Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 1465-1472

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 1465-1472**
Journal homepage: http://www.ijcmas.com

Original Research Article

Association Studies in Little Millet (*Panicum sumatrense* L.) for Yield and Other Important Traits

N. Anuradha*, P. Kranthi Priya, T.S.S.K. Patro, Y. Sandhya Rani and U. Triveni

Acharya NG.Ranga Agricultural University, Agricultural Research Station, Vizianagaram -535 001, A.P., India

**Corresponding author*

A B S T R A C T

Little millet (*Panicum sumatrense*) is one of the neglected crops which is known for its high nutritional value. The amount of genetic variability present in any population is most important for the success of breeding programme. Greater the variation in the material, better is the chance for selecting promising and desired genotypes. In this context, twenty eight genotypes of little millet were evaluated at Agricultural Research Station, Vizianagaram to assess the genetic variability, heritability and genetic advance for ten yield contributing traits. The characters included under study are days to 50 % flowering, days to maturity, plant height, number of productive tillers per plant, panicle length, number of leaves per main tiller, leaf length, leaf width, grain yield and fodder yield per plant. Analysis of Variance revealed significant differences for all the traits studied except for leaf length, leaf width and number of leaves per main tiller which were more influenced by environment. High phenotypic coefficient of variation was observed for grain yield and straw yield per plant. High heritability coupled with high genetic advance as percent of mean was recorded for days to 50 % flowering indicating that it is largely governed by additive gene action. Grain yield was observed to have significant positive association with days to 50% flowering, hence an indirect selection for days to 50% flowering will be worthy to select for superior genotypes.

Keywords

Little millet, Variability, Heritability

Introduction

Little millet belongs to the family Poaceae, sub-family Panicoideae and the tribe Paniceae (Rachie, 1975). Little millet (*Panicum sumatrense* L.) is grown in India under various agro ecological situations and commonly known as samai, samo, moraio, vari, kutki. Little millet is a hardy crop which can withstand drought better than most of other cereal crops and water logging to a certain degree, also. Hence, it can provide us with food security in unfavourable climatic conditions. Little millet is rich in vitamin B, minerals like potassium, phosphorus, iron, zinc and magnesium. Therefore it can address nutritional sensitive agriculture, which aims at nutritional enhancement to combat the present scenario of micronutrient malnutrition (Arunachalam *et al.,* 2005, Kundgol *et al.*, 2014 and Selvi *et al.*, 2015). In India, little millet growing states are Karnataka, Tamil Nadu, Odisha, Madhya Pradesh, Chattisgarh, Jharkhand, Andhra Pradesh, Uttarakhand, Maharashtra and Gujarat.

The existence of variability is essential for resistance to biotic and abiotic factors as well as for wider adaptability in different set of environment. The foremost pre-requisite in crop breeding is, exploitation of genetic variability existing in the crop for yield and related traits (Anuradha *et al.*, 2013, 2014). Genetic improvement through traditional breeding approaches depends mainly on the availability of diverse germplasm and the presence of variability. An insight into the nature and magnitude of genetic variability present in the gene pool is of immense value for starting any systematic breeding programme because the presence of considerable genetic variability in the base material ensures better chances of evolving desirable plant type. Heritability of a genetic trait is important in determining the response to selection. In a similar manner high genetic advance coupled with high heritability offers the most effective condition for selection of a specific character (Anuradha *et al.*, 2017). Hence, an attempt was made to estimate the extent of variation for yield contributing traits in the germplasm accessions by studying PCV, GCV, heritability and genetic advance which may provide suitable selection indices for improvement of the crop.

Materials and Methods

The experiment was conducted with twenty eight little millet genotypes including two check varieties (BL 6 and OLM 203). All genotypes were evaluated at Agricultural Research Station, Vizianagaram, Andhra Pradeshduring *kharif*, 2020. Genotypes were planted in a randomized complete block design (RCBD) with three replications and a spacing of 22.5 × 10 cm. per each entry. Every genotype was grown in 5 lines each of 3 m length. Fertilizers, DAP (87 kg/ha), MOP (42 kg/ha) and Urea (22 kg/ha) were applied basally at the time of land preparation and remaining 22 kg/ha Urea was applied three weeks after sowing. Standard management practices were followed to maintain a healthy crop. Observations were recorded on five plants for plant height (cm), number of productive tillers per plant, panicle length (cm), number of leaves per main tiller, leaf length (cm), leaf width (cm), Days to 50% flowering, days was recorded by visualizing the entire plot. Fodder yield and grain yield were recorded on per plot basis and then converted into per hectare.

Analysis of variance and summary statistics was calculated as per Panse and Sukathme (1967). Phenotypic and genotypic coefficients of variation (PCV and GCV) were computed as per Burton and Devane (1953). Heritability in broad sense was computed as per Allard (1960). Genotypic and phenotypic correlations were calculated according to Falconer (1981). Heritability and genetic advancement were categorized into low, medium and high as per Johnson et al., (1955). Phenotypic correlations were calculated according to Falconer (1981).

Results and Discussion

Analysis of Variance components (Table 1) revealed significant differences for all the traits studied except for leaf length, leaf width and number of leaves per main tiller indicating presence of adequate amount of variability among different genotype for all those traits.

In the present study VS 31 (19.04 q/ha) and VS 33 (19.56 q/ha) had significantly showed higher yields when compared with the local checks OLM 203 (16.52 q/ha) and BL 6 (12.22 q/ha) shown in (Table 2). VS 34 was the earliest with 68 days to maturity followed by VS 9 with 70 days to maturity. These two genotypes can utilized for breeding earliness in little millet. VS 18 can be used for breeding non-lodging genotypes since it was observed to be the shortest (116.4 cm) among all twenty eight genotypes studied.

Table.1 ANOVA of twenty eight little millet genotypes

Source of Variations	Df	Mean sum of squares									
		DFF	DM	PH	NPT	PL	NL	LL	LW	GY	FY
Treatments	27	124.39	136.25	199.81	6.53	9.64	1.19	12.76	0.05	23.40	310.97
Replications	2	7.76	7.37	750.94	3.65	1.75	0.52	3.67	1.08	0.18	98.02
Error	54	1.05	1.06	107.43	1.42	2.90	0.63	7.79	0.04	6.45	79.64

Note: DFF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); NPT: No. of productive tillers per plant; PL: Panicle length(cm); NL: No. of leaves/main tiller ; LL: leaf length (cm); LW: leaf width (cm); GY: Grain yield (q/ha); FY: Fodder yield (q/ha)

Table.2 Performance of twenty eight little millet genotypes

S.No	Entry	DFF	DM	PH	NPT	PL	NL	LL	LW	GY	FY
1	**VS 7**	45	75	132.0	11.7	26.9	7.6	36.0	1.1	10.4	43.6
2	**VS 9**	40	70	134.3	9.3	22.1	6.9	32.8	1.2	13.5	53.2
3	**VS 10**	46	77	134.5	11.5	28.3	7.1	30.1	1.2	15.9	40.8
4	**VS 15**	59	91	135.5	10.8	23.0	7.7	32.7	1.2	15.7	52.2
5	**VS 18**	44	75	116.4	11.7	25.0	6.9	31.5	1.2	9.8	64.2
6	**VS 23**	55	86	141.0	11.2	26.5	6.9	32.2	1.1	13.9	56.4
7	**VS 27**	55	85	133.7	8.6	24.9	7.0	35.2	1.1	17.2	65.7
8	**VS 28**	52	82	126.9	11.7	22.3	7.4	29.7	1.0	13.3	69.6
9	**VS 30**	50	81	132.5	13.5	24.0	7.1	31.7	0.9	14.5	63.4
10	**VS 31**	50	80	151.3	10.7	27.0	8.5	33.8	1.2	19.0	50.9
11	**VS 33**	48	77	147.9	10.5	25.8	8.8	33.3	1.0	19.6	53.7
12	**VS 34**	38	68	133.8	8.5	22.4	6.2	30.0	0.9	15.8	35.6
13	**VS 35**	45	74	143.5	11.1	23.0	7.7	33.0	1.0	16.2	40.9
14	**VS 36**	48	79	125.7	7.0	22.8	7.1	33.0	1.1	14.2	71.4
15	**VS 37**	54	85	130.7	8.0	23.3	7.0	31.2	1.1	17.8	56.4
16	**VS 38**	63	93	135.8	7.9	25.8	7.5	32.0	0.8	19.9	65.9
17	**VS 39**	60	90	135.8	8.7	25.6	7.3	35.5	1.2	13.9	49.5
18	**VS 40**	41	72	135.6	10.7	24.1	5.7	32.3	1.0	12.2	35.8
19	**VS 41**	53	83	139.2	11.1	23.7	6.8	36.7	1.2	16.9	53.6

20	**VS 42**	45	76	140.4	9.7	25.0	7.7	35.5	1.3	9.4	51.4
21	**VS 43**	48	78	151.2	10.0	27.1	7.4	34.8	1.2	18.8	38.1
22	**VS 44**	52	83	139.9	10.9	26.1	7.6	33.3	1.0	14.0	63.0
23	**VS 45**	58	89	131.0	12.2	23.1	7.9	33.3	1.0	14.8	56.8
24	**VS 46**	47	77	153.7	10.0	24.6	7.9	29.4	0.7	16.9	50.7
25	**VS 47**	50	81	140.9	8.8	23.3	6.8	30.9	1.1	16.5	48.3
26	**OLM 203**	61	91	144.5	9.6	27.1	7.3	30.0	1.3	16.5	52.7
27	**DHLM-97-3**	57	88	142.0	9.7	27.0	6.9	33.7	1.1	17.1	44.4
28	**BL 6**	46	76	134.7	10.1	24.2	7.6	29.7	1.2	12.2	65.7
	Mean	50.4	80.7	137.3	10.2	24.8	7.3	32.6	1.1	15.2	53.4
	CD (1%)	2.2	2.2	22.6	2.6	3.7	1.7	6.1	0.4	5.5	19.5
	CD (5%)	1.7	1.7	17.0	1.9	2.8	1.3	4.6	0.3	4.2	14.6
	CV (%)	2.0	1.3	7.5	11.7	6.9	10.9	8.6	17.7	16.7	16.7

Table.3 Genetic parameters of twenty eight little millet genotypes

S.No	**Parameter**	**DFF**	**DM**	**PH**	**NPT**	**PL**	**NL**	**LL**	**LW**	**GY**	**FY**
1	**Mean**	50.4	80.7	137.3	10.2	24.8	7.3	32.6	1.1	15.2	53.4
2	**Minimum**	38.0	68.0	116.4	7.0	22.1	5.7	29.4	0.7	9.4	35.6
3	**Maximum**	63.0	93.0	153.7	13.5	28.3	8.8	36.7	1.3	19.9	71.4
4	**GCV**	12.7	8.3	4.0	12.9	6.1	5.9	4.0	7.1	15.6	16.5
5	**PCV**	12.9	8.4	8.6	17.4	9.2	12.4	9.4	19.1	22.9	23.5
6	**ECV**	2.0	1.3	7.6	11.7	6.9	10.9	8.6	17.7	16.7	16.7
7	**H^2 (B)**	97.5	97.7	22.3	54.6	43.6	22.7	17.6	13.7	46.7	49.2
8	**Genetic Advance**	13.0	13.7	5.4	2.0	2.0	0.4	1.1	0.1	3.4	12.7
9	**GAM**	25.9	16.9	3.9	19.5	8.2	5.8	3.4	5.4	22.0	23.8

Note: DFF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); NPT: No. of productive tillers per plant; PL: Panicle length(cm); NL: No. of leaves/main tiller ; LL: leaf length (cm); LW: leaf width (cm); GY: Grain yield (q/ha); FY: Fodder yield (q/ha).

Table.4 Association of different characters among twenty eight little millet genotypes

Trait	DM	PH	NPT	PL	NL	LL	LW	GY	FY
DFF	0.995**	0.079	-0.114	0.238	0.240	0.136	0.041	0.399*	0.359
DM		0.039	-0.101	0.227	0.199	0.123	0.059	0.357	0.363
PH			-0.041	0.402*	0.417*	0.115	-0.088	0.556**	-0.446*
NPT				0.140	0.184	0.006	-0.027	-0.300	-0.058
PL					0.251	0.196	0.239	0.170	-0.228
NL						0.143	-0.017	0.270	0.225
LL							0.339	-0.045	-0.118
LW								-0.274	-0.072
GY									-0.110

Note: DFF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); NPT: No. of productive tillers per plant; PL: Panicle length(cm); NL: No. of leaves/main tiller ; LL: leaf length (cm); LW: leaf width (cm); GY: Grain yield (q/ha); FY: Fodder yield (q/ha).

Long panicle length is indicative of getting higher grain yield. VS 10 (28.3cm) showed higher panicle length when compared with local checks OLM (27.1) and BL 6 (24.2). No. of leaves/main tiller were more in VS 33 (8.8) while longest leaf (36.7 cm) was observed in VS 41 indicating more photosynthetic ability of these genotypes.

The values of PCV obtained for yield and its attributing characters ranged from (8.41) for days to maturity to (23.47) for fodder yield (Table 3). The values of GCV ranged from (3.95) for leaf length to (16.46) for fodder yield. Phenotypic coefficient of variability is higher than genotypic coefficient of variability for all the characters indicating that the interaction of genotypes with environment. Narrow range of variation for PCV is observed for days to maturity, plant height, panicle length and leaf length. The results were similar with the earlier reports of Anuradha *et al.*, 2017b for panicle length and Dhamdhere *et al.,* (2011) for days to maturity and Lule *et al.,* (2012) days to 50 % flowering. Whereas moderate variation for PCV is observed for days to 50 % flowering, number of productive tillers, number of leaves and leaf width. The results were in consonance with the earlier reports of John (2007) in finger millet. High PCV is observed for grain yield and fodder yield. Similar results were also reported by Reddy (1984) for fodder yield in little millet. Narrow range of variation for GCV is observed for most of the characters except for days to 50 % flowering, number of productive tillers, grain yield and fodder yield (Table 4).

Presence of variability indicates possibility of selections. For reliable selection one has to depend on heritability studies. Highly heritable traits are governed by genotypic variances rather than with environmental variance. Hence, there is more chance for success in selection of genotypes based on heritability. However, heritability informs whether the variation is genetic or non genetic while Genetic Advance as Percent Mean (GAM) enlightens the aspect of gene action. Hence heritability along with GAM studies are meaningful. High heritability was recorded by days to maturity (97.70) followed by days to 50 % flowering (97.52). In the present study, low heritability coupled with low GAM were observed for leaf width indicating that environment is the main role in governing this character and selection for this character may be not effective.

High heritability coupled with high genetic advance as percent of mean is observed for days to 50 % flowering indicating preponderance of additive gene action and selection is effective for these trait. Moderate heritability coupled with high GAM observed for grain yield and fodder yield indicating additive gene action. Low heritability coupled with low GAM was observed for all the remaining characters like plant height, number of leaves, leaf length and leaf width.

Association various characters revealed that grain yield was strongly associated with days to 50% flowering and plant height while number of leaves per plant was significantly associated with plant height. Since grain yield has significant association with days to 50% flowering which is supposed to have additive gene action, it would be better to rely upon indirect selection of grain yield via days to 50% flowering.

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