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Screening of Barnyard Millet Germplasm against Shoot Fly and Stem Borer Damage under Field Conditions

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A B S T R A C T

A field experiment with three replications was conducted at two locations of College of Forestry, Ranichauri, Tehri Garhwal, V.C.S.G. Uttarakhand University of Horticulture and Forestry. One location selected was at Plant Breeding Block (2100-2200 m above msl) and other at Gaja Research Station (1600-1`700 m above msl) for the screening of barnyard millet germplasm in Advance Varietal Trial against per cent damage caused by shoot fly and stem borer during *Kharif* 2017 under ICAR- All India Coordinated Research Project on Small Millets. The screening comprised a total of 06 entries in Barnyard Millet-Advance Varietal Trial (BAVT) along with two checks viz., VL-172 and PRJ-1. Significant differences in resistance were found in the tested entries to both the recorded insect pests at both the locations. However, the damage recorded at Gaja Research Station was comparatively higher for both the insect pests. The results revealed that due to shoot fly infestation, the percentage of noted 'Dead Heart' was in the range of 5.28 to 23.18 per cent at Plant Breeding Block and 7.22 to 25.00 per cent at Gaja Research Station. However, the infestation due to stem borer ranged from 2.91 to 16.63 per cent at Plant Breeding Block and 4.07 to 22.96 per cent at Gaja Research Station. Among the tested entries in BAVT, two entries were found resistant to shoot fly and three entries were found resistant to stem borer. Overall two entries viz., DHBM 996 and TNEF-204 were found resistant to both the insect-pests at both the locations. These experiments conclude that screening of barnyard millet entries in AVT for identifying resistance sources to shoot fly and stem borer is a vital study as entries with stable resistance are of immense value to the breeders and may be used in further breeding programme in developing resistant varieties against both the insect pests.

Introduction

Small millet crops are one of the oldest foods known to humans and possibly the first cereal grain to be used for domestic purpose. They are considered as gods own crop because they can be cultivated in scarcity conditions and require small quantity of water, mature early

and does not demand rich soils for their survival and growth and they can withstands both drought and water logging and are well suited for cultivation under adverse conditions (Kumar, 2014). India is the largest producer of many kinds of millets, which are often referred to as coarse cereals. Small millets grown in India are finger millet, kodo millet, foxtail millet, barnyard millet, proso millet, little millet and brown top millet. Due to the realization of the nutritional superiority of these grains, they are now considered as nutri –cereals because they constitute a major source of energy and protein for millions of people (Vasil and Vasil, 1984).

Among these, barnyard millet [*Echhinochloa frumentacea* (Roxb.) Link] is an important small millet crop grown in many countries like China, Japan, Malaysia, East Indies, Africa and United States of America (Nagaraja *et al.,* 2007). In India, it is grown in Madhya Pradesh, Uttarakhand, Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra and Bihar. In Uttarakhand, it is grown under rainfed and poor soil fertility conditions. The resilience exhibited by this crop is helpful in its adjustment to different ecological situations and makes it an ideal crop for climate change and contingency planting. This crop, being eco-friendly, is highly suitable for fragile and vulnerable agro-ecosystem of Uttarakhand. It is, therefore, preferred for sustainable agriculture and grown under organic farming in the hilly regions of Uttarakhand.

The crop is known to cope up with abiotic and biotic stresses, nevertheless, under vulnerable conditions some of the insects cause heavy losses and can damage the entire crop. Research and survey in many parts of the country have confirmed that seed yield and seed quality are being adversely affected by various insect pests affecting the crop (Kumar, 2016).

Barnyard millet crop has been found to be infested by several insect pests which can be broadly grouped as defoliators, stem borers, root feeders, and sap feeders. Among the insect- pests harboring barnyard millet crop, shoot fly and stem borer are the most damaging insect-pests in Uttarakhand. In Tehri Garhwal region of Uttarakhand, shoot fly and stem borer have emerged as major constraints reducing the productivity of the crop.

There is need to have resistance sources as these vital but underestimated crops are generally grown by poor and marginal farmers who cannot afford the application of insecticides. The present investigation was therefore undertaken with an aim to identify resistant donors of barnyard millet against shoot fly and stem borer.

Materials and Methods

The experiment included 06 (six) entries viz., VL 249, DHBM 99-6, TNEF-204, DHBM 99-7, RBM-36A and DHBM-33 along with two checks VL 172 and PRJ 1 of Barnyard Millet Advance Varietal Trial (BAVT). The entries were sown at two locations of College of Forestry, Ranichauri, Tehri Garhwal, V.C.S.G. UUHF, one at Plant Breeding Block (2100-2200 m above msl) and other at Gaja Research Station (1600-1700 m above msl) on 28th June 2017. The experiment was replicated thrice in RBD design, with a row distance of 22.5 cm, plant to plant distance 10.00 cm, row length of 3.00 m. Recommended dose of FYM @ 10 tonne/hac was provided before sowing for optimum plant growth and no plant protection chemicals were given to ensure the natural biodiversity of insects at both the locations. Observations of the infestation (deadheart per cent) or damage per cent caused by shoot fly (only deadheart) and stem borer (dead heart along with the holes on the main stem) were

recorded per plot (each plot contain two rows) by direct counting the dead heart at weekly intervals. The mean number of deadheart per cent recorded was subjected to analysis of variance. The percentage of dead heart was assessed from the ratio of plant with dead heart and the total number of plants multiplied by hundred (Kumar, 2014).

Percent damage caused by shoot fly was calculated by using following formula

$$\text{Shoot fly damage (\%)} = \frac{\text{Number of plants with dead hearts in a plot}}{\text{Total number of plants in a plot}} \times 100$$

Percent damage caused by Stem borer was calculated by using following formula

$$\text{Stem borer damage (\%)} = \frac{\text{Number of plants with dead hearts in a plot}}{\text{Total number of plants in a plot}} \times 100$$

Results and Discussion

The observations were taken on the reaction of barnyard millet entries against shoot fly and stem borer. The data presented in Table 1 revealed that the damage per cent of shoot fly ranged from 5.28 to 19.33 per cent at Plant Breeding Block and from 7.22 per cent to 25.00 per cent at Gaja Research Station. The recorded damage per cent of stem borer ranged from 2.63 to 16.36 per cent and from 4.07 per cent to 22.96 per cent at Plant Breeding Block and Gaja Research Station, respectively. The data reveals that the damage recorded by both the insect pests was comparatively higher at Gaja Research Station (1600- 1700 m asl).

The mean values on deadhearts formed by shoot fly at Plant Breeding Block (Table 1 and Figure 1) indicated that the entry DHBM 99-6 with a figure of 5.28 per cent and the entry TNEF-204 with a figure of 8.57 per cent recorded the lowest number of deadhearts whereas Highest deadheart counts (18.23 per cent) by shoot fly were recorded in DHBM 33 which was statistically at par with a figure of 19.33 per cent and 17.29 per cent recorded in checks PRJ-1 and VL 172, respectively.

At Gaja research station, the results depicted in Table 1 and Figure 2 clearly showed that the lowest number of dead heart counts formed by shoot fly was again recorded in the entry DHBM 99-6 followed by TNEF with values of 7.22 per cent and 10.00 percent, respectively. Whereas highest number of deadhearts by shoot fly was recorded in the entry DHBM 33 (23.33 per cent) which was at par with check PRJ-1 with a figure of 25.00 per cent as well as with check VL 172 with a figure of 23.18 per cent.

In case of stem borer recorded at Plant Breeding Block, the data presented in Table 1 and Figure 1 revealed that the mean value of deadheart was lowest in the entry DHBM 99-6 with figure of 2.63 percent followed by DHBM 99-7 and TNEF-204 in which the deadheart counts were 2.91 per cent and 3.94 per cent, respectively. While the highest number of deadheart counts was formed in the entry DHBM-33 with a figure of 16.36 per cent which was at par with the figures 14.16 per cent and 13.90 per cent recorded in the checks PRJ 1 and VL 172, respectively.

At Gaja research station, the lowest number of dead hearts formed by stem borer were recorded in the entry DHBM 996 with a figure of 4.07 followed by TNEF 204 (5.00 per cent) and DHBM 99-7 (5.56 per cent) though the highest (21.48 per cent) deadhearts by stem borer were recorded in the entry DHBM 33 which was at par with PRJ-1 with a figure of 22.96 per cent (Table 1 and Figure 2). Based on the data of performance of

barnyard millet genotypes at both the locations, two entries viz., DHBM 99-6 and TNEf-204 showed resistance to shoot fly and stem borer. Identification and utilization of resistant cultivars is the cheapest and feasible way to combat with any disease and insect pests' problems. The identified resistant sources may be utilized for resistance in breeding programme.

The present results are partially in confirmation with Kishore and Soloman (1989) who reported that more than 100 insect pest species are associated with millets based cropping system. While in barnyard millet crop, shoot fly is comparatively more serious insect attacking at vegetative and ear head stage as stated by Parmar *et al.*, (2015). Few studies for identification of resistant sources against diseases and insect pests have been made earlier.

Table.1 Screening of barnyard millet entries for deadhearts caused by shootfly and stem borer

Sl. No.	Entry	Location			
		Plant Breeding Block (2100-2200 m above msl)		Gaja Research Station (1600-1700 m above msl)	
		Shoot fly (deadheart %)	Stem borer (deadheart %)	Shoot fly (deadheart %)	Stem borer (deadheart %)
1.	VL 249	17.20 (4.75)	7.34 (3.40)	21.67 (4.25)	10.74 (2.88)
2.	DHBM 99-6	5.28 (2.85)	2.63 (2.24)	7.22 (2.49)	4.07 (1.89)
3.	TNEF 204	8.57 (3.31)	3.94 (2.44)	10.00 (3.08)	5.00 (2.20)
4.	DHBM 99-7	12.52 (3.99)	2.91 (2.54)	15.00 (3.67)	5.55 (1.96)
5.	RBM 36	18.10 (4.81)	12.62 (4.55)	22.22 (4.36)	19.82 (3.68)
6.	DHBM 33	18.23 (4.93)	16.36 (4.74)	23.33 (4.38)	21.48 (4.15)
	VL 172 ©	17.29 (4.90)	13.90 (4.00)	23.18 (4.27)	15.13 (3.85)
	PRJ 1©	19.33 (5.09)	14.16 (4.88)	25.00 (4.50)	22.96 (3.89)
	General mean	**4.33**	**3.60**	**3.88**	**3.06**
	SEm	**0.12**	**0.12**	**0.11**	**0.12**
	LSD (0.05)	**0.38**	**0.37**	**0.33**	**0.36**
	CV (%)	**5.06**	**5.93**	**4.98**	**6.80**

**Figures in parentheses are square root transformed values

Figure.1 Reaction of different entries of barnyard millet entries to deadhearts caused by shoot fly and stem borer at Plant Breeding Block

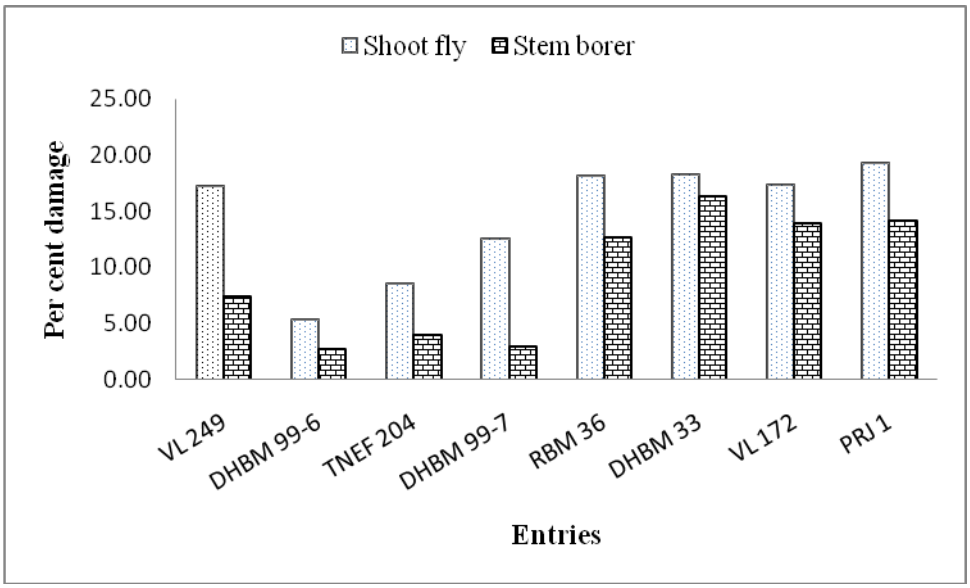
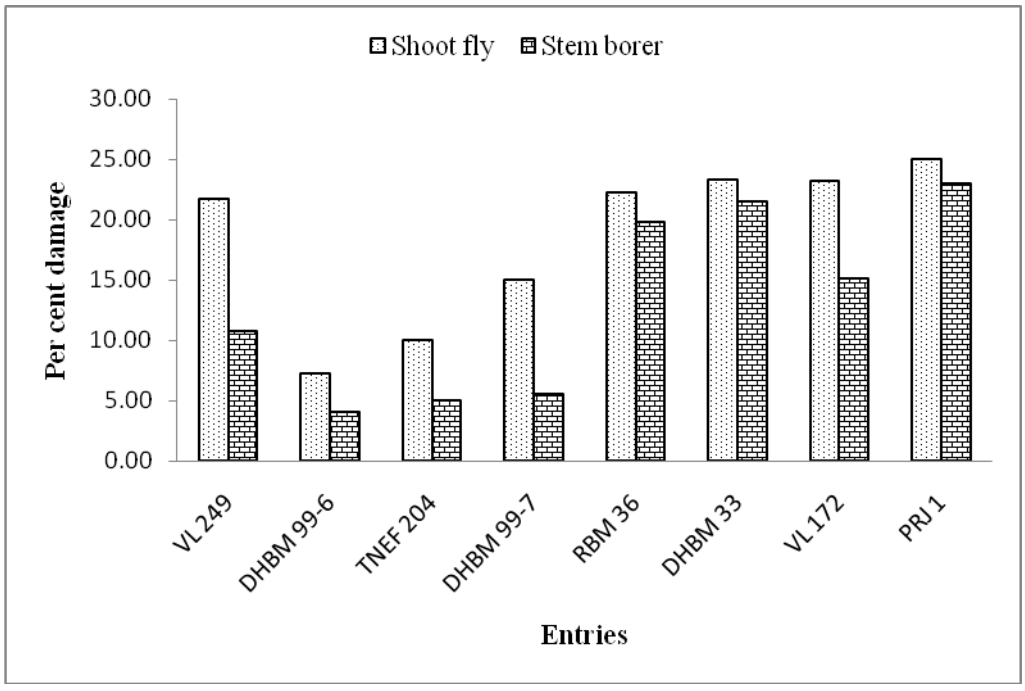


Figure.2 Reaction of different entries of barnyard millet entries to deadhearts caused by shoot fly and stem borer at Gaja Research Station



Nageshchandra and Musthak Ali *et al.*, (1983) reported that a number of shoot fly species attack in small millets with 44.9 per cent yield reduction in barnyard millet, 90.9 per cent in proso millet, 78.5 per cent in little millet, 35.0 per cent in kodo millet and 1.8 per cent in foxtail millet.

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