Genetic variability, heritability, genetic advance and association of traits of finger millet [*Eleusine coracana* (L)]

ABSTRACT

The present investigation was carried out to assess the genetic variability parameters, correlation and path analysis in 20 finger millet genotypes for 13 quantitative traits in *Kharif* 2021 in Randomized Block Design replicated thrice. Analysis of variance revealed that treatment differences were highly significant under study at 1% level. Genotypes FIN 5117 and FIN 5111 depicted highest grain yield. Both high Genotypic and Phenotypic coefficient of variation were recorded for number of tillers per plant. High heritability coupled with high genetic advance as percent of mean was observed for number of fingers per ear, grain yield per plant, days to fifty percent flowering indicating that these traits are most probably under the control of additive gene action and hence these traits can be fixed by proper selection**.** Correlation coefficient analysis revealed that days to maturity, number of tillers per plant, number of fingers per ear, biological yield emerged as most important attributing associates of grain yield per plant in finger millet. Days to maturity, number of fingers per plant, number of tillers per plant had positively direct effect on grain yield per plant. Therefore, effective selection must be attempted for these traits which would help in improvement of grain yield in Finger millet genotypes.

Key Words: Finger millet, Heritability, Genetic advance, Correlation coefficient analysis, Path coefficient analysis

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1. Introduction

Finger millet (*Eleusine coracana* L.), belongs to family *Poaceae* (*Gramineae*), subfamily *Chloridoideae*, and genus *Eleusine*, and it is highly self-fertilized allotetraploid (2n = 36) derived from the wild tetraploid progenitor *E. coracana* subsp. *Africana*.

Finger millet was domesticated around 5000 years ago in Eastern Africa (possibly Ethiopia) and introduced into India, 3000 years ago **(Hilu *et al.* 1979)**. The cultivated *E. coracana* is a tetraploid (2n=4X=36) and exhibits morphological similarity to both *E. indica* (2n=18) and *E. africana* (2n=36). It was earlier thought that cultivated *E. coracana* originated from *E. indica*, of which the distribution is quite wide, from Africa eastwards to Java. *E. coracana* possibly originated from *E. africana* through selection and further mutation towards larger grains **(Channaveeraiah and Hiremath, 1974., Hilu *et al.* 1979)**.

In world, finger millet ranks fourth in importance among millets after sorghum, pearl millet and foxtail millet. It is estimated that some 10 per cent of the world's 30 million tonnes of millet produced is finger millet **(Chandra *et al.* 2016)**. In India, the crop is grown in an area of 1.01 million hectares with a production of 1.38 million tonnes and productivity of 1.36 tonnes ha^{-1}. The major finger millet growing states are Karnataka, Uttarakhand, Maharashtra, Tamil Nadu, Odisha, Andhra Pradesh and Jharkhand. Karnataka, Uttarakhand and Tamil Nadu are the major contributors accounting for more than 80 per cent of the total production. In Karnataka, it occupies an area of 0.59 million hectares with a production of 0.85 million tonnes and productivity of 1.43 tonnes ha^{-1}. Its cultivation is concentrated mostly in the districts of Bangalore, Kolar, Tumkur, Chitradurga, Hassan, Mysore and Mandya (Anonymous, 2016).

Finger millet is commonly called as "Nutritious millet" as its grains are nutritionally superior over other cereals. It stands out as the richest source of calcium (380-450 mg/100g) among all the cereals. It has three times more calcium than milk and 10-fold higher calcium than brown rice, wheat or maize. Besides calcium, finger millet is also very rich source of crude fibre (3.6 mg/100g), iron (3.39 mg/100g), zinc (1.5 mg/100g), essential amino acids, leucine (594 mg/100g of protein) and valine (413 mg/100g of protein), slowly digestible starch and phytochemicals like polyphenols. It is a gluten-free, low fat cereal which is non-allergic and easily digestible. For these characteristics, it is often termed as a "Super cereal". Apart from its nutritional attributes, finger millet has excellent environmental sustainability credentials. It can easily withstand harsh climatic conditions, low soil fertility, requires very little inputs with a short growing season. It has excellent storage quality traits and can be valuable in areas where farmers suffer losses due to dearth of post-harvest management **(Kumar *et al.* 2016)**.

2. Materials and methods

Study site: The experiment was carried out at Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Uttar

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Pradesh) during *Kharif* -2021 The experimental field which was located on the left side of Prayagraj –Rewa (National Highway) new bridge road. It is about ? km away from Prayagraj. Prayagraj is situated between the parallels of 25.4358° N latitude and 81.8463°E longitude. The climate of this area is tropical characterized by fairly hot summer, moderately cold winter with humid and warm monsoon. The rainfall of this region is heavy and normally received from June to September. Most of the precipitation is received through south-west monsoon, concentrating in the months of July and October. The soil of experimental site was loamy mixed with pH ranging from 7.3 to 7.6. The land was prepared by two harrowing followed by planking.

Planting materials and experimental design

The experiment material for present investigation comprised of 20 genotypes of finger millet obtained from Department of Genetics and Plant Breeding, Prayagra. The experiment was conducted in Randomized Block Design (RBD) with three replications. The seedlings were sowing at 20×10 cm2 spacing. The crop was fertilized with 40 Kg N2 and 20 Kg P2O5 per hectare. The nitrogen was applied in two splits, one at the time of transplanting and other at 25 days after transplanting. Entire Phosphorus was applied as basal dose. All recommended practices were followed and timely plant protection measures were taken to avoid damage through insect-pests and diseases. The genotypes were sown on 5 Aug 2021 and harvested on 30th Nov, 2021 at the shuats college Research Station, Prayagraj.

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Table 1: Analysis of Variance (ANOVA) for 20 genotypes of 13 quantitative traits

		Mean Sum of Squares		
S. No	Characters	Replication (d.f=2)	Treatment (d.f=19)	Error (d.f=38)
1	Days to fifty percent flowering	52.550	26.568	26.568
2	Days to maturity	118.950	52.722	52.722
3	Plant height	53.310	26.656	26.656
4	Number of leaves	5.4210	3.911	3.911
5	Number of fingers per plant	0.2590	0.167	0.167
6	Finger length	0.0380	0.246	0.246
7	Finger width	0.0020	0.007	0.007
8	Ear head length	0.6060	0.346	0.346
9	Number of tillers	0.0650	0.051	0.051
10	Biological yield	16.3990	11.262	11.262
11	1000 grain weight	0.0070	0.027	0.027
12	Grain yield per plant	0.2170	0.377	0.377
13	Harvest index	28.2580	160.603	10.614

****Indicates significant at 0.0020% level**

Table 2: Genetic variability, phenotypic variability, heritability and genetic advance for yield contributing characters in 20 finger millet genotypes

PCV: Phenotypic Coefficient of Variation, GCV: Genotypic Coefficient of Variation, h^2 (bs): Heritability (broad sense), GA: Genetic Advance, GAM: Genetic Advance as Percent Mean

Sl. No.	Traits	GCV	PCV	h^2 (Broad sence	Genetic Advancement	Gen. Adv as % of Mean
1	Days to fifty percent flowering	9.903	11.932	68.89	13.114	16.933
2	Days to maturity	6.614	9.634	47.127	9.694	9.353
3	Plant height	4.996	8.469	34.8	4.584	6.071
4	Number of leaves	14.203	16.282	76.093	6.34	25.523
5	Number of fingers per plant	24.162	24.798	94.94	3.548	48.499
6	Finger length	13.421	15.466	75.308	1.549	23.992
7	Finger width	12.14	14.569	69.435	0.215	20.839
8	Ear head length	9.879	12.024	67.505	1.436	16.72
9	Number of tillers	40.004	40.404	98.028	3.239	81.592
10	Biological yield	20.851	22.91	82.837	13.823	39.094
11	1000 grain weight	25.914	26.951	92.452	1.14	51.328
12	Harvest index	20.857	21.989	89.967	3.594	40.753
13	Grain yield per plant	27.183	29.93	82.488	13.229	50.859

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Table 3: Genotypic (above) and phenotypic (below) correlations of among all quantitative characters studied in 20 Finger millet genotypes..

Traits	Genotypic/ phenotypic	Days to fifty percent flowering	Days to maturity	Plant height	Number of leaves	Number of fingers per ear	Finger length	Finger width	Ear head length	Number of tillers	Biological yield	1000 grain weight	Harvest Index	Grain yield per plant
Days to fifty percent flowering	G	1.0000	0.825**	0.546**	0.1534	-0.1544	-0.1784	0.403*	0.0272	-0.317*	-0.0034	-0.1128	-0.2184	-0.257*
	P	1.0000	0.660**	0.290*	0.0737	-0.1038	-0.0541	0.257*	-0.0234	-0.263*	0.0056	-0.1024	-0.1739	-0.1938
Days to maturity	G		1.0000	0.527**	0.269*	-0.266*	-0.1506	0.1695	-0.0027	-0.2393	0.0532	0.0062	-0.1353	-0.1314
	P		1.0000	0.1839	0.1891	-0.2040	-0.1135	0.0073	0.0336	-0.1805	0.0352	0.0049	-0.1381	-0.1004
Plant height	G			1.0000	0.1724	-0.1747	0.695**	0.1256	0.514**	-0.796**	0.1567	-0.0385	-0.2260*	0.0679
	P			1.0000	0.0690	-0.0639	0.327*	0.0243	0.299*	-0.457**	0.1984	0.0126	-0.2096	0.0316
Number of leaves	G				1.0000	-0.0756	0.0344	0.1969	0.0079	0.0501	-0.1135	-0.0136	0.1531	0.1339
	P				1.0000	-0.0817	0.0019	0.1291	0.0798	0.0440	-0.1073	-0.0596	0.1317	0.1126
Number of fingers per ear	G					1.0000	0.0280	-0.1389	0.0404	-0.1035	-0.0792	-0.1258	-0.0320	-0.0962
	P					1.0000	0.0378	-0.1424	0.0517	-0.0878	-0.0525	-0.1068	-0.0463	-0.0959
Finger length	G						1.0000	-0.1689	0.793**	-0.516**	0.1454	0.1217	-0.0975	0.1612
	P						1.0000	-0.0943	0.491**	-0.441**	0.0792	0.0843	-0.0688	0.1025
Finger width	G							1.0000	0.0055	0.0096	0.0357	-0.0576	0.0529	0.1293
	P							1.0000	-0.0260	-0.0104	0.0341	-0.0486	0.0822	0.1379
Ear head length	G								1.0000	-0.535**	0.0310	0.2459	0.1417	0.337*
	P								1.0000	-0.438**	0.0499	0.1967	0.0820	0.269*
Number of tillers	G									1.0000	0.2217	0.2437	0.1272	0.1940
	P									1.0000	0.2037	0.2307	0.1035	0.1794
1000 grain weight	G										1.0000	0.331*	-0.6157**	0.2530
	P										1.0000	0.316*	-0.6188**	0.2398

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Biological yield	G							1.0000	0.485**	0.938**	
	P							1.0000	0.420**	0.878**	
Harvest Index	G								1.0000	0.582**	
	P								1.0000	0.569**	
Grain yield per plant	Gp									1.0000	
										1.0000	

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3. RESULTS AND DISCUSSION

3.1 Analysis of Variance for Quantitative Characters

Analysis of variance for different characters is presented in Table 1 The mean squares for 13 different characters showed highly significant differences (α=0.01) for all characters indicating the presence of substantial amount of genetic variability among the Finger millet genotypes.

The characters under investigation were analyzed for genotypic variance (c^g), phenotypic variance (o2p) genotypic coefficient of variation (GCV), phenotypic coefficient variation (PCV), heritability (Broad sense), genetic advance and expected genetic advance as percent of mean (EGA) and are presented in Table 2.

3.2 Genotypic coefficient of variation

High magnitude of GCV was observed in traits such as number of tillers (40.004) followed by grain yield (27.18), 1000 GM weight (25.91), number of fingers per ear (24.16) and biological yield(20.85), harvest index(10.95). While moderate GCV was observed in traits number leaves per plant (14.20), number of finger length (13.42), finger width (12.14), ear head length (9.87) and days to 50% flowering (6.61) and Lowest GCV was observed in traits plant height (4.96).

3.3. Phenotypic coefficient variation

Phenotypic coefficient of variation was observing greater then genotypic coefficient of variation for all the traits. Highest PCV was observed in the traits no of tillers (40.40) followed by grain yield (29.93), 1000 GM weight (26.95), no of fingers per ear (24.79) and biological yield (22.91), harvest index (21.98). While moderate PCV was observed in traits number leaves per plant (16.28), number of finger length (15.46), finger width (14.56), ear head length (12.02) and days to 50% flowering (9.61) and Lowest GCV was observed in traits plant height (8.46).

3.4. Heritability

The high heritability estimates were observed in the traits no of tillers (98.02) followed by no of fingers per ear (94.94), 1000 GM weight (92.45), harvest index (82.48), grain yield (82.48) and biological yield (82.21), While moderate heritability was observed in traits number leaves per plant (76.09), number of finger length (75.30), finger width (69.43), ear head length (67.50) and days to 50% flowering (68.89) and Lowest GCV was observed in traits plant height (34.8). Showed moderate heritability.

3.5. Genetic advance (5%)

The highest GA (%) was observed in character biological yield per ha (13.82) followed by grain yield per plant (13.22), days to 50 percent flowering (13.11), days to maturity (9.69), no of leaves (6.34), harvest index (3.59) showed moderate genetic advance as percent of mean. While 1000GM weight yield (1.14), finger width (0.215) and plant height showed low genetic advance as percent.

3.6 Highest genetic advance value was observed in the traits no of tillers (81.59) followed by 1000 GM weight (51.32), grain yield per plant (50.85), no of fingers per ear (48.49), harvest index

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(40.75) and biological yield (39.09). While moderate genetic advance mean value was observed in traits number leaves per plant (25.52), number of finger length (23.99), finger width (20.83), ear head length (16.72) and days to 50% flowering (16.93) and Lowest GCV was observed in traits plant height (9.3).

CONCLUSION

From the present investigation it is concluded that among 20 genotypes of finger millet on the basis of mean performance 4 genotypes viz FIN 5117 , FIN 5111, FIN 5113 , FIN 7051 and possessed maximum grain yield per plant over the check variety **GPU-48.** It is concluded from experimental results that significant variation can be exploited further for the improvement of the finger millet. High GCV, PCV, heritability and genetic advance for all characters implies selection will be effective in this studied population. Number of tillers per plant exhibited high estimates of GCV and PCV. The grain yield per plant exhibited a significant positive phenotypic correlation with number of number of tillers, ear head length, 1000 grain weight, biological yield and harvest index, paves the way of indirect selection of the traits. For grain yield improvement. Harvest index showed high direct effect on grain yield, hence should be given utmost important during selection.

Conclusion needs correction

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