearl millet in semi-arid eastern regions of Rajasthan. The shoot fly (*A. Approximata*) female lays eggs singly on the under surface of leaves. After hatching, the larvae move to the growing point and cut the central leaf, resulting in the production of a dead heart. Infestation normally occurs in the 1-4 weeks after the seedling emergence stage. However, the tillers are also attacked under high shoot fly (*A. Approximata*) pressure [1]. Other than shoot fly (*A. Approximata*), stem borer (*C. partellus* Swinhoe) larva feeding to leaf scarification and than to shot holes, followed by dead formation. The larvae riddle the stem from the inside and there may be up to 20 larvae in one plant. The stems of attacked plants break easily.

2. Materials and methods

The variety RHB-177 of pearl millet was sown in an area of 100 m² at Research Farm, Rajasthan Agricultural Research Institute (RARI), Durgapura, Jaipur during *Kharif* 2014 and 2015 with a row to row and plant to plant distance of 50 cm and 15 cm, respectively. Incidence and damage of various insect-pests were recorded at weekly interval from 30 randomly selected plants in measured area.

The data on weather parameters, viz., temperature, relative humidity, sunshine hours and total rainfall were obtained from the meteorological section of RARI, Durgapura and correlation with incidence was analyzed.

3. Results and discussion

Shoot fly and stem borer pests were major pest causing damage to the pearl millet crop, other pests minor pests were observed in very less numbers and were categorized as minor pests, and hence they were not taken in account of other experiments.

The infestation of shoot fly (*A. Approximata*) was recorded from 31st standard meteorological week (SMW) and remained throughout the crop season in both years. Initially, the damage of 6.67 and 10.00% plant infestation was during *Kharif* 2014 and 2015, respectively was recorded which gradually increased and reached to its peak in 33rd and 34th standard meteorological weeks of first and second years, with a plant damage of 16.67 and 20.00 percent, respectively. Thereafter, the shoot fly (*A. Approximata*) infestation was declined and disappeared after 39th standard meteorological week during both years.

The infestation of stem borer was observed in the 32nd standard meteorological week during both the years. The damage of stem borer (*C. partellus* Swinhoe) varied from 3.33 to 13.33 and 3.33 to 16.67 percent plant infestation during both years, respectively, and maximum in 36th and 34th SMW of 2014 and 2015, respectively, thereafter, the infestation decreased gradually. The infestation of white grub was observed in 31st standard meteorological weeks during both the years. The peak plant damage (30.00 and 26.67 percent) was observed in 32nd standard meteorological week during both the years.

Table 1, 2 and 3 indicated that during 2014, the shoot fly (*A. Approximata*) infestation started in 31st standard meteorological week when temperature ranged between 33.0 °C (maximum) and 25.2 °C (minimum), average relative humidity 76.5 percent, total rainfall 52.8 mm and 4.6 sunshine hours. The shoot fly (*A. Approximata*) infestation increased gradually reached to maximum (16.67%) on 33rd standard meteorological week at 31.9 °C maximum temperature and 24.3 °C minimum temperature, average relative humidity 70.5 percent, 6.4 sunshine hours and with no total rainfall. There after, the infestation of shoot fly (*A. Approximata*) declined. The correlation matrix indicated a non significant negative correlation with maximum temperature ($r = -0.485$), minimum temperature ($r = -0.133$), total rainfall ($r = -0.156$) and sunshine hours ($r = -0.123$) with shoot fly (*A. Approximata*) infestation. However, non significant positive correlation existed between average relative humidity ($r = 0.402$).

Table 1, 2 and 3 indicated that during 2015, the shoot fly (*A. Approximata*) infestation started in 31st standard meteorological week when temperature ranged between 28.8 °C (maximum) and 23.8 °C (minimum), average relative humidity 81.5 percent, total rainfall 272 mm and 1.5 sunshine hours. The shoot fly (*A. Approximata*) infestation increased gradually reached to maximum (20.00%) on 34th standard

meteorological week at 32.8 °C maximum temperature and 23.9 °C minimum temperature, average relative humidity 64.5 percent, 8.5 sunshine hours and with no total rainfall. Thereafter, the infestation of shoot fly (*A. Approximata*) declined. The correlation matrix indicated a non significant negative correlation with maximum temperature ($r = -0.292$), total rainfall ($r = -0.039$) and sunshine hours ($r = -0.203$) with shoot fly infestation. However, non significant positive correlation existed between minimum temperature ($r = 0.186$) and average relative humidity ($r = 0.308$). [3]. reported that the shoot fly incidence started in the 28th SWW (standard weather week) (3.33%) which reached to its peak in the 32nd SWW (23.58%) and noticed upto 39th SWW (10.67%) at Jamnagar. However, the stem borer incidence was observed from 29th SWW (3.33%) to 39th SWW (4.00%). Highest infestation of stem borer was noticed in 31st SWW (6.67%) support the present finding.

Table 1, 2 and 3 indicated that during 2014, the stem borer (*C. partellus* Swinhoe) infestation started in 32nd standard meteorological week when temperature ranged between 29.3 °C (maximum) and 23.9 °C (minimum), average relative humidity 87.5 percent, total rainfall 166 mm and 1.4 sunshine hours. The stem borer infestation increased gradually reached to maximum (13.33%) on 36th standard meteorological week at 30.2 °C maximum temperature and 23.9 °C minimum temperature, average relative humidity 79.5 percent, total rainfall 59.4 mm and 4.2 sunshine hours. Thereafter, the infestation of stem borer (*C. partellus* Swinhoe) declined. The correlation matrix indicated a non significant negative correlation with maximum temperature ($r = -0.364$), minimum temperature ($r = -0.162$) and total rainfall ($r = -0.213$) with stem borer infestation. However, non significant positive correlation existed between average relative humidity ($r = 0.269$) and sunshine hours ($r = 0.056$).

Table 1, 2 and 3 indicated that during 2015, the stem borer (*C. partellus* Swinhoe) infestation started in 32nd standard meteorological week when temperature ranged between 31.9 °C (Maximum) and 25.1 °C (Minimum), average relative humidity 76 percent, total rainfall 5.6 mm and 1.0 sunshine hours. The stem borer infestation increased gradually reached to maximum (16.67%) on 34th standard meteorological week at 32.8 °C maximum temperature and 23.9 °C minimum temperature, average relative humidity 64.5 percent, 8.5 sunshine hours and with no total rainfall. There after, the infestation of stem borer (*C. partellus* Swinhoe) declined. The correlation matrix indicated a non significant negative correlation with total rainfall ($r = -0.387$) with stem borer (*C. partellus* Swinhoe) infestation. However, non significant positive correlation existed between maximum temperature ($r = 0.010$), minimum temperature ($r = 0.294$), average relative humidity ($r = 0.120$) and sunshine hours ($r = 0.177$). [4]. Reported that the shoot fly incidence was started in the 32nd week (3.33%), reached to peak in the 37th week (15.00%) and remained upto 39th week (12.00%) at Jamnagar. Stem borer incidence was observed from 33rd week (3.33%) to 39th week (4.00%) and peaked stem borer incidence was in 35th week (10.00%), which partially supports the present findings.

Table 1: Incidence of shoot fly (*A. Approximata*) and Stem borer (*C. partellus* Swinhoe) on pearl millet during *Kharif* 2014

Duration	Standard Meteorological Week	Temperature (°C)		Average Relative Humidity (%)	Total Rainfall (mm)	Sunshine (hrs)	Shoot fly Infestation (%)	Stem borer Infestation (%)
		Maximum	Minimum					
16/7/14 to 22/7/14	29	34.6	24.1	72.0	158.6	5.0	0.00	0.00
23/7/14 to 29/7/14	30	32.6	24.7	74.0	32.4	3.2	0.00	0.00
30/7/14 to 5/8/14	31	33	25.2	76.5	52.8	4.6	0.00	6.67
6/7/14 to 13/8/14	32	29.3	23.9	87.5	116	1.4	6.67	13.33
14/8/14 to 19/8/14	33	31.9	24.3	70.5	0	6.4	10.00	16.67
20/8/14 to 26/8/14	34	36.9	26.1	50.0	0	10.8	6.67	6.67
27/8/14 to 2/9/14	35	35.1	24.8	65.0	21.4	9.1	10.00	6.67
3/9/14 to 9/9/14	36	30.2	23.9	79.5	59.4	4.2	13.33	6.67
10/9/14 to 16/9/14	37	32.4	24.4	75.5	20.2	6.7	10.00	13.33
17/9/14 to 23/9/14	38	34.3	23.6	57.5	0	9.9	6.67	10.00
24/9/14 to 30/9/14	39	34	23.2	52.5	0	9.8	3.33	3.33
1/10/14 to 7/10/14	40	35.8	24.9	40.0	0	9.7	0.00	0.00

Table 2: Incidence of shoot fly (*A. Approximata*) and Stem borer (*C. partellus* Swinhoe) on pearl millet during *Kharif* 2015

Duration	Standard Meteorological Week	Temperature (°C)		Average Relative Humidity (%)	Total Rainfall (mm)	Sunshine (hrs)	Shoot fly Infestation (%)	Stem borer Infestation (%)
		Maximum	Minimum					
16/7/15 to 22/7/15	29	34.2	25.2	67.0	79.4	5.8	0.00	0.00
23/7/15 to 29/7/15	30	31.6	24.3	80.0	28	4.5	0.00	0.00
30/7/15 to 5/8/15	31	28.8	23.8	81.5	272	1.5	10.00	0.00
6/8/15 to 13/8/15	32	31.9	25.1	76.0	5.6	1	16.67	6.67
14/8/15 to 19/8/15	33	32.2	24.8	78.0	14	4.4	13.33	10.00
20/8/15 to 26/8/15	34	32.8	23.9	64.5	0	8.5	20.00	16.67
27/8/15 to 2/9/15	35	35.1	25.4	57.0	0	9.7	10.00	10.00
3/9/15 to 9/9/15	36	35.6	25.8	47.0	4.2	9.3	6.67	6.67
10/9/15 to 16/9/15	37	37.3	25.6	45.0	0	9.7	10.00	3.33
17/9/15 to 23/9/15	38	35.1	28.8	62.0	2.4	6.6	6.67	6.67
24/9/15 to 30/9/15	39	34	23.3	43.5	0	8.7	3.33	0.00
1/10/15 to 7/10/15	40	36.7	20.9	38.0	0	9.2	0.00	0.00

Table 3: Correlation coefficient (r) of abiotic factors with incidence of shoot fly (*A. Approximata*) and stem bore (*C. partellus* Swinhoe) r on pearl millet

Weather variables	Shoot fly		Stem borer	
	2014	2015	2014	2015
Maximum Temperature (°C)	-0.485NS	-0.292NS	-0.364NS	0.010NS
Minimum Temperature (°C)	-0.133NS	0.186NS	-0.162NS	0.294NS
Average Relative humidity (%)	0.402NS	0.308NS	0.269NS	0.1201NS
Total Rainfall (mm)	-0.156NS	-0.039NS	-0.213NS	-0.387NS
Sunshine (hrs)	-0.123NS	-0.203NS	0.056NS	0.177NS

* Significant at 5 percent level of probability, NS= Non- significant

4. Conclusion

The infestation of shoot fly was started from 31st standard meteorological week and remained throughout the crop season in both the years. Initially, the plant damage of 6.67 and 10.00% during *Kharif* 2014 and 2015, respectively were observed which gradually increased and reached to its peak in 33rd and 34th standard meteorological weeks of first and second years, respectively, with the plant infestation of 16.67 and 20.00 percent. Thereafter, the shoot fly infestation was declined and disappeared after 39th standard meteorological week during both years. The infestation of stem borer was noticed in the 32nd standard meteorological week during both the years. The damage of stem borer varied from 3.33 to 13.33 and 3.33 to 16.67 percent plant infestation during *Kharif* 2014 and 2015, respectively and showed maximum infestation in 36th and 34th standard meteorological week, respectively.

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