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Seasonal incidence of white grub of pearl millet [*Pennisetum glaucum* (L.) R. Br.] In semi-arid region of Rajasthan

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Abstract
Investigation on "Incidence and Management of Major Insect-Pests of Pearl Millet [*Pennisetum glaucum* (L.) R. Br.]*"*. 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 borer was noticed in the 32nd SMW during both the years and respective peak of 2014 and 2015 in 36th and 34th SMW.
The damage of white grub was observed in 31st SMW and peak was in 32nd SMW during both the years. The effect of abiotic factors on white grub damage exhibited significant negative correlation with maximum temperature, non-significant negative correlation with minimum temperature and sunshine hours with white grub damage during 2014. However, significant positive correlation existed with average relative humidity and non-significantly positive correlation with total rainfall. During 2015, the non-significant negative correlation was observed with maximum temperature, total rainfall and sunshine hours, however, non-significant positive correlation existed with average relative humidity and minimum temperature.
The two years survey during *Kharif* 2014 and 2015 on insect-pests of pearl millet in Semi-arid Eastern Plain of Rajasthan revealed that nine insect species, *viz.*, shoot fly, stem borer, white grub, termite, grey weevil, leaf roller, chaffer beetle, grasshopper and *Helicoverpa* larvae appeared on pearl millet. White grub was observed as major pests, however, the incidence of other pests was meager.

Keywords: sunshine, abiotic, correlation, white grub, *Helicoverpa*, SMW

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. extruded products like sev and sweet vermicelli; flakes and pops and many more. Pearl millet grain contains 13-14 per cent protein, 5-6 per cent fat, 74 per cent carbohydrate, 1-2 per cent minerals and also contains higher amount of carotene, (riboflavin (Vit B_2) and niacin (Vit B_4). The food products based on them especially suitable for those suffering from to diabetes.
Pearl millet ranks first under the category of millets in India, in terms of area, production and productivity. The states of Rajasthan, Uttar Pradesh, Maharashtra, Haryana and Gujarat account for roughly more than 90% of total area under this crop and contribute similar level of production. 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 (Anonymous, 2015c).
Number of insect-pest have been reported to damage pearl millet and cause economic loss *viz.*, White grub, *Holotrichia consanguinea* Blanchard; Shoot fly, *Atherigona approximata* Malloch; Root bug, *Aethus latticolis* Orientalis; Red hairy caterpiler, *Amsacta moorei* Butler; Grey weevil, *Myllocerus* spp. F.; Leaf roller, *Marasmia* spp.; Thrips, *Anaphothips sudanensis* Trybom; Shoot bug, *Eysarcoris inconspicuous* (H. and S.); Blister beetle, *Cylindrothorax tenuicolis* (Pallas); Chafer beetle, *Rhinyptia laeviceps* (Arrow) and Earhead bug, *Nysius ericae* (Sch.) (Anonymous,1990). Besides these insect-pests the termite, stem borer and grasshopper also reported to cause serious damage to this crop (Anonymous, 1988).
Out of these, White grub are the major insect-pests of pearl millet in semi-arid eastern regions of Rajasthan.

Material and Methods

The variety RHB-177 of pearl millet was sown in an area of 100 m^2 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.

Result and Discussion

The data presented in table 1, 2 and 3 revealed that insect-pest species *viz.*, white grub, *Holotrichia consanguinea* Blanchard; were recorded on pearl millet during both the years (*i.e.* 2014 and 2015). These 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 table 1, 2 and 3 indicated that during 2014, the white grub damage started in 31st standard meteorological week when temperature ranged between 33.0 ^{0}C (maximum) and 25.2 ^{0}C (minimum), average relative humidity 76.5 per cent, total rainfall 52.8 mm and 4.6 sunshine hours. The white grub damage increased gradually reached to maximum (30.00%) on 32nd standard meteorological week at 29.9 ^{0}C (maximum) and 23.9 ^{0}C (minimum), average relative humidity 87.5 per cent, total rainfall 116 mm and 1.4 sunshine hours. Thereafter, the infestation of white grub damage declined. The correlation matrix indicated a significant negative correlation with maximum temperature (r= -0.694), non significant negative correlation with minimum temperature (r= -0.127) and sunshine hours (r= -0.479) with white grub damage. However, significant positive correlation existed between average relative humidity (r= 0.614) and non significantly positive correlation with total rainfall (r= 0.385).

The table 1, 2 and 3 indicated that during 2015, the white grub damage started in 31st standard meteorological week when temperature ranged between 28.8 ^{0}C (maximum) and 23.8 ^{0}C (minimum), average relative humidity 81.5 per cent, total rainfall 272 mm and 1.5 sunshine hours. The white grub damage increased gradually reached to maximum (26.67%) on 32nd standard meteorological week at 31.9 ^{0}C (maximum) and 25.1 ^{0}C (minimum), average relative humidity 76 per cent, total rainfall 5.6 mm and 1.0 sunshine hours. Thereafter, the infestation of white grub damage declined. The correlation matrix indicated a non significant negative correlation with maximum temperature (r= -0.347), total rainfall (r= -0.010) and sunshine hours (r= -0.439) with white grub damage. However, non significant positive correlation existed between average relative humidity (r=0.412) and minimum temperature (r= 0.100).

The present findings are agreement with that of Rangarajan (1966) who reported 30.0 - 53.3 per cent incidence of white grub (*Holotrichia spp.*) on pearl millet in India. However the incidence of shoot fly (*A. approximata*) reported by Natarajan *et al.* (1973) and Singh and Jotwani (1973) was 29.9 - 66.8 and 35.3 per cent, respectively, which partially support the present findings.

The present findings are also in agreement with that of Anonymous (2014) reported that the white grub was noticed during 31st to 37th week at Jaipur. Plant damage due to grub ranged from 3.33 to 13.20%. The highest damage (13.20%) was recorded during 34th week. Shoot fly infestation started in the 32nd week and remained upto 40th week. The highest incidence *i.e.* 18.75% dead hearts were recorded during 34th week. Stem borer damage was also observed in the weeks of 37 to 40th. Its intensity ranged from 2.0 to 4.0 per cent.

Table 1: Incidence of white grub on pearl millet during *Kharif* 2014

Duration	Standard Meteorological Week	Temperature (^{0}C)		Average Relative Humidity (%)	Total Rainfall (mm)	Sunshine (hrs)	Whitegrub Damage (%)
		Maximum	Minimum				
16/7/14 to 22/7/14	29	34.6	24.1	72.0	158.6	5.0	0.00
23/7/14 to 29/7/14	30	32.6	24.7	74.0	32.4	3.2	0.00
30/7/14 to 5/8/14	31	33	25.2	76.5	52.8	4.6	13.33
6/7/14 to 13/8/14	32	29.3	23.9	87.5	116	1.4	30.00
14/8/14 to 19/8/14	33	31.9	24.3	70.5	0	6.4	16.67
20/8/14 to 26/8/14	34	36.9	26.1	50.0	0	10.8	6.67
27/8/14 to 2/9/14	35	35.1	24.8	65.0	21.4	9.1	13.33
3/9/14 to 9/9/14	36	30.2	23.9	79.5	59.4	4.2	16.67
10/9/14 to 16/9/14	37	32.4	24.4	75.5	20.2	6.7	6.67
17/9/14 to 23/9/14	38	34.3	23.6	57.5	0	9.9	6.67
24/9/14 to 30/9/14	39	34	23.2	52.5	0	9.8	3.33
1/10/14 to 7/10/14	40	35.8	24.9	40.0	0	9.7	0.00

Table 2: Incidence of white grub on pearl millet during *Kharif* 2015

Duration	Standard Meteorological Week	Temperature (^{0}C)		Average Relative Humidity (%)	Total Rainfall (mm)	Sunshine (hrs)	Whitegrub Damage (%)
		Maximum	Minimum				
16/7/15 to 22/7/15	29	34.2	25.2	67.0	79.4	5.8	0.00
23/7/15 to 29/7/15	30	31.6	24.3	80.0	28	4.5	0.00
30/7/15 to 5/8/15	31	28.8	23.8	81.5	272	1.5	10.00
6/8/15 to 13/8/15	32	31.9	25.1	76.0	5.6	1	26.67
14/8/15 to 19/8/15	33	32.2	24.8	78.0	14	4.4	20.00
20/8/15 to 26/8/15	34	32.8	23.9	64.5	0	8.5	10.00
27/8/15 to 2/9/15	35	35.1	25.4	57.0	0	9.7	13.33
3/9/15 to 9/9/15	36	35.6	25.8	47.0	4.2	9.3	10.00
10/9/15 to 16/9/15	37	37.3	25.6	45.0	0	9.7	6.67
17/9/15 to 23/9/15	38	35.1	28.8	62.0	2.4	6.6	0.00
24/9/15 to 30/9/15	39	34	23.3	43.5	0	8.7	0.00
1/10/15 to 7/10/15	40	36.7	20.9	38.0	0	9.2	0.00

Table 3: Correlation coefficient (r) of abiotic factors with incidence of white grub on pearl millet

Weather variables	White grub	
	2014	2015
Maximum Temperature (^{O}C)	-0.694*	-0.347 NS
Minimum Temperature (^{O}C)	-0.1277 NS	0.100 NS
Average Relative humidity (%)	0.614*	0.412 NS
Total Rainfall (mm)	0.385 NS	-0.010 NS
Sunshine (hrs)	-0.479 NS	-0.439 NS

* Significant at 5 per cent level of probability
NS= Non- significant

Conclusion
The infestation of white grub was observed in 31st SMW and peak was in 32nd SMW during both the years.

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