

Genetic Variability Studies for Yield and Related Attributes in Finger millet (*Eleusine coracana*) Genotypes

Abstract

The present investigation was carried out for fifty finger millet (*Eleusine coracana*) genotypes that were tested for four different environments viz., E₁ and E₂ at Student Research Farm, C.S.A.U.A.&T. Kanpur and E₃ and E₄ sown at Research Farm, Daleep Nagar, Kanpur. The genotypes were evaluated in randomized block design with three replications to estimate analysis of variance, mean, range and genetic variability for days to 50% flowering, days to maturity, plant height (cm), number of productive tillers per plant, number of fingers per ear, length of finger (cm), finger width (cm), ear head width (cm), ear head length (cm), ear head weight (g), straw yield per plant (g), harvest index (%), 1000 grain weight (g), protein content (%) and grain yield per plant (g). This experiment showed GCV and PCV were low for days to 50 % flowering, days to maturity, ear head width for all the environments and protein content for all the environment except for E₂. Ear head weight, straw yield per plant, 1000 grain weight and grain yield per plant showed high values of GCV and PCV. The magnitude of GCV was generally less than the respective PCV for all the environment. High heritability coupled with high genetic advance was recorded for plant height, finger width, ear head weight, straw yield per plant, harvest index, 1000 grain weight and grain yield per plant for all the environment. The yield is a complex and highly variable character and is a result of cumulative effect of its components characters and therefore, direct selection for yield may not be very effective.

Introduction

Finger millet is mainly grown as rainfed crop because of its valued food grains and wider adaptable behaviour to various geographical regions in India. It is nutritionally superior to many cereals and is well known for its higher nutrients of calcium (344 mg/100 g), protein (7-10%), iron and other minerals. The total area under finger millet in India is 10.04 lakh hectares and the production is about 17.55 lakh tonnes with productivity of 1747 kg/ha. (India stat, 2019- 2020). Finger millet has been perceived as a potential “super cereal” by the United State National

Academias being one of the most nutritious among all major cereals. Millet is an annual plant widely grown as an important cereal crop largely grown in the arid areas and semi-arid areas of Africa and Asia. It is also known by different common names as mandua, nagli, kapai and thaidalu etc. Finger millet is said to be originated from Africa and India as a secondary centre of origin (**Chandra *et al.*, 2016**). Epidemiological studies have demonstrated that regular consumption of whole grain and their products can protect against the risk of cardio-vascular disease, *type II* diabetes, obesity, gastro-intestinal cancer, anti-tumorigenic and atherosclerogenic effects antioxidant and microbial properties and a range of other disorders (**Mckeown, 2002**). Apart from its nutritional attributes, finger has excellent environmental sustainability credentials. It can easily withstand harsh climatic condition, low soil fertility, requires very low inputs with a short growing season. Among the abiotic stresses constraining finger millet production is soil salinity, which is a devastating environmental stress factor that has a substantial negative impact on crop quality and production (**Hema *et al.*, 2014**). Looking to the merits of this crop, this crop needs major attention with respect to crop improvement programme to enhance the productivity. One of the means to boost its production and productivity is by identification and development of the improved genotypes with wider adaptability over environments with knowledge of variability, inheritance, direction and magnitude of association between various traits. The progress in plant breeding for yield and yield contributing characters of any crop is genetically controlled, environmentally influenced and determined by the magnitude and nature of their genetic variability (**Wright, 1921 and Fisher, 1936**).

Material and Methods

The present study was conducted at Student Research Farm, College of Agriculture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur and Research Farm, Daleep Nagar Kanpur (Table 1). Proper crop management practices was followed to raise a better crop. Evaluation of fifty different genotypes of finger millet that were sown during *Kharif*, 2021 in Randomized Block Design with three replications with four different environments, having number of rows per plot seven with the spacing 30 cm x 10 cm. Biometrical observations were recorded on randomly five plants in each genotype in three replications on days to 50 per cent flowering, days to maturity, plant height, number of fingers/ear, finger length, finger width, ear

head length, earhead weight, thousand seed weight, grain yield/plant, straw yield/plant, harvest index and protein content. All the recommended package of practices were followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded and the data was subjected to statistical analysis. The variability was estimated as per procedure for analysis of variance suggested by **Panase and sukhatme** (1985), PCV and GCV were calculated by the formula by **Burton** (1952) heritability in broad sense (h^2) by **Burton and De Vane** (1953) and genetic advance i.e., the expected genetic gain were calculated by using the procedure given by **Johnson et al.** (1955).

Result and Discussion

Analysis of variance imparted for fifteen characters studied was significant mean sum of square as shown in Table 2, these indicates there is a sufficient variability present in the genotypes taken for the study. This indicated that, the choice of the germplasm line was appropriate they were quite distinct in relation to the characters studied and hence, suitable for genetical studies. The highest mean value was recorded in E_1 and lowest found in the E_4 for all the characters except for harvest index. In harvest index, the lowest mean value was recorded for E_2 . All the genotypes showed early flowering and early maturity in E_2 and E_4 environment as compared to pooled mean. The highest grain yield per plant as per mean values was recorded in E_1 followed by E_2 , E_3 and E_4 as shown in Table 3. The genotypic coefficient of variation and phenotypic coefficient of variation were low for days to 50 % flowering, days to maturity, ear head width for all the environments and protein content for all the environment except for E_2 . The characters *viz.*, finger length, finger width, ear head length showed moderate values of GCV and PCV for all the environments and harvest index for all environments except E_4 and plant height for E_1 , E_3 and pooled. Ear head weight, straw yield per plant, 1000 grain weight and grain yield per plant showed high values of GCV and PCV. The magnitude of genotypic coefficient of variation was generally less than the respective phenotypic coefficient of variation for all the environment. The estimates of heritability in broad sense ranged from 10.70 to 95.30 percent in E_1 , 18.80 to 97.5 in E_2 , 2.40 to 96.10 in E_3 and 27.90 to 96.00 in E_4 and in pooled analysis, it varied from 15.20 to 92.80. The genetic advance as percent of mean varied from 4.12 to 48.81 in E_1 , 9.64 to 53.19 in E_2 , 1.05 to 57.28 in E_3 and 9.14 to 74.17 in E_4 and in

pooled analysis, it varied from 5.41 to 55.17. High heritability coupled with high genetic advance was recorded for plant height, finger width, ear head weight, straw yield per plant, harvest index, 1000 grain weight and grain yield per plant for all the environment while, high heritability coupled with low genetic advance was observed in days to 50 % flowering for E₁. The yield is a complex and highly variable character and is a result of cumulative effect of its components characters and therefore, direct selection for yield may not be very effective. Thus, to bring changes in yield and other characters to a desired direction, proper understanding of association among the yield and yield contributing characters is must.

Conclusion

Based on present investigation experimental material consisting of 50 genotypes were studied to estimate the genetic variability for 15 characters. Genetic variability existence was confirmed by significant differences for different characters through ANOVA for all the environments as well as genotypic coefficient of variation. Hence, material has considerable genetic variability for selection program. High heritability coupled with high genetic advance was recorded for plant height, finger width, ear head weight, straw yield per plant, harvest index, 1000 grain weight and grain yield per plant for all the environments and pooled making these characters available for selection with sound direct selection parameters.

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Table 1: Fifty indigenous genotypes of finger millet.

S. No.	Genotypes	S. No.	Genotypes
1.	IC0476421	26.	IC0474840
2.	IC0475978	27.	IC0474862
3.	IC0476092	28.	IC0475053
4.	IC0474806	29.	IC0475798
5.	IC0475525	30.	IC0475678
6.	IC0476115	31.	IC0049949
7.	IC0283454	32.	IC0476418
8.	IC0475654	33.	IC0478776
9.	IC0346263	34.	IC0283451
10.	IC0478760	35.	IC0283409
11.	IC0476577	36.	IC0474089
12.	IC0475697	37.	IC0346264
13.	IC0476359	38.	IC0474887
14.	IC0476076	39.	IC0298448
15.	IC0475457	40.	IC0476818
16.	IC0321513	41.	IC0347254
17.	IC0475334	42.	IC0476303
18.	IC0476315	43.	IC0478720

19.	IC0476006	44.	IC0476242
20.	IC0298482	45.	IC0347252
21.	IC0475632	46.	VL324(CH)
22.	IC0476610	47.	VL380(CH)
23.	IC0478790	48.	VL352(CH)
24.	IC0475129	49.	VL376(CH)
25.	IC0347251	50.	VL379(CH)

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Table:2 Pooled analysis of variance for grain yield, its components and quality characters in finger millet.

Sources	D.F.	Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of productive tillers per plant	Number of Fingers per ear	Finger length (cm)	Finger width (cm)	Ear head width (cm)	Ear head length (cm)	Ear head weight (g)	Straw yield per plant (g)	Harvest Index (%)	1000 grain weight (g)	Protein content (%)	Grain yield per plant (g)
Genotypes	49	80.164**	146.146**	685.631**	0.342**	1.044**	3.002**	0.054**	0.016*	3.088**	19.917**	174.437**	127.610**	0.930**	1.285**	76.460**
Environments	3	1878.738**	8501.768**	4044.727*	23.185**	51.606**	33.488**	0.487**	0.021	0.637	19.897**	1476.092*	18.586*	21.746*	11.656**	360.433**
G × E	147	5.328	8.991	12.669*	0.141	0.399	0.141	0.003**	0.006	0.983	0.354*	12.582	6.167	0.128	0.088*	0.709
E+(G×E)	150	42.796**	178.846**	93.310**	0.601**	1.423**	0.808**	0.012**	0.006	0.977	0.745**	41.852**	6.415	0.555**	0.320**	7.903**
E (linear)	1	5636.214**	25505.304*	12134.182**	69.556**	154.818**	100.464**	1.461**	0.062*	1.911	59.691**	4428.276*	55.758*	64.427*	34.967**	1081.298*
G×E (linear)	49	6.318	12.324*	21.906**	0.106	0.409	0.137	0.006**	0.001	0.688	0.544**	12.981	6.537	0.152	0.145**	0.256
Pooled deviation	100	4.736	7.178	7.890*	0.155**	0.386**	0.140**	0.001	0.008**	1.108**	0.254**	12.135**	5.862**	0.114	0.059**	0.917**
Pooled Error	392	4.292	8.744	5.947	0.097	0.158	0.077	0.001	0.001	0.091	0.102	1.394	1.207	0.015	0.014	0.405

* Significant at 5%,

** Significant at 1%

*Significant at p = 0.05

**Significant at p = 0.01

G= Genotype, E=Environment

Table 3 : Mean, range, coefficient of variation, heritability, and genetic advance for grain yield, its component traits and protein content

S.No.	Characters		Mean	Range	GCV	PCV	Heritability in % (Broad sense)	Genetic advance (%of mean)
1.	Days to 50% flowering	E ₁	78.07	68.33-89.67	5.79	7.20	64.50	9.57
		E ₂	65.89	56.00-79.33	7.59	8.44	80.90	14.07
		E ₃	73.59	64.33-83.67	5.51	7.85	49.30	7.98
		E ₄	65.51	54.00-76.67	6.31	8.97	49.50	9.14
		P	70.77	60.67-81.67	6.14	8.07	57.90	9.63
2.	Days to maturity	E ₁	121.50	101.33-133.33	4.80	6.54	53.90	7.25
		E ₂	97.57	79.33-111.00	6.62	7.54	77.10	11.98
		E ₃	118.08	101.00-129.00	4.08	6.66	37.50	5.14
		E ₄	97.11	76.00-108.00	6.45	8.25	61.20	10.41
		P	108.56	90.33-118.08	5.40	7.18	56.50	8.36
3.	Plant height (cm)	E ₁	81.36	66.88-118.77	16.03	17.19	86.90	30.77
		E ₂	63.91	43.78-95.32	20.95	21.68	93.40	41.72
		E ₃	74.12	53.10-108.84	18.34	19.10	92.20	36.26
		E ₄	62.24	41.84-94.58	20.70	21.75	90.50	40.57
		P	70.40	52.27-99.81	18.49	19.72	87.90	35.71
4.	Number of productive tillers per plant	E ₁	3.27	2.33-3.67	6.13	18.78	10.70	4.12
		E ₂	2.43	1.67-3.67	10.80	24.95	18.80	9.64
		E ₃	2.05	1.00-3.00	20.54	33.25	38.20	26.14
		E ₄	1.69	1.00-2.33	17.90	33.89	27.90	19.48
		P	2.36	1.83-3.08	10.23	26.26	15.20	8.21

5.	Number of fingers per ear	E ₁	6.83	5.33-8.33	10.02	13.16	57.90	15.70
		E ₂	5.89	4.00-7.33	15.66	18.34	72.90	27.56
		E ₃	4.77	3.33-6.33	3.27	20.86	2.40	1.05
		E ₄	4.70	3.33-5.33	11.13	15.51	51.50	16.46
		P	5.55	4.33-6.42	8.17	16.85	23.50	8.16
6.	Finger length (cm)	E ₁	7.68	6.02-9.29	9.62	14.02	47.10	13.60
		E ₂	6.84	4.01-8.78	15.02	15.23	97.30	30.53
		E ₃	6.33	3.55-8.85	14.60	15.63	87.20	28.09
		E ₄	5.75	3.07-7.12	14.13	15.78	80.20	26.06
		P	6.65	4.16-8.37	12.82	15.12	71.90	22.39
7.	Finger width (cm)	E ₁	0.96	0.62-1.29	13.68	14.95	83.80	25.79
		E ₂	0.94	0.53-1.21	13.49	16.08	70.40	23.31
		E ₃	0.84	0.60-1.05	12.76	13.93	83.90	24.09
		E ₄	0.75	0.52-0.96	14.99	15.85	89.50	29.21
		P	0.87	0.57-1.10	13.11	15.30	73.40	23.13
8.	Ear head width (cm)	E ₁	1.28	1.10-1.44	5.91	7.16	68.10	10.05
		E ₂	1.26	1.06-1.44	7.26	7.79	86.80	13.93
		E ₃	1.24	1.06-1.47	5.96	8.20	52.80	8.91
		E ₄	1.23	1.03-1.43	7.49	9.20	66.20	12.55
		P	1.25	1.12-1.39	4.61	8.10	32.40	5.41
9.	Ear head length(cm)	E ₁	7.82	6.15-10.14	11.61	15.18	58.40	18.28
		E ₂	7.80	5.21-10.64	16.93	17.24	96.40	34.25
		E ₃	7.79	5.07-10.07	14.08	15.41	83.40	26.48
		E ₄	7.58	5.06-10.40	18.19	19.16	90.20	35.59

		P	7.75	6.28-10.27	10.71	16.79	40.70	14.07
10.	Ear head weight(cm)	E ₁	9.41	4.67-13.43	23.94	25.21	90.20	46.84
		E ₂	8.90	4.00-13.10	26.15	26.49	97.50	53.19
		E ₃	8.65	2.05-13.74	28.37	28.94	96.10	57.28
		E ₄	7.89	4.07-11.77	25.53	26.42	93.40	50.84
		P	8.71	4.35-12.75	25.50	26.79	90.60	50.01
11.	Straw yield per plant (g)	E ₁	35.27	19.28-51.47	21.97	22.96	91.60	43.31
		E ₂	33.92	14.42-49.64	25.36	26.24	93.40	50.49
		E ₃	29.78	14.15-41.67	21.90	22.66	93.50	43.62
		E ₄	23.18	10.17-33.23	23.62	24.77	91.00	46.40
		P	30.54	14.50-42.04	21.35	24.47	76.10	38.36
12.	Harvest index (%)	E ₁	34.49	19.84-45.12	15.51	16.03	93.60	30.92
		E ₂	33.10	17.30-45.33	17.45	18.32	90.70	34.24
		E ₃	34.18	22.95-45.30	16.57	17.80	86.60	31.75
		E ₄	33.65	19.77-45.26	20.43	21.31	91.90	40.35
		P	33.85	21.74-45.17	16.52	18.43	80.30	30.48
13.	1000 grain weight(g)	E ₁	2.95	1.83-4.11	23.95	24.95	92.20	47.36
		E ₂	2.56	1.17-3.91	21.09	23.11	83.30	39.64
		E ₃	2.12	1.06-3.56	27.14	29.81	82.90	50.89
		E ₄	1.43	0.91-2.10	25.43	26.21	94.20	50.84
		P	2.27	1.26-3.35	20.75	26.42	61.70	33.58
14.	Protein content (%)	E ₁	7.16	6.01-8.24	8.15	8.85	84.80	15.46
		E ₂	6.56	5.18-7.83	10.68	11.18	91.20	21.01
		E ₃	6.17	5.02-6.94	9.39	9.78	92.30	18.59

		E ₄	6.11	4.99-6.92	9.40	9.77	92.50	18.61
		P	6.50	5.39-7.41	8.61	9.91	75.40	15.40
15.	Grain yield per plant (g)	E ₁	18.53	9.74-27.47	24.28	24.88	95.30	48.81
		E ₂	16.58	8.12-23.50	26.00	27.05	92.40	51.49
		E ₃	15.50	7.09-24.10	27.63	28.73	92.40	54.71
		E ₄	12.12	3.11-19.70	36.74	37.50	96.00	74.17
		P	15.68	7.04-23.45	27.79	28.84	92.80	55.17

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