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ASSESSMENT OF LITTLE MILLET (*PANICUM SUMATRENSE* L.) GERMPLASMS FOR MORPHOPHYSIOLOGICAL AND DUS CHARACTERS

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ABSTRACT

A field experiment was conducted during *kharif* season of 2023-24 under irrigated conditions at Rahuri (Ahmednagar) region to study the "Assessment of little millet (*Panicum sumatrense* L.) germplasms for morphophysiological and DUS characters." with objectives to study the morpho-physiological, growth and nutritional traits differences and characterization as per DUS guidelines of little millet germplasms. The experiment was laid out in Randomized Block Design with two replications. There were 17 Little millet germplasms studied for morpho-physiological, growth and nutritional traits, characterization as per DUS guidelines for quantitative and qualitative characters and effect of environment *viz.*, IGPLM-19-05, IGPLM-19-26, IGPLM-19-10, IGPLM-19-24, IGPLM-19-30, IGPLM-19-36, IGPLM-19-28, IGPLM-19-01, IGPLM-19-23, IGPLM-19-14, IGPLM-19-15, IGPLM-19-07, IGPLM-19-12, IGPLM-19-08, IGPLM-19-21, IGPLM-19-34, IGPLM-19-17 along with one check variety Phule Ekadashi. The set of germplasms under study showed wide range of variability for all the qualitative and quantitative traits studied. Based on the one season of research in consideration with objectives of present research among different germplasms studied IGPLM-19-08, IGPLM-19-01, IGPLM-19-17 and IGPLM-19-34 recorded superior results with respect to growth, yield and yield contributing characters alongside the check variety Phule Ekadashi.

Keywords : Germplasms, Variability, Growth, Little millet.

Introduction

Little millet belongs to the family *Poaceae*, sub-family *Panicoideae* and the tribe *Paniceae* (Rachie, 1975). It is self pollinated, C4 crop and diploid (2n=36) in nature. The common name of the crops are *kutki*, *sawa*, *samai*, *samalu* (Padulosi *et al.*, 2009). It is an annual herbaceous plant which grows straight or with folded blades to a height of 30 cm to 100 cm. The grains are round, smooth and 1.8 to 1.9 mm long. It is sown during the main rainy season (June to October) or even in summer when adequate rain is received. It is described as a quick growing, short duration cereal, which can withstand both drought and water logging (Doggett, 1989).

There are two subspecies of *P. sumatrense*: subsp. *sumatrense* (cultivated little millet) and subsp. *psilopodium* (wild progenitor). Based on panicle morphology *P. sumatrense* subsp. *sumatrense* is classified into two races: *nana* and *robusta*. Race *nana* mature faster than *robusta*, however it produces less biomass. Plants of race *nana* spines have a variety of growth habits from decumbent to practically prostrate culms that rise erect while flowering. At maturity inflorescences are broad). Traits like short plant stature, small leaf area with large leaf area index, erect leaf type with high radiation use efficiency, thickened cell walls, and dense root system helps to circumvent the adverse effects of abiotic stresses (Carberry and Campbell, 1985).

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). Little millet has a significant role in providing nutraceutical components such as phenols, tannins and phytates along with other nutrients. The developed diabetic feed lower the blood glucose level, control the body weight, improve lipid profile and provide safety valve., open and the higher branches are sometimes clumped and curled. The other race *robusta* has erect plants with heavily branching inflorescence that is big, compact, or open (De Wet *et al.*, 1983). In a tribal region of the Indian Kolli hills, despite a limited sampling area, diversity among locally produced landraces of little millet was found to be substantial for all morphological characteristics measured both within and across landraces. (Arunachalam *et al.*, 2005).

Material and Methods

The research work was undertaken during *khariif* season of the year 2023-24 at CAAST (Centre for Advanced Agricultural Science and Technology) Research Farm, MPKV, Rahuri, and laboratory work was carried out at Sorghum Improvement Project Laboratory, MPKV, Rahuri.

Experimental Materials

The seventeen little millet genotypes were evaluated with one check variety for the present studies. The seed material of these germplasms were obtained from the Zonal Agricultural Research Station (ZARS), Igatpuri and evaluated in Randomized block design with two replications to study genotypic differences in morphophysiological, growth and yield contributing characters. The net plot size was 3.0 m x 2.4 m. The spacing was 30 cm x 10.0 cm.

Selection of Plants for Recording Observations

Five plants in each plot were randomly selected in a net plot area and tagged for recording the various growth traits, yield, and other morpho-physiological parameters. The biochemical parameters were estimated in laboratory after the harvesting of genotypes.

Quantitative DUS (Distinctiveness, Uniformity and Stability) Characters

The observations of quantitative DUS (Distinctness, Uniformity and Stability) characters were taken according to the Protection of Plant Varieties and Farmers Rights (PPV & FR) act 2001.

Results

Quantitative Characters.

- **Plant height (Cm) :** The check variety Phule Ekadashi recorded plant height at 127 cm. No germplasm was found to be significantly superior than the check variety Phule Ekadashi. IGPLM-19-34 was found to be numerically superior than the check variety. Among seventeen germplasms, six were found to be semi-dwarf with plant height ranging between 80-120 cm, and remaining were tall having plant height more than 120 cm.
- **Number of Basal Tillers :** Anuradha *et al.* (2017) assessed 30 little millet genotypes and observed high positive association of number of tillers plant-1, panicle length and fodder yield with grain yield. Three germplasms *viz.*, IGPLM-19-10 (6.0), IGPLM-19-01 (5.9), IGPLM-19-05 (5.8) were found to be significantly superior than the check variety Phule Ekadashi. All seventeen germplasms were found to be having low number of basal tillers with values less than 10.
- **Peduncle Length (cm) :** The mean peduncle length was 12.1 cm. The check variety Phule Ekadashi recorded peduncle length with a numerical value of 11.7. Three germplasms *viz.*, IGPLM-19-23 (13.4 cm), IGPLM-19-01 (13.1 cm), IGPLM-19-08 (13.1 cm) were found to be significantly superior than the check variety Phule Ekadashi.
- **Panicle Length (cm) :** Three germplasms *viz.*, IGPLM-19-34 (25.5 cm), IGPLM-19-08 (25.1 cm), IGPLM-19-23 (25.1 cm) were found to be numerically superior than the check variety Phule Ekadashi. All seventeen germplasms were categorized into Short to medium panicle length between 20-30 cm.
- **Flag Leaf Blade Length (cm) :** The check variety Phule Ekadashi recorded flag leaf blade length with a numerical value of 25.2 cm. Five germplasms *viz.*, IGPLM-19-15 (25.9 cm), IGPLM-19-07 (25.7 cm), IGPLM-19-01 (25.3 cm), IGPLM-19-34 (25.3 cm) and IGPLM-19-24 (25.2cm) were found to be numerically superior than the check variety Phule Ekadashi.
- **Flag Leaf Blade Width (cm) :** The mean flag leaf blade width was 0.93 cm. The check variety Phule Ekadashi recorded flag leaf blade width with a numerical value of 0.93. Two germplasms IGPLM-19-17 (1.11 cm) and IGPLM-19-01(1.07 cm) were found to be significantly superior than the Phule Ekadashi. Among seventeen germplasms, eleven

were categorized into narrow category with flag leaf blade width less than 1 cm. and remaining six were categorized into Medium category with flag leaf blade width between 1-2 cm.

- **1000 Seed Weight (gm) :** The mean 1000 seed weight was 2.43 gm. The check variety Phule Ekadashi recorded 1000 seed weight with a numerical value of 2.45gm. Four germplasms *viz.*, IGPLM-19-12 (2.52 gm), IGPLM-19-14(2.50 gm), IGPLM-19-24 (2.49 gm) and IGPLM-19-17 (2.49 gm) were significantly superior than Phule Ekadashi. All the germplasms were grouped in medium category for 1000 seed weight.
- **Days to 50% Flowering :** The days for 50% flowering ranged from 85 to 101. The mean days were 94 days while the check Phule Ekadashi took 93 days. It was found that two germplasms *viz.*, IGPLM-19-28 and IGPLM-19-12 were significantly superior than the check variety for days to 50% flowering. All the germplasms were grouped as late flowering germplasms.
- **Days to Maturity :** The days for maturity ranged from 124 to 142. IGPLM-19-05 (124 days) recorded the lowest number of days for maturity while IGPLM-19-28 (142 days) recorded highest number of days. The mean days were 137 days while the check Phule Ekadashi took 138 days. It was found that the germplasm IGPLM-19-28 was significantly superior than the check variety for days to maturity. All the germplasms were grouped as late maturing germplasms.
- **Grain Yield (kg/ha) :** Nirmalakumari *et al.* (2010) observed that grain yield per plant had significant positive correlation with all the component characters studied except flag leaf sheath length and panicle length. The germplasm IGPLM-19-05 recorded lowest yield with 1092 kg/ha while IGPLM-19-21 recorded highest yield with 1522 kg/ha and the mean grain yield was 1234.33 kg/ha. Germplasm IGPLM-19-21 was significantly superior than the check Phule Ekadashi
- **Fodder Yield (kg/ha) :** IGPLM-19-30 recorded the lowest fodder yield with value of 4040 kg/ha while IGPLM-19-08 recorded highest fodder yield with 6082 kg/ha. The mean fodder yield was 4877.72 kg/ha. Germplasm IGPLM-19-08 was found to be significantly superior than the check variety.
- **Harvest Index (%) :** Sasamala *et al.*, (2015) evaluated 22 genotypes of little millet under 12 environments and revealed that biological yield

showed maximum positive direct effect on grain yield followed by harvest index and days to maturity. Highest harvest index shown by the germplasm IGPLM-19-14 (24.1 %) and the lowest harvest index was shown by the germplasm IGPLM-19-08 (16.2 %). The check variety recorded harvest index at 20.3%. Ten germplasms were found to have higher harvest index than check variety Phule Ekadashi.

Qualitative Characters.

- **Plant Growth Habit :** Among 17 germplasms and a check variety, three germplasms *viz.*, IGPLM-19-10, IGPLM-19-12 and IGPLM-19-34 were having erect plant growth habit, germplasm IGPLM-19-26 was prostrate and remaining thirteen germplasms and a check variety were having decumbent plant growth habit.
- **Plant Pigmentation at Leaf Sheath :** Among 17 different germplasms and check variety studied, plant pigmentation at leaf sheath was present in all germplasms including Phule Ekadashi.
- **Leaf Sheath Pubescence :** Among 17 germplasms and Phule Ekadashi, visual observations clearly shows that only two germplasms had leaf sheath pubescence *viz.*, IGPLM-19-28 and IGPLM-19-07 and leaf sheath pubescence was absent in remaining germplasms including Phule Ekadashi.
- **Ligule Pubescence :** The data reveals the presence of ligule pubescence in just a single germplasm *i.e.*, IGPLM-19-23 while the ligule pubescence was absent in remaining germplasms including the check Phule Ekadashi.
- **Leaf Blade Pubescence :** The visual observations for leaf blade pubescence was taken at complete flowering. The data reveals the presence of leaf blade pubescence in a single germplasm *i.e.*, IGPLM-19-15 while the leaf blade pubescence was absent in remaining.
- **Inflorescence Shape:** The visual observation of inflorescence shape was taken at complete flowering. The data reveals the presence of Diffused type of inflorescence shape in just a single germplasm *i.e.*, IGPLM-19-24 while the two germplasms had Elliptic shape *viz.*, IGPLM-19-14 and IGPLM-19-26 and the remaining germplasms including the check Phule Ekadashi were Arched shape.
- **Panicle Compactness :** The visual observation for Panicle Compactness were taken at dough stage.

The data reveals the presence of Open type of panicle compactness in just a single germplasm *i.e.*, IGPLM-19-24 while five germplasms had Intermediate panicle *viz.*, IGPLM-19-26, IGPLM-19-10, IGPLM-19-15, IGPLM-19-14 and IGPLM-19-07 and the remaining germplasms including the check Phule Ekadashi were having compact panicle.

- **Lodging :** The visual observation for Lodging were taken at maturity stage. The data presented for 17 germplasms and a check provides the presence of lodging in nine germplasm *viz.*, IGPLM-19-24, IGPLM-19-36, IGPLM-19-28, IGPLM-19-14, IGPLM-19-11, IGPLM-19-12, IGPLM-19-21, IGPLM-19-34 and IGPLM-19-17 while the remaining eight germplasms including the check variety Phule Ekadashi had no lodging.
- **Grain Colour :** Among the 17 different germplasms and a check examined, the assessment of seed colour showed predominant observations in which all germplasms including Phule Ekadashi exhibited a Golden Yellow seed colour.

Nutritional Quality Parameters

- **Fibre Content (%) :** Crude fiber content across various germplasms ranged from 5.78% to 7.16%. three germplasms *viz.*, IGPLM-19-08 (7.16%), IGPLM-19-17 (6.99%), and IGPLM-19-15 (6.98%) were significantly superior for crude fiber content compared to the check variety Phule Ekadashi (6.75%).
- **Protein Content (%) :** The crude protein percentage ranged from 6.65 % (IGPLM-19-36) to 7.29 % (IGPLM-19-30) across the various germplasms. This range indicates variability in crude protein levels among the examined genotypes, reflecting different protein concentrations within the grains. Four germplasms *viz.*, IGPLM-19-30 (8.29%), IGPLM-19-01 (8.23 %), IGPLM-19-10 (8.10%) and IGPLM-19-07 (8.11%) were significantly superior than the check variety Phule Ekadashi (7.88%).

Table 1 : Mean morphological and yield contributing quantitative characters of Little millet germplasms.

Sr. No.	Germplasms	Plant height (cm)	No. of Basal tillers	Peduncle length (cm)	Panicle length (cm)	Flag leaf blade length (cm)	Flag leaf blade width (cm)	1000 Seed Weight (gm)	Grain yield (kg/ha)	Fodder yield (kg/ha)	Harvest index (%)
1	IGPLM-19-05	121	5.8*	11.7	22.7	25.0	0.87	2.36	1092	4145	20.8
2	IGPLM-19-26	118	5.1	12.2	21.7	24.5	0.86	2.42	1183	4532	20.7
3	IGPLM-19-10	117	6.0**	11.9	24.0	23.8	0.90	2.37	1269	4667	21.3
4	IGPLM-19-24	122	4.0	12.3	23.7	25.2	1.05	2.49*	1179	5300	18.2
5	IGPLM-19-30	103	5.2	11.5	22.1	25.0	0.96	2.36	1109	4040	21.5
6	IGPLM-19-36	121	5.0	13.0	24.9	24.2	0.84	2.42	1185	4595	20.5
7	IGPLM-19-28	126	4.9	10.7	23.4	23.4	0.89	2.41	1116	4330	20.4
8	IGPLM-19-01	121	5.9*	13.1*	23.5	25.3	1.07*	2.46	1408	5715	19.7
9	IGPLM-19-23	118	3.9	13.4*	25.1	25.2	0.93	2.45	1199	5155	18.8
10	IGPLM-19-14	122	4.3	11.6	24.8	24.4	0.75	2.50*	1327	4167	24.1
11	IGPLM-19-15	123	5.0	13.2	24.0	25.9	0.85	2.33	1137	4527	20.0
12	IGPLM-19-07	119	4.0	10.4	23.7	25.7	0.80	2.40	1158	4520	20.3
13	IGPLM-19-12	121	4.4	12.1	24.3	24.2	1.05	2.52**	1130	5325	17.5
14	IGPLM-19-08	119	5.0	13.1*	25.1	24.3	1.00	2.47	1179	6082*	16.2
15	IGPLM-19-21	123	4.2	12.2	23.7	25.0	0.86	2.43	1522*	5772	20.8
16	IGPLM-19-34	137	4.9	11.9	23.7	25.3	1.04	2.44	1324	5420	19.6
17	IGPLM-19-17	122	4.5	12.5	25.5	24.8	1.11*	2.49*	1411	4452	24.0
18	P. Ekadashi (C)	127	4.8	11.7	25.0	25.2	0.93	2.45	1290	5055	20.3
	Mean	121	4.8	12.1	23.9	24.8	0.93	2.43	1234.3	4877.7	-
	S.E.±	6.5	0.28	0.46	1.37	1.07	0.05	0.01	48.01	271.73	-
	C.D. at 5%	19.4	0.85	1.39	4.08	3.18	0.13	0.04	143.26	810.77	-
	C.D. at 1%	26.7	1.17	1.91	5.61	4.37	0.19	0.06	585.38	1113.75	-

Table 2 : Qualitative data of little millet germplasms according to the PPV and FR Act, 2001.

Sr. No	Germplasms	Plant growth habit	Plant pigmentation at leaf sheath	Leaf sheath pubescence	Ligule Pubescence	Leaf Blade Pubescence	Inflorescence shape	Panicle compactness	Lodging	Grain colour
1	IGPLM-19-05	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Absent	Golden yellow
2	IGPLM-19-26	Prostrate	Present	Absent	Absent	Absent	Elliptic	Intermediate	Absent	Golden yellow
3	IGPLM-19-10	Erect	Present	Absent	Absent	Absent	Arched	Intermediate	Absent	Golden yellow
4	IGPLM-19-24	Decumbent	Present	Absent	Absent	Absent	Diffused	Open	Present	Golden yellow
5	IGPLM-19-30	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Absent	Golden yellow
6	IGPLM-19-36	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Present	Golden yellow
7	IGPLM-19-28	Decumbent	Present	Present	Absent	Absent	Arched	Compact	Present	Golden yellow
8	IGPLM-19-01	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Absent	Golden yellow
9	IGPLM-19-23	Decumbent	Present	Absent	Present	Absent	Arched	Compact	Absent	Golden yellow
10	IGPLM-19-14	Decumbent	Present	Absent	Absent	Absent	Elliptic	Intermediate	Present	Golden yellow
11	IGPLM-19-15	Decumbent	Present	Absent	Absent	Present	Arched	Intermediate	Present	Golden yellow
12	IGPLM-19-07	Decumbent	Present	Present	Absent	Absent	Arched	Intermediate	Absent	Golden yellow
13	IGPLM-19-12	Erect	Present	Absent	Absent	Absent	Arched	Compact	Present	Golden yellow
14	IGPLM-19-08	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Absent	Golden yellow
15	IGPLM-19-21	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Present	Golden yellow
16	IGPLM-19-34	Erect	Present	Absent	Absent	Absent	Arched	Compact	Present	Golden yellow
17	IGPLM-19-17	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Present	Golden yellow
18	P. Ekadashi (C)	Decumbent	Present	Absent	Absent	Absent	Arched	Compact	Absent	Golden yellow

Table 3 : Crude fibre (%), Crude protein (%) of little millet germplasm.

Sr. No.	Germplasms	Crude fibre (%)	Crude Protein (%)
1	IGPLM-19-05	5.90	7.98
2	IGPLM-19-26	5.86	7.71
3	IGPLM-19-10	6.26	8.10*
4	IGPLM-19-24	5.82	7.84
5	IGPLM-19-30	5.78	8.29**
6	IGPLM-19-36	6.37	6.65
7	IGPLM-19-28	6.36	7.16
8	IGPLM-19-01	6.39	8.23**
9	IGPLM-19-23	6.44	7.35
10	IGPLM-19-14	6.65	7.52
11	IGPLM-19-15	6.98*	7.25
12	IGPLM-19-07	6.64	8.11*
13	IGPLM-19-12	6.84	6.98
14	IGPLM-19-08	7.16**	7.11
15	IGPLM-19-21	6.39	6.87
16	IGPLM-19-34	6.67	6.67
17	IGPLM-19-17	6.99*	7.43
18	P. Ekadashi(C)	6.75	7.88
	Mean	6.57	7.51
	S.E.±	0.06	0.07
	C.D. at 5%	0.18	0.20
	C.D. at 1%	0.25	0.27

Conclusion

In case of quantitative parameters, germplasms IGPLM-19-08, IGPLM-19-01, IGPLM-19-34 and IGPLM-19-17 showed above average performance in all the attributes including plant height, number of basal tillers, peduncle length, panicle length, flag leaf blade length and width and seed weight amongst all the germplasms. The check variety Phule Ekadashi was

found to outperform almost all other germplasms in many attributes like plant height, grain yield, fodder yield, panicle length etc. IGPLM-19-08 and IGPLM-19-30 were found to have highest crude fibre percentage and crude protein percentage. The set of germplasms under study showed wide range of variability for all the qualitative and quantitative traits studied.

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