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Screening for finding resistant sources among little millet entries/genotypes against shootfly in Ranchi, Jharkhand

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Abstract
A field trial was conducted at little millet research plot of Birsa Agricultural University, Kanke, Ranchi during *Kharif* season of 2017, in order to screen out the resistant little millet genotypes against the shootfly, a total number of 19 genotypes i.e. DLM95, WV126, DLHLT28-4, OLM217, WV167, IIMR LM7012, OLM233, IIMR LM7162, TNPSu183, GPUL4(MLT9), TNPSu186, GPUL5 252, WV 125, RLM 37, RLM 367, JK 8, OLM 203 and BL 6 including the susceptible check BG 1, against shootfly. The experiment was laid out in randomized block design with three replications. The genotype IIMR LM7012 (10.78%) recorded the lowest percentage of plants bearing shootfly eggs and it remained at par with BG 1 (12.77%) which were however, not better than DLM95 (16.26%). The genotype IIMR LM7012 recorded the lowest deadhearts per cent and remained at par with BG 1, DLM95, OLM217, BL 6 and DLHLT28-4 in which the deadheart counts were 13.35, 14.02, 16.17, 17.42 and 17.65 per cent, respectively. the genotypes IIMR LM7012 though recorded significantly more productive tillers per plant (3.36) but remained at par with BG 1 (2.83), WV 125 (2.13), GPUL5 252 (2.16), OLM217 (2.23), TNPSu186 (2.26), BL 6 (2.30), and DLHLT28-4 (2.40). The genotypes IIMR LM7012 recorded significantly more productive tillers per plant (3.36) but remained at par with BG 1 (2.83), WV 125 (2.13), GPUL5 252 (2.16), OLM217 (2.23), TNPSu186 (2.26), BL 6 (2.30), and DLHLT28-4 (2.40). The genotypes IIMR LM7012 though recorded significantly more productive tillers per plant (3.36) but remained at par with BG 1 (2.83), WV 125 (2.13), GPUL5 252 (2.16), OLM217 (2.23), TNPSu186 (2.26), BL 6 (2.30), and DLHLT28-4 (2.40). And The cultivar OLM 203, with 27.31 per cent deadhearts, was considered to be the most susceptible one against shootfly.

Keywords: Little millet, shootfly, *Atherigona soccata*, screening of genotypes

Introduction

Little millet is scientifically known as *Panicum sumatrense* (*miliare)* (Rolk Roem and Schult). It is an important indigenous crop in Indian subcontinent. In India, it is grown in Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha and Tamil Nadu. It is locally called by different names, Kutki in Hindi and Same/ savi in Kannada, Samai in Tamil Nadu, Samulla in Telugu, Chama in Malyalam. In Jharkhand, little millet crop is grown in Kharif season. In Jharkhand, mostly short duration variety of Gundli is preferred by the farmers as they get sufficient time to grow another crop after the harvest of little millet. The nutritional value of the little millet grain is superior to fine cereals. Often, little millet serves as a food and contributes to the nutritional security of small and marginal farmers who live in remote areas. In India, out of the total net sown area of 141 m ha, rainfed area accounts for 85 m ha, spread over 177 districts. This constitutes approximately 60 per cent of total farming area in the country [6]. Rainfed Agriculture contributes 44 per cent of the total food grain production of the country and produces 75 per cent of pulses and more than 90 per cent of sorghum, small millet and groundnut from arid and semi-arid regions. The grain compares well with other cereals. It has a fair source of protein (7.70 to 16.50%), Fat (2.45 to 9.04%), Carbohydrate (62.50 to 76.30%) and is an excellent source of dietary fiber (15.90 to 18.10) with good amount of soluble (3.15 to 5.70) and insoluble (10.20 to 14.95%) fraction [5, 8, 14]. Jharkhand is one of the largest producers of little millet in India, shootfly is one of the main constraints in its successful cultivation. Shootfly is a dominant pest among several pests attacking the little millet [7]. The shootfly ranks first among the insect pests that attack little millet and often resulting in per cent loss to the crop [3]. Shootfly alone able to bring a yield loss of 36 per cent in proso millet [11] and 39 per cent in case of little millet.

Shootfly species produced significantly less number of deadhearts in DMR-5, Suwan-1, Bracaticos (Y), NLD (Recons), VC-80 and Bracaticos (w). The reaction of Diara EV (MFS4) to the shootfly species and the maize stalk borer, *Chilo partellus* (Swinhoe) indicated that this cultivar was a multiple pest resistance source (Pawar and Sarup, 1988) [12]. Rao and Rao (1956) [13] and Mote, U.N. (1982) [11] reported 40 lines for their reaction to shoot fly in the rainy season. The incidence of shoot fly ranged from 12.42 to 66.24 per cent. Among the lines evaluated PS-18527, PS-14533, SPV-491 and RHR-5 were highly resistant to shoot fly showing less than 20 per cent deadhearts. Mote, U.N. (1988) [10] indicated the correlation between the number of deadhearts caused and grain and fodder yield of the sorghum hybrids CSH-5 (*kharif*) and CSH-8R (*rabi*). The damage caused by the pest ranged from 9.22 to 60.82 per cent deadhearts in CSH-5 and from 60 to 95.53 per cent in CSH-8R. There was a significant negative correlation between percentage deadhearts, grain and fodder yield in both the hybrids. This experiment was done to screen out the resistant source among 19 test genotypes/entries.

Materials and Methods

This field experiment was conducted to study the response of different entries/genotypes of little millet against shootfly. Seeds of little millet entries/genotypes were received from PC unit, All India Coordinated Small Millet Improvement Project, Bengaluru and the small millet Breeder, Department of Plant Breeding and Genetics, BAU, Kanke, Ranchi. The experiment was laid out in randomized block design with three replications. Standard agronomical practices were followed for growing the crops. Seeds were sown in plots of 3m X 1.5m on 29th June, 2017 at Small Millets Research Plots with 20cm row to row and 10 cm plant to plant spacing. Crops were harvested at different dates, depending upon the maturity. Harvesting was done between the last week of August to second week of September, 2017. In order assess the reaction of little millet genotypes against the shootfly, a total number of 19 genotypes including the susceptible check BG 1 were sown at Small Millet' research plot of Birsa Agricultural University, Kanke.

Observations recorded

Observations on egg count of shootfly and dead hearts per cent formed due to shootfly were recorded weakly per row from each plot by pre- determined stratified random sampling method. The mean number of egg per plant and dead heart per cent recorded were subjected to analysis of variance. The data were subjected to square root transformation and angular transformation (as per data) before analysis. The percentage of dead hearts was assessed from the ratio of plant with dead hearts and the total number of plant multiplied by hundred.

$$\text{Number of eggs per plant} = \frac{\text{Total number of eggs on plants in a row}}{\text{Total number of plants in a row}}$$

$$\text{Dead heart (\%)} = \frac{\text{Total number Dead hearts on plants in a row}}{\text{Total number of plants in a row}} \times 100$$

Results and Discussion

The results obtained are presented under the following heads.

1. Percentage of plants with shootfly eggs.
2. Shootfly eggs per 10 plants.
3. Deadheart percentage.
4. Tiller per plant
5. Productive tiller per plant.

1. 14 DAE

1.1 Percentage of plants with shoot fly egg.

The plants in which the female shoot fly deposited eggs were counted for three successive weeks starting from 14 DAE (days after emergence) to 28 DAE on ten randomly selected plants in each treatment. The data thus obtained were transformed into percentages for statistical analysis. The percentage of plants with shoot fly eggs recorded during the course of investigation has been presented in Table 1.

At 14 DAE, the plants with shoot fly eggs varied from 10.34 (IIMR LM7012) to 26.53 (OLM 203) per cent. All the entries/genotypes tested were found to be having less number of plants with shoot fly eggs than the check genotype BG1. The genotypes *viz*., IIMR LM7012 (10.34%), BG 1 (12.34%), DLM95 (15.78%), OLM217 (16.56%), WV167 (17.78%), TNPSu186 (18.8%) and WV125 (19.78%) were observed to have minimum plants with deposition of shoot fly eggs and remained at par with each other. The later mentioned genotype was however, not better than JK 8 which recorded 21.68 per cent plants deposited with shoot fly eggs. Significantly highest plants with shoot fly eggs were recorded on the genotype OLM 203 (26.53%).

1.2 Shoot fly eggs per 10 plants.

The number of shoot fly eggs per 10 plants recorded at 21 DAE (days after emergence) presented in Table 1 indicated significant differences among the different genotypes tested under the present investigation. The mean egg count ranged from 3.0 to 5.8 per plant. The genotypes, IIMR LM7012 with a figure of 3.0 eggs/ 10 plants recorded the lowest egg deposition and it remained at par with TNPSu183 (3.3) which were however, not better than the genotype, OLM217 (3.6/ 10 plants). The other entries in which less than 5 eggs per 10 plants deposited on were JK 8 (3.30), WV 167 (3.60), OLM217 (3.60), WV126 (3.61), DLM95 (4.00), TNPSu186 (4.0), WV125 (4.30), GPUL4 (MLT9) (4.30), and BL 6 (4.30 eggs/ plant). The highest egg counts of 5.8 eggs per 10 plants were observed in RLM37 and GPUL5 252.

Table 1: Reaction of different genotypes of little millet against shootfly infestation (14 DAE)

TR. NO.	Entries	Plants with shoot fly eggs %	Eggs/ 10 plants
T_1	DLM95	15.78 (23.34) **	4.0 (2.12) *
T_2	WV126	22.43 (28.25)	3.6 (2.02)
T_3	DLHLT28-4	17.23 (24.50)	4.0 (2.12)
T_4	OLM217	16.56 (23.97)	3.6 (2.02)
T_5	WV167	17.78 (24.95)	3.6 (2.02)
T_6	IIMR LM7012	10.34 (18.72)	3.0 (1.87)
T_7	OLM233	15.78 (23.34)	4.3 (2.19)
T_8	IIMR LM7162	18.56 (25.48)	5.0 (2.34)
T_9	TNPSu183	22.76 (28.45)	3.3 (1.94)
T_{10}	GPUL4(MLT9)	23.46 (29.06)	4.3 (2.19)
T_{11}	TNPSu186	18.80 (25.70)	4.0 (2.12)
T_{12}	GPUL5 252	23.76 (29.13)	5.8 (2.50)
T_{13}	WV 125	19.78 (26.35)	4.3 (2.19)
T_{14}	RLM 37	24.45 (29.67)	5.8 (2.50)
T_{15}	RLM 367	22.76 (28.45)	5.3 (2.40)
T_{16}	JK 8	21.68 (27.67)	3.3 (1.94)
T_{17}	OLM 203	26.53 (30.98)	5.5 (2.44)
T_{18}	BL 6	20.21 (26.71)	4.3 (2.19)
T_{19}	BG 1	12.34 (20.62)	4.3 (2.19)
	SEM (±)	1.371	0.290
	C.D. (5%)	3.949	0.834
	C.V. (%)	12.163	12.060

** Figures in parentheses are √arc sine transformed values.
* Figures in parentheses are √X+0.5 transformed values.

2. At 21 DAE.

2.1 Percentage of plants with shootfly eggs

The results on percentage plants with shootfly eggs at 21 DAE indicated that there was substantial increase in shootfly infestation as compared to 14 DAE. However, much variation in the level of infestation in different genotypes was noticed at 21 DAE. There was a sizeable increase (3.72%) in infestation in the genotype OLM233 at 21 DAE as compared to 14 DAE. The percentages of plants with shootfly eggs ranged from 10.76 to 26.32 per cent. The lowest percentages of plants bearing shootfly eggs was noticed in IIMR LM7012 and they remained at par with BG 1 (12.87%) which in their turn was, not better than DLM95 (16.25%), OLM217 (17.23%). The genotype OLM 203 (26.32%) had the highest percentage of plants with shootfly eggs (Table 2).

2.2. Shootfly eggs per 10 plants

Increase in number shoot fly eggs per 10 plants was noticed as the age of the plants advanced from 14 to 28 days after emergence among different genotypes. All the genotypes registered more number of eggs per 10 plants at 21 DAE as compared to the check genotype BG 1 and IIMRLM 7012 whereas OLM 203 (7.5), WV 125 (7.3), TNPSu183 (7.3), WV126 (7.0), OLM217 (6.6), WV167 (6.6), GPUL4(MLT9) (6.6) and BL 6 (6.6) showed highest shootfly eggs per 10 plants (Table 2.)

Table 2: Reaction of different genotypes of little millet against shootfly infestation 21 DAE

TR. NO.	Entries	Plants with shootfly eggs %	Eggs/ 10 plants
T_1	DLM95	16.25 (23.73) **	6.0 (2.54) *
T_2	WV126	22.86 (28.52)	7.0 (2.73)
T_3	DLHLT28-4	17.78 (24.88)	6.3 (2.60)
T_4	OLM217	17.23 (24.50)	6.6 (2.66)
T_5	WV167	18.22 (25.25)	6.6 (2.66)
T_6	IIMR LM7012	10.76 (19.06)	5.6 (2.46)
T_7	OLM233	19.50 (26.11)	6.3 (2.60)
T_8	IIMR LM7162	19.22 (25.99)	5.3 (2.40)
T_9	TNPSu183	23.11 (28.73)	7.3 (2.79)
T_{10}	GPUL4(MLT9)	23.75 (29.13)	6.6 (2.66)
T_{11}	TNPSu186	18.55 (25.48)	6.0 (2.54)
T_{12}	GPUL5 252	24.17 (29.40)	6.3 (2.60)
T_{13}	WV 125	20.19 (26.64)	7.3 (2.79)
T_{14}	RLM 37	26.19 (30.72)	6.5 (2.64)
T_{15}	RLM 367	23.22 (28.79)	6.3 (2.60)
T_{16}	JK 8	22.11 (28.04)	5.6 (2.46)
T_{17}	OLM 203	26.32 (30.85)	7.5 (2.82)
T_{18}	BL 6	20.76 (27.06)	6.6 (2.66)
T_{19}	BG 1	12.87 (20.96)	5.3 (2.40)
	SEM (±)	1.550	0.450
	C.D. (5%)	4.464	1.296
	C.V. (%)	13.249	12.103

** Figures in parentheses are √arc sine transformed values.
* Figures in parentheses are √X+0.5 transformed values.

3. At 28 DAE

3.1 Percentage of plants with shootfly eggs.

At 28 DAE, the genotypes proved significantly better than IIMR LM7012 (11.25%) and BG 1 (13.12%) with regard to plants with lower shootfly eggs. The percentages of plants with shoot fly eggs varied from 11.25 in IIMR LM7012 to 26.73 in OLM 203. The genotype IIMR LM7012 though, recorded the lowest plants infested but it remained at par with BG 1 (13.12%). Highest (26.76%) plants with shootfly eggs was recorded in OLM203 and remained at par with eight more entries, viz. JK 8 (22.85), WV126 (23.22), TNPSu183 (23.63), GPUL4(MLT9) (23.86), RLM 367 (23.87), GPUL5 252 (24.76), RLM 37 (25.23) and OLM 203 (26.76) per cent respectively. (Table 3.)

3.2. Shoot fly eggs per 10 plants

It was observed that at 28 DAE, there was an increase in egg counts in eight out the 19 genotypes tested as compared to 21 DAE. Significantly less number of eggs per 10 plants was recorded in BG 1 (5.9) but it was not better than DLM95 (7.0), RLM 367 (7.0), TNPSu183 (7.0), OLM217 (6.6), BL 6 (6.6), WV 125 (6.3), DLHLT28-4 (6.3), TNPSu186 (6.3), IIMR LM7162 (6.3), IIMR LM7012 (6.0) eggs per 10 plants genotypes as compared to check BG 1. (Table 3.)

Table 3: Reaction of different genotypes of little millet against shootfly infestation (28 DAE)

Tr. No.	Entries	Plants with shootfly eggs %	Eggs/ 10 plants
T_1	DLM95	16.75 (24.12)	7.0 (2.73)
T_2	WV126	23.22 (28.79)	7.6 (2.84)
T_3	DLHLT28-4	18.12 (25.18)	6.3 (2.60)
T_4	OLM217	17.76 (24.88)	6.6 (2.66)
T_5	WV167	18.76 (25.62)	7.3 (2.79)
T_6	IIMR LM7012	11.25 (29.82)	6.0 (2.54)
T_7	OLM233	16.76 (24.12)	7.0 (2.73)
T_8	IIMR LM7162	19.78 (26.35)	6.3 (2.60)
T_9	TNPSu183	23.63 (29.06)	7.0 (2.73)
T_{10}	GPUL4(MLT9)	23.86 (29.20)	7.3 (2.79)
T_{11}	TNPSu186	19.22 (25.99)	6.3 (2.60)
T_{12}	GPUL5 252	24.76 (29.80)	7.1 (2.75)
T_{13}	WV 125	20.86 (27.13)	6.3 (2.60)
T_{14}	RLM 37	25.23 (30.13)	7.6 (2.84)
T_{15}	RLM 367	23.87 (29.20)	7.0 (2.73)
T_{16}	JK 8	22.85 (28.52)	8.0 (2.91)
T_{17}	OLM 203	26.76 (31.11)	8.0 (2.91)
T_{18}	BL 6	20.88 (27.13)	6.6 (2.66)
T_{19}	BG 1	13.12 (21.30)	5.9 (2.52)
	SEM (±)	1.473	0.426
	C.D. (5%)	4.241	1.227
	C.V. (%)	12.509	10.625

** Figures in parentheses are √arc sine transformed values
* Figures in parentheses are √X+0.5 transformed values.

4. Per cent deadhearts

The data pertaining to deadhearts due to shootfly recorded at different days after emergence of the crop showed increasing trend as the age of the plant increase (Table-4). The results on the reaction of various entries at 14, 21 and 28 DAE are presented in the following paragraphs

4.1. At 14 DAE

At 14 DAE, the deadhearts ranged from 11.86% (IIMR LM7012) to 26.76% (OLM 203) among the different genotypes. The lowest (11.86%) dead hearts were observed in IIMR LM7012 followed by BG 1, DLM95 and OLM217 in which the dead hearts observed were 12.86, 13.66, and 15.45 per cent respectively, which remain at par with each other. However, none of the entries showed tolerant reaction i.e. less than 10 per cent dead heart. (Table 4).

4.2. At 21 DAE

At 21 DAE, the deadhearts ranged from 12.33% (IIMR LM7012) to 27.33% (OLM 203). The local check BG 1 also

recorded less per cent of deadhearts. However, the least deadhearts were observed in IIMR LM7012 (12.33%) followed by BG 1 (13.33%), DLM95 (13.86%) OLM217 (16.33%), BL 6 (17.55%), DLHLT28-4 (17.86) but were at par with each other. The highest (27.33%) dead heart was recorded OLM 203 (Table 4).

4.3. At 28 DAE

The observations recorded at 28 DAE revealed significant differences in deadheart percentages among different genotypes screened for their reaction against shootfly. The genotype, IIMR LM7012 with 12.76% deadheart remained the most promising genotype. However, it remained at par with BG 1 (13.86%), DLM95 (14.55%) and OLM217 (16.75%) which in their turn were not better than DLHLT28-4 (18.33%). Highest (27.86%) deadhearts were recorded in the OLM 203 (Table 4).

Table 4: Reaction of different genotypes of the little millet for the deadhearts caused by the shootfly

TR. NO.	Entries	Deadheart %		
		14 DAE	21 DAE	28 DAE
T_1	DLM95	13.66 (21.64)**	13.86 (21.81)**	14.55 (22.38)**
T_2	WV126	22.33 (28.13)	22.76 (28.45)	23.33 (28.86)
T_3	DLHLT28-4	16.76 (24.12)	17.86 (24.95)	18.33 (25.33)
T_4	OLM217	15.45 (23.11)	16.33 (23.81)	16.75 (24.12)
T_5	WV167	19.86 (26.42)	20.23 (26.71)	20.76 (27.06)
T_6	IIMR LM7012	11.86 (20.09)	12.33 (20.53)	12.76 (20.88)
T_7	OLM233	19.86 (26.42)	21.22 (27.42)	21.86 (27.87)
T_8	IIMR LM7162	18.66 (25.25)	19.66 (26.28)	20.33 (20.33)
T_9	TNPSu183	17.55 (24.73)	18.33 (25.33)	18.86 (25.50)
T_{10}	GPUL4(MLT9)	25.66 (30.40)	25.86 (30.53)	26.23 (30.79)
T_{11}	TNPSu186	23.76 (29.13)	24.33 (29.53)	24.76 (29.80)
T_{12}	GPUL5 252	25.76 (30.46)	26.33 (30.85)	26.86 (31.18)
T_{13}	WV 125	20.76 (27.06)	21.86 (27.83)	22.33 (28.18)
T_{14}	RLM 37	26.25 (30.79)	26.76 (31.76)	27.33 (31.50)
T_{15}	RLM 367	24.33 (29.53)	24.86 (29.87)	25.33 (30.20)
T_{16}	JK 8	22.23 (28.11)	22.76 (28.45)	23.33 (28.86)
T_{17}	OLM 203	26.76 (31.76)	27.33 (31.50)	27.86 (31.82)
T_{18}	BL 6	16.86 (24.20)	17.55 (24.73)	17.86 (24.95)
T_{19}	BG 1	12.86 (20.96)	13.33 (21.39)	13.86 (21.81)
	SEM (±)	1.547	1.928	1.630
	C.D. (5%)	4.454	5.553	4.695
	C.V.%	13.237	16.096	13.304

** Figures in parentheses are √**arc sine** transformed values.

5. Mean percentage of plants with shootfly eggs, egg counts, deadhearts, productive tillers and seed yield of little millet.

The mean values of the data recorded for three consecutive weeks starting from 14 DAE to 28 DAE on percentage of plants with shootfly eggs, eggs per 10 plants and deadhearts per cent are presented in Table-4. Final yield obtained in various treatments is also mentioned in the table.

The data on percentage of plants with shoot fly eggs indicated significant differences among various genotypes screened. The genotype IIMR LM7012 (10.78%) recorded the lowest percentage of plants bearing shootfly eggs and it remained at par with BG 1 (12.77%) which were however, not better than DLM95 (16.26%). The OLM 203 had the highest (26.53%) plants with shootfly eggs and remained at par with seven more entries *viz.*, RLM 37 (25.29%), GPUL5 252 (24.23%), GPUL4(MLT9), RLM 367 (23.28), TNPSu183 (23.16%), WV126 (22.83) and JK8 (22.21%).

The genotype, IIMR LM7012 with the mean egg counts of 4.86 per 10 plants, remained the most promising genotype as it had significantly least number eggs than rest of the entries. It followed by BG 1, TNPSu186, DLHLT28-4, DLM95 and WV167 OLM233 in which the egg counts recorded were 5.16, 5.43, 5.53, 5.66, 5.83 and 5.86 respectively. Highest (7.0) eggs per 10 plants were deposited in the genotype OLM 203 whereas the local genotype BG 1 had 5.16 eggs per 10 plants.

The mean values of deadhearts indicated that in the genotype IIMR LM7012 with a figure of 12.31 per cent recorded the lowest deadhearts and remained at par with BG 1, DLM95, OLM217, BL 6 and DLHLT28-4 in which the deadheart counts were 13.35, 14.02, 16.17, 17.42 and 17.65 per cent, respectively. Highest (27.31%) deadhearts were recorded in the genotype OLM 203 and remained at par with RLM 37 (26.78%), GPUL5 252 (26.31%) and GPUL4 (MLT9) (25.91%).

The result further indicate that the genotypes IIMR LM7012 though recorded significantly more productive tillers per plant (3.36) but remained at par with BG 1 (2.83), WV 125 (2.13), GPUL5 252 (2.16), OLM217 (2.23), TNPSu186 (2.26), BL 6 (2.30), and DLHLT28-4 (2.40). Significantly least (1.60) productive tillers per plant were recorded in TNPSu183, OLM 203 and they remained at par with JK 8, RLM 37, GPUL4 (MLT9) and OLM233 where the number of productive tillers were 1.63, 1.70, 1.80 and 1.70 per plant, respectively (Table-5, Fig-1).

Table 5: Mean percentage of plants with shootfly eggs, eggs counts, dead hearts, productive tillers and seed yield.

TR. NO.	Entries	Plants with shootfly eggs (%)	Eggs /10plants	Deadheart %	Productive Tillers/plants	Yield (q/h)
T_1	DLM95	16.26 (23.73) **	5.66 (2.48) *	14.02 (21.97) **	2.50 (1.73) *	5.57
T_2	WV126	22.83 (28.52)	6.06 (2.56)	22.80 (28.80)	1.73 (1.49)	4.86
T_3	DLHLT28-4	17.71 (24.88)	5.53 (2.45)	17.65 (24.80)	2.40 (1.70)	5.43
T_4	OLM217	17.18 (24.43)	5.60 (2.46)	16.17 (23.66)	2.23 (1.65)	5.22
T_5	WV167	18.25 (25.48)	5.83 (2.51)	20.28 (26.71)	1.70 (1.48)	4.22
T_6	IIMR LM7012	10.78 (19.09)	4.86 (2.31)	12.31 (20.53)	3.36 (1.96)	5.89
ST_7	OLM233	17.34 (24.58)	5.86 (2.52)	20.98 (27.20)	1.70 (1.48)	4.58
T_8	IIMR LM7162	19.18 (25.92)	5.53 (2.45)	19.55 (26.21)	1.76 (1.50)	4.54
T_9	TNPSu183	23.16 (28.73)	5.86 (2.52)	18.24 (25.25)	1.60 (1.44)	3.76
T_{10}	GPUL4(MLT9)	23.69 (29.06)	6.06 (2.56)	25.91 (30.59)	1.80 (1.51)	4.26
T_{11}	TNPSu186	18.85 (25.70)	5.43 (2.43)	24.28 (29.47)	2.26 (1.66)	5.36
T_{12}	GPUL5 252	24.23 (29.47)	6.40 (2.62)	26.31 (30.85)	2.16 (1.63)	5.10
T_{13}	WV 125	20.27 (26.71)	5.96 (2.67)	21.65 (27.69)	2.13 (1.62)	5.42
T_{14}	RLM 37	25.95 (30.59)	6.63 (2.67)	26.78 (31.11)	1.70 (1.48)	4.32
T_{15}	RLM 367	23.28 (28.79)	6.20 (2.58)	24.84 (29.87)	1.80 (1.51)	4.56
T_{16}	JK 8	22.21 (28.11)	5.63 (2.47)	22.77 (28.45)	1.63 (1.45)	4.22
T_{17}	OLM 203	26.53 (30.98)	7.00 (2.73)	27.31 (30.50)	1.60 (1.44)	3.89
T_{18}	BL 6	20.61 (26.99)	5.83 (2.51)	17.42 (24.65)	2.30 (1.67)	5.36
T_{19}	BG 1	12.77 (20.88)	5.16 (2.37)	13.35 (21.39)	2.83 (1.82)	5.77
	SEM (±)	1.674	0.346	1.868	0.154	44.076
	C.D. (5%)	4.822	0.996	5.379	0.443	126.93
	C.V.(%)	14.444	10.242	15.652	12.964	15.708

* *Figures in parentheses are arcsine transformed values
* Figures in parentheses are √X+0.5 transformed values

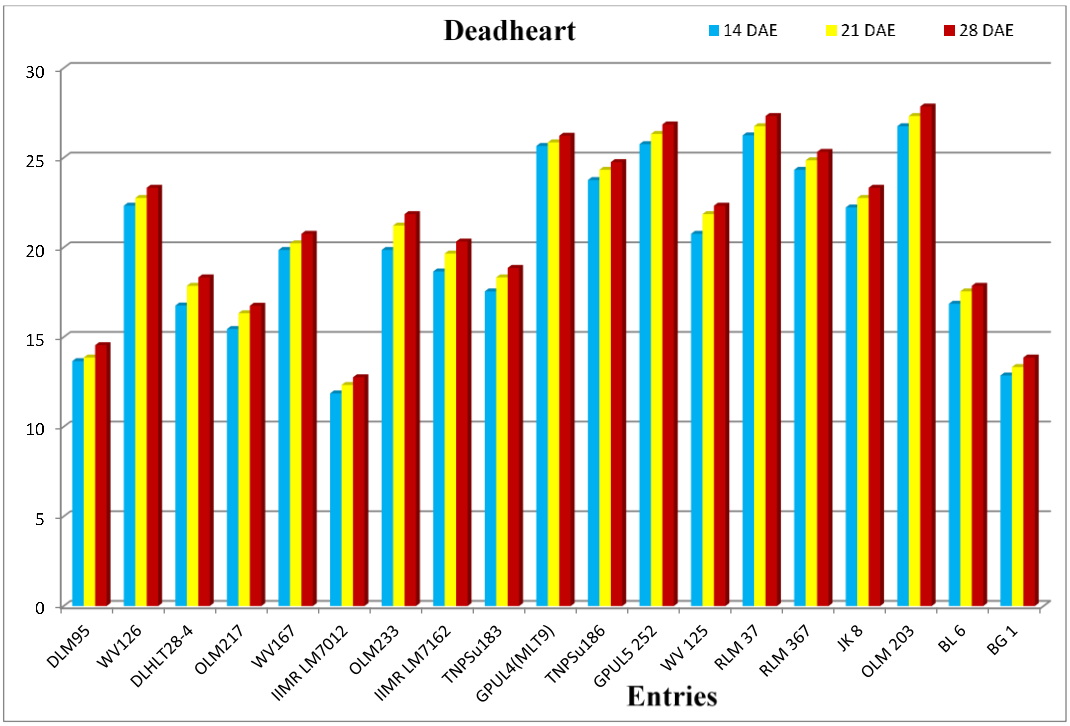

Fig 1: mean Percentage of plants with shootfly eggs, eggs counts, deadhearts, productive tillers and seed yield.

Effect of little millet genotype to shootfly

Number of shootfly egg per 10 plants of little millet genotypes recorded at weekly intervals starting from 14 DAE steadily increased and reaches to a peak at 28 DAE. Earlier, Dalvi *et al*. (1990) [4] stated that oviposition intensity and preference of *A. soccata* of sorghum varieties at weekly intervals starting from 7 days after sowing steadily increased and reached to the peak at 21 days in both the kharif and rabi seasons. Under the present study among the 19 genotypes tested for their resistance against shootfly, the incidence of the pest in terms of less egg deposition per 10 plants, IIMR LM70 12 genotypes was found to be superior and could be considered as source of resistance for further varietal improvement programme. The results obtained on the trial conducted on screening of little millet entries under AICSMIP stated that IIMR LM7012. BGI and DLM 95 entries had also lesser shootfly infestation in terms of deadhearts (Anonymous, 2012-2013) [1,2]. More or less similar results were found under the present study.

Per cent plants with shootfly eggs

The percentage of plants with shootfly egg deposition on various little millet genotypes recorded at weekly intervals starting from 14 DAE gradually increased and

reached to its peak at 28 DAE. The results of the present study are in conformity with Dalvi *et al*. (1990) [4].

Dead heart percentage

Percentage of dead heart caused by shootfly on little millet genotypes recorded at weekly intervals starting from 14 DAE to 28 DAE indicated that none of the 19 entries cereened was found free from shootfly infestation. The dead heart formation in different fest entries at 14 DAE ranged from 11.86 (IIMR LM) to 26.76 (OLM 203). The incidence of shootfly at 21 DAE gradually increased to 12.33 to 27.33 per cent, the lowest being in IIMR LM7012 while the susceptible entry OLM 203 had the maximum infestation. Observations recorded at 28 DAE indicated the similar trends where IIMR LM7012 and OLM 203 recorded lowest (12.76%) and highest (27.86%) dead hearts, respectively. A few more entries, like BL 6, DLM95 and BGI showed promise. Earlier.

several little millet genotypes were screened under AICSMIP trials. However, most of the genotypes tested in the present investigation were not tried earlier.

Mote, U.N. (1982) [11] evaluated 40 lines for their reaction to shoot fly in the rainy season. The incidence of shoot fly ranged from 12.42 to 66.24 per cent. Among the lines evaluated PS-18527, PS-14533, SPV-491 and RHR-5 were highly resistant to shoot fly showing less than 20 per cent deadhearts.

Mote, U.N. (1988) [10] indicated the correlation between the number of deadhearts caused and grain and fodder yield of the sorghum hybrids CSH-5 (*kharif*) and CSH-8R (*rabi*). The damage caused by the pest ranged from 9.22 to 60.82 per cent deadhearts in CSH-5 and from 60 to 95.53 per cent in CSH-8R. There was a significant negative correlation between percentage deadhearts, grain and fodder yield in both the hybrids.

Kumar *et al*. (2000) [9] studied the interactive mechanism of resistance to shoot fly. *Atherigona soccata* with seedling characteristics in sorghum. The genotype IS 2312 and is 116B were more vigorous while DJ 6514 (susceptible) was found too weak. This is direct consequence of higher root and shoot development in resistant groups than in susceptible lines. Resistant varieties (IS 2312 and IS 18551) were found more vigorous than susceptible ones. Vigour is more in healthy plants than in plants with deadhearts. Lower percentage deadhearts were seen in ISV 708 and ICSC 708 and IS 11859 (resistant check), while, M 35-1, selection-3, 104 B, SPV 497 RS 585 were also recorded lower deadheart percentage. Higher deadheart formation was recorded in susceptible checks (CSV-1 and DJ-6514) and some forage sorghum varieties (SSV-118, SR-350 and SSG-59-3).

Conclusion

On the basis of screening of various genotypes/ entries the best results were achieved through IIMR LM7012, BG1, and DLM95 as they were responsible for the minimizing the shootfly incidence and enhancing the grain yield. As these genotypes (IIMR LM7012, BG1 and DLM95) were early maturing entries/genotypes. These entries could be used in breeding programme for evolving tolerant varieties.

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