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Assessment of genetic variability, heritability and correlation studies of finger millet (*Eleusine coracana* Gaertn.) for yield and its yield components

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ABSTRACT

In the present study fifty germplasm lines of finger millet varieties were evaluated for twelve yield components at Agricultural Research Station, Vizianagaram during *kharif* 2022. Analysis of variance for fifty finger millet genotypes revealed significant differences among the varieties for all twelve traits studied indicating the presence of considerable genetic variability among the varieties studied. High PCV and GCV were recorded for finger width, leaf width, grain yield and fodder yield indicating sufficient variation among the genotypes for this trait and direct selection may be effective for these traits. High heritability along with high genetic advance was observed for number of productive tillers per plant, ear length, finger length, finger width, leaf width, grain yield and fodder yield. Leaf length showed positive and significant correlation with grain yield

Keywords: *Correlation, Finger millet, Genetic advance, Heritability and Variability*

Finger millet (*Eleusine coracana* Gaertn.) is the third most significant millet crop in India, after Sorghum and Pearl millet (Madhavilatha *et al*., 2021). It is one of the important hardy crop predominantly cultivated in the arid and semiarid regions of the world. It is an important food crop in traditional low input cereal-based farming systems in Africa, and is of particular important in upland areas of eastern Africa. It is widely recognized as "Nutritious millet" due to the grains' nutritional superiority over various cereals. It contains protein (7-10%), calcium (344 mg/100 g), iron, and other minerals. The carbohydrates in finger millet possess the distinctive characteristic of slow digestion. It contains significant amounts of phosphorus (283 mg/100 g) and potassium (408 mg/100 g) (Jadhav *et al*., 2015). Being rich in protein, iron and calcium, finger millet serves as an important staple food for rural populations in developing tropical countries where calcium deficiency and anaemia are widespread (Owere *et al*., 2015). Although yields may vary when compared with cereals, the yield of finger millet are generally good and needs improvement.

The challenge to changes in climate can be addressed by crop improvement. Development of new varieties over existing varieties is a pre-requisite to cater the needs of present and future (Anuradha *et al*., 2017). For any crop, genetic variability among the available breeding lines provides a hope for improvement of the crop through selection (Suryanarayana *et al.,* 2014). Selection will be effective when the trait is highly heritable. Heritability of a character provides an insight into the heritable variance and it is needed for any plant breeding programme. Grain yield is a complex character governed by many genes and further influenced by the nearby environment (Owere *et al.,* 2015). Hence, direct selection of yield is not worthy. Consequently, a sound knowledge on correlation of yield contributing traits with grain yield helps in indirect selection of yield *via* highly heritable traits (Bezaweletaw *et al.,* 2006). Hence, in the present study 50 finger millet germplasm lines were studied for variability, heritability and correlation for yield and other important traits.

MATERIAL AND METHODS

The present study comprised of 50 germplasm lines of finger millet evaluated at Agricultural Research Station, Vizianagaram, Andhra Pradesh during *kharif*, 2022. All the germplasm lines

were sown in alpha lattice design with two replications having ten genotypes in each block. Recommended doses of 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. Healthy crop was maintained following standard management practices. Observations were recorded for twelve yield attributing traits viz., days to 50% flowering, days to maturity, plant height (cm), number of productive tillers per plant, number of fingers per ear, ear length (cm), finger length (cm), finger width (cm), leaf length (cm), leaf width (cm), grain yield (kg/ha), fodder yield (kg/ha).

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). The correlations were calculated according to Falconer (1981). Heritability and genetic advancement were categorized into low, medium and high as per Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Genetic variability studies outline the basis for crop improvement. It also helps us to know the main root cause of variation whether it is sensitive to environment or not, whether it can be transformed to the next generation or not, based on this breeding programme can be planned.

Analysis of variance for fifty germplasm lines of finger millet genotypes revealed significant differences for all traits studied indicating the presence of considerable genetic variability among the genotypes studied. Substantial variation was reported by earlier workers (Reddy *et al.*, 2013; Ulaganathan and Nirmalakumari, 2015). Mean performance and the summary of statistics (Table 1) indicated that days to 50% flowering ranged from 70 to 100 days while, days to maturity ranged from 101 to 133 days. The earliest in terms of flowering and duration was IC0402576 and IC0308872 while, IC0402827 was late. Phenotypic coefficient of variance (PCV) was slightly higher than genotypic coefficient of variance (GCV) for the traits studied indicating less interaction of traits with environment (Table 2). High PCV and GCV is observed for finger width (34.3, 33.7), leaf width (24.7, 23.4), grain yield (26.3, 25.5) and fodder yield (23.7, 22.4) indicating sufficient variation among the genotypes for these traits and direct selection may be effective for these characters. Moderate PCV and GCV is observed for number of productive tillers per plant (15.2, 13.8), ear length (14.8, 13.4) and finger length (15.4, 14.0). Similar findings were observed in the studies of Manyasa *et al*. (2016). All the other traits like days to 50 % flowering, days to maturity, plant height, number of fingers per ear, and leaf length had low PCV and GCV values indicating the presence of limited genetic variability for these characters. The results were similar with the earlier reports of (Madhavilatha *et al*., 2021 and Abhilsh *et al*., 2020). Genotypic coefficient of variation is not a correct measure to know the heritable variation present and should be considered together with heritability estimates.

Heritability estimates for all the traits under study were ranging from 34.0 to 96.3 All the characters showed high heritability values except plant height (34.0). Finger width, leaf width, grain yield and fodder yield had high heritability value coupled with high GCV and PCV indicating that phenotypic selection could be effective in improvement of the traits. Tesfaye and Mengistu (2017) and Jyothsna *et al.* (2016) reported similar results for fodder yield. High heritability alone is not a sufficient criterion for selection unless information is accompanied with substantial amount of genetic advance. Genetic advance is another important selection parameter which can be exploited along with heritability of the trait in varietal development. In the present study high heritability coupled with high genetic advance as percent of mean was observed for number of productive tillers per plant, ear length, finger length, finger width, leaf width, grain yield and fodder yield. indicating the importance of additive gene action in governing the inheritance of these traits. These results are in accordance with Manoj *et al*. (2015) and Ganapathy *et al*. (2011) for fodder yield and grain yield.

Association of different characters gives an insight about simultaneous selection of characters. The Phenotypic correlation coefficients were determined between twelve quantitative traits and were presented in Table 3. Leaf length showed positive and significant correlation with grain yield at phenotypic level. This suggests selection for these traits would improve the grain yield in finger millet. Positive and significant

Table 1: Mean performance and summary statistics of finger millet germplasm

S.No	Genotype	DFF	DM	PH	NPT	NFE	EL	FL	FW	LL	LW	FY	GY
1	IC0402773	77.5	107.5	93	3.6	7	8.9	7.1	1	32.2	0.9	4750	2232.5
2	IC0402576	70.5	101.5	81.5	3.2	8.2	8.7	7.2	0.8	33.5	0.7	4947	1870.5
3	IC0321797	75	108	87.5	3.1	7.1	8.4	7.4	1.6	29.1	0.6	4742	2397.5
4	IC0402638	89.5	119.5	89.1	4	7.2	9.2	8	0.6	29.4	0.8	4255.5	1721.5
5	IC0344962	72	103	89.5	4.2	8.1	9.7	9.4	0.6	33.9	1.5	6155	2305
6	IC0283679	86.5	117.5	101.2	4.2	9	11.3	10.9	0.7	30.8	0.9	4120.5	1639.5
7	IC0402775	81.5	111.5	90	3.1	7.9	7.9	7.4	1	33.9	1.5	3036.5	1509.5
8	IC0342934	78	108	88.4	3.1	7.1	7.7	6.5	0.6	31.7	0.8	4822	2907
9	IC0041803	82	113	86.6	4.1	8	10.2	7.7	1.1	33.8	1	4443	1701
10	IC0402827	100	133	82	3.1	8.9	11.5	8.6	1.4	39.7	1.5	5258.5	2929.5
11	IC0053733	72	103	84	3.7	7.9	10.2	9.5	1.4	25.6	1.2	3255.5	1455
12	IC0308872	70.5	101.5	103.6	3.5	8	10.2	7.2	0.7	27.2	1.1	4235.5	1585
13	IC0321233	80	111	96.6	3.8	9	10.2	8.7	1.6	30.5	1	4595.5	1753
14	IC0403123	73.5	103.5	89.7	3.3	8.1	7.4	6.2	0.6	31.1	1	3467	2404
15	IC0361119	81	112	89.1	3.6	8.1	10.2	8	0.7	28.9	1.1	4388.5	1956
16	IC0004680-1	86	117	100.7	3.1	7.5	10.4	10.1	1.2	27.1	1	2763	1721.5
17	EN52	90	121	84.3	4.2	7.5	8.7	8.7	1.3	37.1	1.3	4059	2055.5
18	IC0053716-x	81.5	111.5	97.1	3.8	7.9	8.8	8.4	0.9	27.8	1	2759	1645
19	IC0344134	88.5	118.5	82	3.6	7	9.4	8.1	0.7	33.9	1.1	4545	2484
20	IC0402987	71.5	102.5	83	3.5	7.8	8.4	7.8	0.6	30.2	0.8	4166.5	2069.5
21	IC0344941	82.5	113.5	100.1	3.1	7.2	9.2	8.5	1.4	35	1.3	4342.5	1696.5
22	IC0316048	78.5	108.5	96.2	4	7.3	8.7	8.2	0.7	32	0.9	3318.5	1558
23	IC0331565	78.5	108.5	99.5	4	8.2	10.1	8	1.2	33	1.5	4320	1836.5
24	IC0402911	90.5	121.5	84.7	3.2	9.4	9.3	9.1	0.7	36.6	1	4405	1701
25	IC0041808	74.5	106.5	82.6	3.4	8.1	7.4	6.3	0.7	32.1	1.5	4562.5	3041.5
26	IC0383401	88.5	118.5	97.3	3.6	9	10.8	9.4	1.6	28.7	1.3	3655	1819.5
27	IC0402841	74	105	89.1	5.2	6.8	6.8	6	0.9	33.7	0.7	2959	1330
28	ELB79	84	117.5	89.2	3.6	8	7.8	6.7	0.8	32.6	0.8	2821.5	1205
29	IC0403156	71	103	91.1	3.2	7	9.7	9	0.6	32.2	1.4	2560.5	1239.8
30	IC0403153	76	106	93.1	3.6	7.3	9.8	9	0.6	26.2	0.8	3096.5	1223.1
31	IC0345134	78.5	108.5	82.5	4.2	8.8	10.7	9.9	0.9	26.8	1.4	2555	1253
32	IC053737-X	81.5	111.5	96.1	3.2	7.2	11.3	9	1.3	25.8	1	4492	2328
33	IC0402833	85	117.5	94.1	3.2	8	11.4	10.1	0.8	25.7	0.7	2821.5	1290
34	IC0403158	77	107	80.7	3.1	8.1	7.3	6	0.6	33.2	0.6	3822	1808
35	IC0402592	77.5	106.5	90.1	3.5	8.3	9.1	8.5	0.7	32	0.9	2872	1297.5
36	IC040166	87	118	93.6	3.1	8.2	9.3	8.2	0.9	30.8	0.8	4055	2150.5
37	IC0402582	71.5	102.5	82.7	3.6	8.2	7.1	5.9	0.7	30.4	1	3557.5	1438
38	IE2971-2	91	124	92.1	4.4	7	10.9	9	0.5	32.5	0.7	3652	1558
39	IC0529781	80.5	110.5	98.5	3.2	8.3	8.7	8.5	1.2	28.4	1.3	6438.6	2707.5
40	IC0281766	74.5	106.5	93.7	4	8.2	7.4	7.1	1.1	26.1	0.9	4821.5	1760.5
41	IC0053732	79	109	76.2	4.7	7.7	8.4	8.3	0.9	29	1.1	4786.5	2119.5
42	IC0403251	80	111.5	94.1	4.4	7.9	7.1	6.8	0.9	35	1	3625	1440
43	ER37	76	107.5	86.8	3.3	7.3	6.4	6.2	1.2	27.6	0.9	2760.5	1345.3
44	IC0262816	76.5	106.5	95.5	4.8	7.5	9.1	8	1.3	30.3	0.8	3619.5	1374.5
45	IC0071335-X	84	117	89	3.1	6.8	7.3	6	0.6	30.9	1.1	2785.5	1436
46	ER73	95	128.5	81.2	3.2	7.8	8.7	8.6	1.5	34.2	1.4	4354.5	1965.5
47	IC0447140	84	117.5	92.5	5.1	7.6	7.3	7	0.8	27.5	0.9	4640	1891
48	ER76	83	115.5	106	3.7	7.6	10.1	9.7	0.8	26.8	1.4	2741.5	1356
49	IC0403073	87	119.5	85.6	3.1	7.4	9	8.7	0.8	28.9	1	2652.5	1232.1
50	IC0403106	81.5	111.5	84.6	3.5	7.5	8.4	7.2	1	30.6	1.3	3074.5	1572.5
	Mean	80.7	111.8	90.3	3.6	7.8	9	8	0.9	30.8	1	1806.3	3898.7
	CD(5%)	4.1	5.5	15.6	0.6	1.1	1.6	1.5	0.2	5.7	0.2	331.6	862.5
	CV(%)	2.5	2.5	8.6	8.9	7.2	8.9	9.1	9.3	9.2	11.2	9.1	11
	Min	70.5	101.5	76.2	3.1	6.8	6.4	5.9	0.5	25.6	0.6	1205	2555
	Max	100	133	106	5.2	9.4	11.5	10.9	1.6	39.7	1.5	3041.5	6438.6

Note: DFF: Days to 50 % flowering, DM: Days to maturity, PH: Plant height, NPT: Number of productive tillers per plant, NFE: Number of fingers per ear, EL: Ear length, FL: Finger length, FW: Finger width, LL: Leaf length, LW: Leaf width, GY: Grain yield, FY: Fodder yield

Table 2: Genetic parameters of finger millet germplasm lines

	DFF	DM	PH	NPT	NFE	EL	FL	FW	LL	LW	GY	FY
GCV	8.1	6.2	4.4	13.8	6.2	13.4	14	33.7	8.3	23.4	25.5	22.4
PCV	8.3	6.4	7.5	15.2	8	14.8	15.4	34.3	10.5	24.7	26.3	23.7
ECV	2.5	2.5	8.6	8.9	7.2	8.9	9.1	9.3	9.2	11.2	9.1	11
h^2 broad sense	95.4	92.6	34	82.9	60.2	82.1	82.4	96.3	61.9	89.7	94	89.2
GA	13.2	13.7	4.7	0.9	0.8	2.3	2.1	0.6	4.1	0.5	919.3	1695.1
GAM	16.4	12.2	5.2	26	10	25.1	26.1	68.1	13.4	45.7	50.9	43.5

Note: DFF: Days to 50 % flowering, DM: Days to maturity, PH: Plant height, NPT: Number of productive tillers per plant, NFE: Number of fingers per ear, EL: Ear length, FL: Finger length, FW: Finger width, LL: Leaf length, LW: Leaf width, GY: Grain yield, FY: Fodder yield

Table 3: Phenotypic Correlation of yield and its related traits

	DFF	DM	PH	NPT	NFE	EL	FL	FW	LL	LW	GY	FY
DFF	1											
DM	0.9878**	1										
PH	-0.0055	-0.0163	1									
NPT	-0.0807	-0.0848	0.0619	1								
NFE	0.1369	0.1133	-0.0035	-0.068	1							
EL	0.3635*	0.3326*	0.3340*	-0.067	0.2977*	1						
FL	0.3752*	0.3448*	0.3191*	0.0117	0.2965*	0.8425**	1					
FW	0.214	0.2147	0.1177	-0.065	0.1388	0.1901	0.1805	1				
LL	0.3188*	0.3104*	-0.3301*	-0.027	0.0985	-0.1332	-0.1974	0.0121	1			
LW	0.1805	0.1696	0.0499	-0.103	0.2523*	0.2238	0.2651*	0.3001*	0.2054	1		
GY	0.1153	0.0977	-0.2093	-0.229	0.0799	-0.0223	-0.148	0.136	0.2654*	0.173	1	
FY	0.0297	0.0209	-0.0898	0.0282	0.221	0.0629	-0.0408	0.1952*	0.2657*	0.109	0.7590**	1

Note: DFF: Days to 50 % flowering, DM: Days to maturity, PH: Plant height, NPT: Number of productive tillers per plant, NFE:Number of fingers per ear, EL: Ear length, FL: Finger length, FW: Finger width, LL: Leaf length, LW: Leaf width, GY: Grain yield, FY: Fodder yield

phenotypic correlations were recorded between days to 50 % flowering with days to maturity, ear length, finger length and leaf length, days to maturity with ear length and finger length, Plant height with ear length, finger length and leaf length, number of fingers per ear with finger length and leaf width, ear length with finger length and finger width having positive and significant correlation with leaf width. The results indicated that leaf length and leaf width can be considered together in a positive direction towards in the improvement of grain yield of finger millet genotypes.

CONCLUSION

Significant variation for all the traits studied was observed in the present study for 50 genotypes of finger millet. GCV and PCV were low to high for the traits studied indicating low to high variability in the present population. Grain yield is controlled by both additive and non additive gene action, hence direct selection may not be effective. As this trait is highly associated with leaf length which is predominantly controlled by additive gene action, selection of grain yield via this trait is desirable.

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