Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5962

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (1):** 1466-1471 (2018)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Genetic Variability for Yield and Yield Attributing Traits in Elite Germplasm Lines of Little Millet

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Received: 2.11.2017 | Revised: 8.12.2017 | Accepted: 14.12.2017

ABSTRACT

Little millet is a small grained, annual, warm weather cereal which is the staple food for millions in many parts of the world especially among tribal. The present study aims to reveal the existence of genetic variability and importance of some quantitative traits in the 64 elite genotypes. The objectives were to assess the variability, heritability, and genetic advance for yield and 12 yield component characters. Highly significant mean sum of squares due to genotypes and wide range of variability were noticed among the genotypes for all the characters studied. Phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all the characters studied. High values for phenotypic and genotypic coefficients were recorded for plant height, number of tillers per plant, flag leaf length, flag leaf width, panicle length, thousand seed weight and grain yield per plant. All the characters recorded high heritability in the present study indicated that these characters were relatively less influenced by environmental factors and phenotypic selection would be effective for the improvement of these characters. All the characters recorded high heritability coupled with high genetic advance which indicated that these characters were governed by additive genes and selection would be effective for improvement of such characters. Since there is significant variability observed in all the little millet genotypes, this could be used for genetic improvement through selection and hybridization.

Key words: *Little millet, Genetic variation, Heritability, Genetic advance*

INTRODUCTION

Millets have traditionally played an important role in farming and food culture in many regions of the world, including Sub-Saharan Africa and South Asia, with India being the world's largest producer of these crops. Millets mature quickly, a valuable trait important for rain-fed farming and require relatively few inputs compared to major cereals. Small millets offer both nutritional and livelihood security for human beings and also feed and fodder security for poultry and livestock population in dryland regions of rural India[8].

Cite this article: Geetha, N., Uma, M.S., Ravishankar, P., Genetic Variability for Yield and Yield Attributing Traits in Elite Germplasm Lines of Little Millet, *Int. J. Pure App. Biosci.* **6(1):** 1466-1471 (2018). doi: http://dx.doi.org/10.18782/2320-7051.5962

Little millet is widely cultivated across India, China, Sri Lanka, Nepal and western Burma. In India, little millet is cultivated in Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Orissa, Bihar, Madhya Pradesh, Uttar Pradesh, Jharkhand, Chhattisgarh, and Gujarat. Little millet is presently grown throughout India in about one million hectares. Little millet is the staple food for millions in many parts of the world especially among tribal. It is particularly grown in the Eastern Ghats of India, where it forms an important part of tribal agriculture[11]. Little millet is a hardy crop, well known for its drought tolerance and is considered as one of the least water demanding crops. Although this millet has received comparatively little attention from plant breeders, it appears to thrive under conditions where no other food crops will survive. It matures in about two and half-to-three months. The yield is generally less than half tones/ha, but under favourable conditions may reach to one t/ha[1].

Characterization and evaluation are important pre-requisites for effective utilization of germplasm and also to identify sources of useful genes. Possibility of achieving improvement in any crop plants depends heavily on the magnitude of genetic variability. Phenotypic variability expressed by a genotype or a group of genotypes in any crop species can be partitioned into genotypic and phenotypic components. The heritability of yield and its component characters influences the selection strategies to be adopted by the breeders. The heritability estimates in conjunction with the predicted genetic advance will be more reliable, as heritability is also influenced by environment. Heritability gives the information on the magnitude of inheritance of quantitative traits while genetic advance will be helpful in formulating suitable selection procedures.

MATERIAL AND METHODS

Experimental material

The material for the present study consisted of 64 elite germplasm lines of little millet (*Panicum sumatrense* Roth. ex. Roemer and Schultes) including two checks maintained at All India Coordinated Small Millets Improvement Project (AICSMIP), ZARS, GKVK, Bengaluru. The detailed description of germplasm lines used in the study is provided in Table 1.

METHODS

Method of sampling and recording observations

Five randomly selected plants from each genotype were labelled for recording observations on all below mentioned characters. The mean of observations recorded on these five plants were considered for statistical analysis.

Days to 50 per cent flowering

Days to 50 per cent flowering was taken from sowing date to the stage when ears have emerged from 50 per cent of main tillers.

Plant height at maturity (cm)

The height of the main tiller from the ground level to the top of the panicle was recorded in centimetres and mean was computed.

Number of tillers per plant

Tiller number was counted from each tagged plant and the mean of five plants were computed as tillers per plant.

Flag leaf length (cm)

The length of flag leaf from nodal region to tip was measured and mean of the five plants was computed.

Flag leaf width (cm)

The width of the flag leaf between two edges of the leaf was measured in centimetres and mean of five plants was computed.

Panicle length (cm)

The panicle length measured as the total length from the base of panicle to its tip.

Days to Maturity

Days to maturity was taken from date of sowing to stage when 50 per cent of main tillers have mature ears when the ear colour changes from green to brownish.

Thousand seed weight (g)

Weight of one thousand random grains were counted manually from total grain yield of tagged plants and mean was recorded in grams.

Grain yield per plant (g)

Weight of total grain yield of tagged plants in rows was recorded and the mean yield per plant was calculated by dividing it by the corresponding number of plants harvested.

RESULTS AND DISCUSSION

The analysis of variance using simple lattice design is presented in Table 2. The analysis of variance for yield and various yield related characters for 64 elite germplasm lines was found to be significant for all the characters evaluated which had indicated that the lines under study were genetically diverse. The genetic variability parameters *viz.,* mean, range, phenotypic coefficient of variation (PCV), genotypic co-efficient of variation (GCV), heritability (broad sense) and genetic advance as per cent mean for all characters are presented in the Table 3.The mean number of days to 50 per cent flowering was 51.63 with a range of 44.00 to 70.50 days. The GPMR-1253 was the earliest to flower (44.00 days) The phenotypic and genotypic coefficients of variability were 11.48 and 11.24 per cent, respectively. High heritability estimates of 95.92 per cent coupled with high expected genetic advance as per cent mean (25.50) was observed for this trait.Plant height of 64 elite germplasm lines of Little millet varied from 75.72 cm to 156.44 cm with a mean value of 106.49 cm. Moderate phenotypic and genotypic coefficient of variability of 17.35 per cent and 17.19 per cent respectively was observed with broad sense heritability of 98.25 per cent coupled with 36.66 per cent genetic advance as per cent mean. The GPMR- 253 recorded highest plant height where as GPMR-688 recorded lowest plant height Number of tillers per plant varied from 5.00 to 17.50 with a mean value of 9.88. GPMR-1060 recorded maximum number of tillers (17.50) where as GPMR- 1062 recorded minimum number of tillers per plant (5.00). Phenotypic and genotypic coefficient of variability of 25.50 and 24.50, respectively, was observed with broad sense heritability of 92.33 per cent coupled with 61.78 per cent of genetic advance as per cent mean.

Flag leaf length varied from 12.13 to 38.72 cm. with a mean value of 21.16 cm. The maximum flag leaf length of 38.72 was recorded by GPMR-253 and GPMR-1010 recorded minimum flag leaf length of 12.133 cm. The trait flag leaf length recorded high phenotypic coefficient of variability of 28.74 per cent and genotypic coefficient of variability of 28.65 per cent. The broad sense heritability of 99.34 per cent along with 63.91 per cent of genetic advance as per cent mean was observed. The mean flag leaf width recorded was 0.87 cm with a range of 0.48 to 1.73 cm. Maximum flag leaf width of 1.73 cm was recorded by GPMR-1338 and the lowest flag leaf width of 0.48 cm was recorded by GPMR- 1285. The phenotypic and genotypic coefficients of variability were 28.73 and 27.79 per cent, respectively. High heritability of 93.62 per cent with of high genetic advance as per cent mean (67.16) was observed for flag leaf width.

The mean panicle length recorded was 25.01 cm with a range of 13.47 cm to 38.75 cm. Maximum panicle length of 38.75 cm was associated with GPMR-708 and the lowest panicle length of 13.47 cm was recorded by GPMR-1060. Moderate phenotypic and genotypic coefficients of variability of 21.84 and 21.52 per cent, respectively was noted for this trait. Heritability of 97.09 per cent with an expected genetic advance as per cent mean of 48.88 was observed for panicle length. The mean number of days to maturity was 81.14 with a range of 72.50 to 98.00 days. The GPMR-1165 was the earliest to mature (72.5 days) and GPMR-1338 was late (98.00 days). The phenotypic and genotypic coefficients of variability were 7.36 and 7.23 per cent, respectively. High heritability estimates of 96.51 per cent coupled with low expected genetic advance as per cent mean (16.35) was observed for this trait.

Test weight ranged from 1.84 to 3.70 g with a mean of 2.59 g. The coefficient of variability for phenotypic and genotype were 15.90 and 15.52 per cent, respectively. The maximum test weight of 3.70 g was observed in GPMR-70 and the minimum weight was noticed in the GPMR-1219 (1.84 g). Heritability of 95.29 per cent and genetic advance as per cent mean of 69.51 was observed for this character.

The grain yield per plant ranged from 2.77 to 12.33 g with a mean value of 6.26 g. Highest grain yield per plant was recorded in GPMR-193 (12.33g) and GPMR-1147 showed the lowest grain yield per plant (2.77g). Phenotypic and genotypic coefficients of

variability observed were 35.92 and 30.17 per cent, respectively. High heritability of 70.57 per cent and high genetic advance as per cent mean (85.28) was observed for this trait.

In the present study, high GCV and PCV was obtained for plant height, number of tillers per plant flag leaf length, flag leaf width, panicle length, thousand seed weight and grain yield per plant. This is in accordance with the results of Nirmalakumari *et al*.[5,7] and Manimozhi Selvi *et al.*[4] in little millet, Salini *et al*.[9] in proso millet, Nirmalakumari and Vetriventhan[5,7] and Brunda *et al.*[2] in foxtail millet, Ulganathan and Nirmalakumari[11] in ragi. Moderate PCV and GCV was shown by days to 50 per cent flowering and days to maturity exhibited low GCV and PCV. The results are in line with the reports of Nirmalakumari *et al*.[5,7] in little millet, Nirmalakumari and Vetriventhan[5,7] in foxtail millet and Ganapathy *et al*.[3] in finger millet.

The order of Genetic variability for different characters grain yield per plant > flag leaf length > flag leaf width > number of tillers per plant > Panicle length > plant height > thousand weight > days to 50 per cent flowering > days to maturity.

High heritability and high genetic advance as per cent mean was recorded for the traits like plant height, number of tillers per plant, flag leaf length, panicle length, test weight and grain yield per plant whereas days to 50 per cent flowering and days to maturity recorded high heritability associated with moderate genetic advance as per cent mean. These results are in agreement with the findings of Manimozhi Selvi *et al.*[4] in little millet, Nirmalakumari and Vetriventhan[5,7] in foxtail millet and Ulganathan and Nirmalakumari[11] in ragi.

High heritability in conjunction with high genetic advance as per cent mean depicts that variation obtained is mainly due to genetic factors and also moderate role of environment factors. These traits will be under the control of additive gene action and hence simple selection may be effective for improving this trait. It can be exploited by pure line selection and mass selection. High heritability with moderate genetic advance as per cent mean indicates the role of non-additive gene action in the inheritance of this trait. The high heritability being exhibited may be due to influence of environment rather than genotype and hence simple selection for such trait may not be rewarding.

Table 1: List of Little millet germplasm lines studied in the present investigation

Sl. No.	Name of the germplasm	Sl. No.	Name of the germplasm	Sl. No.	Name of the germplasm	Sl. No.	Name of the germplasm
1	GPMR-4	17	GPMR-1165	33	GPMR-728	49	GPMR-966
2	GPMR-9	18	GPMR-732	34	GPMR-677	50	GPMR-903
3	GPMR-12	19	GPMR-65	35	GPMR-1130	51	GPMR-688
4	GPMR-16	20	GPMR-78	36	GPMR-1029	52	GPMR-253
5	GPMR-23	21	GPMR-192	37	GPMR-1094	53	GPMR-1288
6	GPMR-50	22	GPMR-193	38	GPMR-904	54	GPMR-1253
7	GPMR-51	23	GPMR-1091	39	GPMR-1010	55	GPMR-1338
8	GPMR-66	24	GPMR-708	40	GPMR-1344	56	GPMR-574
9	GPMR-67	25	GPMR-956	41	GPMR-187	57	GPMR-1219
10	GPMR-97	26	GPMR-1060	42	GPMR-1285	58	GPMR-827
11	GPMR-116	27	GPMR-1104	43	GPMR-1062	59	GPMR-661
12	GPMR-133	28	GPMR-105	44	GPMR-585	60	GPMR-922
13	GPMR-613	29	GPMR-1149	45	GPMR-1303	61	GPMR-990
14	GPMR-1123	30	GPMR-999	46	GPMR-96	62	GPMR-1002
15	GPMR-1147	31	GPMR-1203	47	GPMR-1170	63	OLM-203
16	GPMR-1153	32	GPMR-70	48	GPMR-977	64	JK-8

Table 2: Analysis of variance for yield and yield related characters in Little millet genotypes during *Kharif* 2015

Source	df	Days to 50per cent flowering	Plant height (cm)	No. of tillers per plant	Flag leaf length (cm)	Flag leaf width (cm)	Panicle length (cm)	Days to maturity	Thousand seed weight (g)	Yield per plant (g)
Replication	1	4.132	11.834	12.500	2.877	0.0005	1.540	1.531	0.0004	2.1788
Blocks within replications(Adjus)	14	1.293	8.284	0.223	0.394	0.0061	1.412	1.334	0.0072	2.2787
Genotypes (Unadjusted)	63	68.813**	676.440**	12.476**	73.746**	0.121**	58.810**	70.0709**	0.3315**	8.6012**
Intra Block Error	49	1.433	5.936	0.497	0.245	0.003	0.869	1.240	0.0087	1.4845
LSD @ 5per cent		2.392	4.880	1.409	0.990	1.257	1.863	2.225	0.1869	2.4348
S.Em		0.521	1.627	0.225	0.535	0.021	0.481	0.525	0.0360	0.199

***- Significant at 1per cent level*

Table 3: Genetic parameters of nine quantitative characters in Little millet elite germplasm lines

Characters	Minimum	Maximum	Mean	V_P	V_G	PCV %	GCV %	H (%)	Expected GA as per cent mean
Days to 50 per cent flowering	44.00	70.50	51.63	35.12	33.69	11.48	11.24	95.92	25.50
Plant height (cm)	75.72	156.44	106.49	341.20	335.24	17.35	17.19	98.25	36.66
No. of tillers per plant	5.00	17.50	9.88	6.49	5.99	25.50	24.50	92.33	61.78
Flag leaf length(cm)	12.13	38.72	21.16	37.00	36.75	28.74	28.65	99.34	63.91
Flag leaf width(cm)	0.48	1.73	0.87	0.06	0.06	28.73	27.79	93.62	67.16
Panicle length(cm)	13.47	38.75	25.01	29.84	28.97	21.84	21.52	97.09	48.88
Days to maturity	72.50	98.00	81.14	35.66	34.41	7.36	7.23	96.51	16.35
Thousand seed weight (g)	1.84	3.70	2.59	0.17	0.16	15.90	15.52	95.29	69.51
Yield per plant(g)	2.77	12.33	6.26	5.04	3.56	35.92	30.17	70.57	85.28

CONCLUSION

In the present investigation, 64 diverse germplasm accessions of little millet were studied to assess their genetic potential. All the genotypes displayed considerable amount of differences in their means with respect to all the characters studied. This had also been exemplified by highly significant mean sum of squares for these traits, which had indicated that the lines under study were genetically diverse. Wide range of variation was observed among the genotypes which provide an opportunity for inclusion of superior and desired genotypes in breeding programme. An assessment of heritable and non- heritable component in the total variability is crucial for adopting suitable breeding procedures. The heritable portion of the overall observed variation can be ascertained by studying the components of variations such as coefficients of phenotypic and genotypic variation, heritability and predicted genetic advance. Presence of narrow gap between phenotypic coefficient of variation and genotypic coefficient of variation for all the characters under study, suggested that these traits studied had low environmental influence.

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