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Genetic variability studies for growth, yield and seed quality of finger millet (*Eleusine coracana* (L.) Gaertn)

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Abstract
The study evaluated forty advanced finger millet genotypes during the 2024-25 *Kharif* season at Dr. PDKV, Akola, to assess genetic variability, heritability, and genetic advance for 17 growth, yield and seed quality traits. Significant variation was recorded for all traits. High GCV and PCV values for productive tillers, panicle length, seed yield, and vigour index-II indicated strong genetic variability and good potential for selection. Heritability was notably high for all traits, including days to 50% flowering, plant height and seed yield suggesting the influence of additive gene effects. Traits such as days to 50% flowering, days to maturity, panicle length, total and productive tillers, 1000 seed weight, seed yield, seedling dry weight, vigour index and iron content exhibited high heritability combined with high genetic advance as a percentage of the mean. This indicates a predominance of additive gene action and highlights these traits as valuable targets for selection in breeding programs.

Keywords: Finger millet, genetic variability, heritability, genetic advance

Introduction

Eleusine coracana (L.) Gaertn., commonly called finger millet, Millets are highly nutritious, rich in protein, fibre, and essential minerals like calcium, iron, and magnesium, offering nutritional security, especially for women and children. Their adaptability to diverse agro-ecological zones and health benefits make them ideal for managing diabetes and cardiovascular diseases (Patil *et al.*, 2019) [15].

Finger millet (*Eleusine coracana* L.) is one of the three major cultivated millets, thriving in dryland and rainfed conditions. It stands out among small millets for its high calcium and dietary fibre content and is consumed in both raw and processed forms. In 2024-2025, finger millet covered 1.037 million hectares in India, producing 1.386 million tonnes at 1336 kg/ha productivity.

Low productivity is mainly due to poor-yielding cultivars and lack of stress-tolerant varieties (Madhavilatha *et al.*, 2021) [12]. Since many yield-related traits have higher heritability than seed yield itself, selection based on these traits is more effective (Johnson *et al.*, 1955b) [9]. To support breeding efforts, this study evaluated thirty nine finger millet genotypes along with one check for growth, yield and seed quality traits using GCV, PCV, heritability, and genetic advance.

Materials and Methods

Thirty nine genotypes of Finger Millet along with check Phule Nachani were selected. The trial conducted during the *Kharif* season of 2024-25 on the experimental field of the Department of Agricultural Botany, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. A randomized complete block design with three replications was used. Standard agronomic and plant protection practices were implemented as needed. In each replication, five plants per genotype were randomly selected. Observations on various traits were recorded, and the mean values were used for statistical analysis. Data was recorded for days to 50% flowering, days to maturity, plant height, panicle length, total number of tillers, number of productive tillers, 1000 seed weight, seed yield per plant, seed yield per plot, seed yield per hectare, seed germination percentage, seedling length, seedling dry weight, vigour index-I, vigour index-II protein content and iron content. Analysis of variance was done as per Panse and Sukhatme

(1967) [14]. PCV and GCV were calculated following Burton and Devane (1953) [6], broad-sense heritability as per Allard (1960) [1] and heritability and genetic advance were categorized according to Johnson *et al.* (1955) [9].

Results and Discussion

In the present investigation, analysis of variance was found to be significant for all the 17 characters studied. This indicates that there were significant differences among the genotypes for all the characters. These findings align with earlier results by Ganapathy *et al.* (2011) [8].

The mean performance for growth and yield contributing characters is presented in Table 1. The variation for the mean of the character days to 50% flowering in finger millet genotypes ranged from 53 days to 93 days. Days to maturity ranged from 77 days to 120 days. The plant height ranged from 78.33 cm to 116.26 cm. The panicle length ranged from 6.11 cm to 12.48 cm. The total number of tillers ranged from 3.46 to 7. The number of productive tillers ranged from 1.6 to 5.2. 1000 seed weight in finger millet genotypes were ranged from 1.91 g to 3.61 g. The seed yield per plant in finger millet genotypes were ranged from 3.52 g to 7.11 g. The seed yield per plot were ranged from 0.317 kg to 0.794 kg.

The mean performance for seed quality and nutrient quality traits is presented in Table2. The variation for the mean of character seed germination percentage ranged from 63.33% to 95.66%. The seedling length for genotypes were ranged from 7.36 cm to 14.76 cm. The seedling dry weight were ranged from 9.26 mg to 19.43 mg. The vigour index-I values were ranged from 466 to 1363.13. The vigour index-II values were ranged from 0.586 to 1.794. The biochemical analysis character like protein content was ranged between 6.92% to 8.75%. The iron content showed the range from 2.31 mg/100g to 3.95 mg/100g.

Genotypes such as IC369704 IC403069, IC403086 and IC369714 showed superior performance like high seed yield per plant, number of productive tillers, 1000 seed weight, seed germination percentage, protein and iron content. These results are consistent with those reported by Mahanthesha *et al.* (2017) [13] and Anand *et al.* (2024) [2].

The estimates of genetic variability parameters are presented in Table 3. The estimates of phenotypic coefficient of variation (PCV) were higher than the genotypic coefficient of variation showing that the apparent variation was not only due to genotypes but also due to the influence of environment.

Genotypic as well as phenotypic coefficients of variation were highest for panicle length, number of productive tillers, seed yield per plot, seed yield per hectare and vigour index-II indicating the presence of high degree of variability and better scope for selection of desirable genotypes. Similar results were founded by Anusha Udamala *et al.* (2022) [18], S. Ganapathy *et al.* (2011) [8], Ashok Singamsetti *et al.* (2018) [17].

Moderate values for GCV and PCV were obtained by the characters, days to 50 percet flowering, days to maturity, total number of tillers, 1000 seed weight, seed yield per plant, seedling length, seedling dry weight, vigour index-I and iron content. Similar results were founded by Anusha Udamala *et al.* (2022) [18], S. Ganapathy *et al.* (2011) [8], Ashok Singamsetti *et al.* (2018) [17], Kebere Bezaweletaw *et al.* (2006) [5], Ravikanth Bendi and Sarma (2017) [4].

Low GCV and PCV estimates were observed for plant height, seed germination% and protein content indicating that these characters were less variable among these genotypes. Similar results were founded by Anusha Udamala *et al.* (2022) [18], N Anuradha *et al.* (2020) [3].

High estimates of heritability in broad sense were recorded for days to 50% flowering followed by plant height, days to maturity, seed germination%, vigour index-II, 1000 seed weight, seedling dry weight, panicle length, seed yield per plot, number of productive tillers, seed yield per hectare, iron content, seed yield per plant, protein content, total number of tillers, vigour index-I and seedling length indicated that these characters are largely governed by additive gene and selection for improvement of such characters could be rewarding. These results are supported by Ketema *et al.* (2023) [11], Divya *et al.* (2022) [7], Patel *et al.* (2024) [15], and Keerthana *et al.* (2019) [10].

High genetic advance as percent of mean was observed for number of productive tillers, panicle length, vigour index-II, seed yield per plot, seed yield per hectare, 1000 seed weight, seedling dry weight, seed yield per plant, iron content, total number of tillers, days to 50% flowering, seedling vigour index-I, days to maturity which indicated that maximum genetic gain can be received by using these characters that are transmitted from parent to their progeny. These results equivalent to C. Priyadharshini *et al.* (2011) [16], Ashok Singamsetti *et al.* (2018) [17], S. Ganapathy *et al.* (2011) [8].

High heritability combined with high genetic advance as a percentage of the mean was recorded for several growth, yield and seed quality traits, including days to 50% flowering, days to maturity, panicle length, total number of tillers, number of productive tillers, 1000 seed weight, seed yield per plant, seed yield per plot, seed yield per hectare, seedling dry weight, vigour index-I, vigour index-II, and iron content. This suggests the predominance of additive gene action and strong potential for effective genetic improvement through selection. Similar results had been reported by Keerthana *et al.* (2019) [10], Udamala *et al.* (2022) [18], Madhavilatha *et al.* (2021) [12], Divya *et al.* (2022) [7], Patel *et al.* (2024) [15], Ketema *et al.* (2023) [11].

Table 1: Mean performance of finger millet genotypes for growth and yield contributing traits

Sr. No.	Genotypes	Days to 50% flowering	Days to maturity	Plant height (cm)	Panicle Length (cm)	Total no. of tillers	No. of Productive tillers)	1000 Seed weight (g)	Seed yield per Plant (g)	Seed yield per Plot (kg)	Seed yield per hectare (qt)
1	IC402960	70	96	108.5	7.51	5.86	3.93	2.23	4.56	0.506	14.07
2	IC402961	71	98	96.4	6.26	4.53	2.46	2.36	4.41	0.477	13.24
3	IC402962	73.33	98	97.46	7.1	6.96	4.46	3.23	4.8	0.508	14.12
4	IC402963	69.33	95.33	96.36	6.26	5.16	3.43	2.08	4.27	0.486	13.51
5	IC402974	56	77.66	88.26	6.47	4.36	2.03	2.27	4.46	0.469	13.02
6	IC403035	57	78	100.26	7.56	5.36	4.03	2.66	4.8	0.528	14.66
7	IC403036	70	99	98.23	6.26	4.51	2.1	2.24	4.4	0.462	12.82
8	IC403064	75	100.66	99.56	6.14	3.7	1.86	2.13	3.96	0.349	9.69
9	IC403067	78	104	100.83	7.5	4.33	2.03	1.98	4.9	0.509	13.15
10	IC403068	93.33	120.66	116.26	12.4	5.66	3.36	1.92	4.66	0.476	13.21
11	IC403069	74.33	98.66	98.5	8.2	6.53	4.36	3.13	6.51	0.722	20.07
12	IC403072	71	96.33	109.4	8.8	5.46	3.43	2.13	4.84	0.54	15.02
13	IC403076	75	99.33	95.2	6.11	5.56	3.33	2.24	4.36	0.393	10.91
14	IC403082	92.66	116.66	109.36	10.36	6.5	4.5	2.83	5.96	0.572	15.9
15	IC403086	66.66	92	87.63	6.33	6.83	4.66	3.18	6.56	0.709	19.69
16	IC403087	55.33	80.66	88.13	6.33	5.43	2.3	2.3	5.8	0.603	14.09
17	IC403092	75	103.33	97.26	7.56	6.46	4.4	2.9	6.18	0.668	18.55
18	IC403093	87.66	107.66	100.3	7.13	6.5	4.46	2.75	5.61	0.584	16.22
19	IC403206	71	97.33	103.4	8.83	5.63	3.66	2.45	5.41	0.584	16.22
20	IC403219	57.33	85	112.33	12.13	7	4.63	3.61	6.99	0.769	19.02
21	IC403328	74.33	98.33	90.26	6.13	3.7	1.6	1.91	3.52	0.317	8.8
22	IC345017-X	74.66	100.66	101.46	10.2	6.4	4.56	2.73	5.8	0.568	15.78
23	IC345026-X	73.33	99.66	89.4	7.33	4.1	2.8	2.1	3.97	0.421	11.7
24	IC345029-X	53.33	81.66	91.33	8.1	5.4	3.46	2.46	5.2	0.478	13.28
25	IC345035-X	58	85	91.43	6.33	6.4	4.46	2.84	6.3	0.68	18.89
26	IC273708	73.33	99	78.33	6.12	4.8	2.73	2.13	4.08	0.383	10.65
27	IC345138-X	82.66	106.33	104.26	10.2	5.53	3.8	2.41	5.23	0.476	13.22
28	IC342922	72	97.66	88.43	6.16	6.46	3.53	2.1	5.2	0.525	14.58
29	IC344161	84	106.33	103.26	10.2	6.4	4.5	2.41	5.83	0.6	16.01
30	IC344203	69	96.66	89.36	6.73	6.43	4.26	3.12	6.54	0.674	18.05
31	IC344213	73	99.33	87.53	6.09	3.46	1.73	1.96	3.8	0.342	9.49
32	IC369612	87.66	116	104.36	10.45	6.6	4.46	2.85	6.2	0.545	15.15
33	IC369644	58	87.66	81.46	6.96	4.16	2.26	2.3	4.28	0.321	8.92
34	IC369704	73.33	99.33	87.4	6.86	6.46	4.86	3.52	6.97	0.794	22.07
35	IC369714	71	97	89.7	6.93	6.53	5.2	3.61	7.11	0.711	19.76
36	IC369731	73.33	98	91.86	8.13	3.96	1.76	2.16	5.03	0.488	13.55
37	IC369770	66.66	92.33	85.53	9.46	6.5	4.26	3.13	6.43	0.675	18.75
38	IC370816	57	86	90.2	8.83	4.63	2.5	2.49	5.2	0.53	14.72
39	IC382697	79.66	109	107.26	11.43	5.53	3.466	2.82	6.02	0.674	18.72
40	Phule Nachani	92.33	119.33	115.26	12.48	5.93	4.4	2.93	6.1	0.671	17.3
	SE (m$\pm$)	0.718	0.786	0.653	0.388	0.299	0.22	0.091	0.248	0.024	0.702
	CD @ 5%	2.02	2.213	1.839	1.093	0.842	0.62	0.257	0.699	0.07	1.977

Table 2: Mean performance of finger millet genotypes for seed quality and biochemical traits

Sr. No.	Genotypes	Seed Germination%	Seedling Length (cm)	Seedling Dry Weight (gm)	Vigour Index-I	Vigour Index-II	Protein Content%	Iron (mg/100 g)
1	IC402960	93	13.4	16.06	1246.8	1.494	7.1	2.31
2	IC402961	90	11.2	11	1008.13	0.989	7.16	2.43
3	IC402962	89.33	12	12.2	1073	1.088	8.4	3.51
4	IC402963	95.66	11.3	12.33	1081	1.18	7.08	2.42
5	IC402974	88.33	12.66	12.93	1119.6	1.142	7.05	2.31
6	IC403035	92	12.7	12.73	1168.53	1.172	7.09	2.42
7	IC403036	88	11.6	12.26	1020.93	1.079	7.61	2.63
8	IC403064	74	10.6	11	784.66	0.813	7.07	2.42
9	IC403067	87.66	14	16.5	1228.16	1.447	6.93	2.61
10	IC403068	85	14.4	18.33	1224.2	1.557	6.98	2.71
11	IC403069	93	12.3	11	1143.76	1.022	8.46	3.81
12	IC403072	93	11.8	12	1095.9	1.116	7.23	2.62
13	IC403076	75.66	11.6	12	877.13	0.907	7.3	2.72
14	IC403082	80	14.53	18.33	1163.4	1.465	7.52	3.91
15	IC403086	90	12.8	12.26	1153.33	1.104	8.13	3.95
16	IC403087	87	11.43	12.2	994.43	1.06	7.4	2.37
17	IC403092	90.33	11.2	11	1011.8	0.993	7.87	2.48
18	IC403093	87	13.16	18.2	1145.23	1.581	8.43	3.85
19	IC403206	90.33	13.93	18.2	1258.73	1.644	7.17	2.71
20	IC403219	92.33	14.76	19.43	1363.13	1.794	8.56	3.95
21	IC403328	75.66	12.65	12.3	957.18	0.93	6.93	2.81
22	IC345017-X	82.66	12.76	13.16	1055.3	1.088	7.43	3.61
23	IC345026-X	89.33	12.6	13.1	1125.73	1.17	7.11	2.65
24	IC345029-X	77	12.5	12.8	962.46	0.985	7.4	2.85
25	IC345035-X	90	12	12	1082.73	1.08	8.6	2.35
26	IC273708	79.33	13.5	14.06	1071.2	1.115	7.12	2.95
27	IC345138-X	76.33	12.2	12	933.26	0.916	7.43	2.73
28	IC342922	84.33	11.7	11.2	986.9	0.943	7	3.51
29	IC344161	86	12.83	12.43	1103.33	1.068	7.11	2.81
30	IC344203	85.33	12.4	13.2	1058.4	1.126	8.41	2.85
31	IC344213	75	11.6	12.06	872.11	0.904	6.92	2.53
32	IC369612	74.33	13.86	14.2	1031	1.055	8.33	2.95
33	IC369644	63.33	7.36	9.26	466	0.586	7.4	2.81
34	IC369704	95.66	11.16	12.33	1067.96	1.18	8.15	3.82
35	IC369714	84.33	11.76	13.03	992.26	1.099	8.75	3.45
36	IC369731	81.33	12.6	13.16	1025.46	1.071	7.13	2.75
37	IC369770	88	11.9	13.5	1047.06	1.185	8.12	2.75
38	IC370816	85.66	11.96	12.63	1025.56	1.083	7.41	2.85
39	IC382697	94.66	13.73	16.46	1299.66	1.559	8.18	3.61
40	Phule Nachani	92.66	14.46	18.36	1341.2	1.701	8.16	2.99
	SE (m ±)	1.065	0.497	0.489	47.534	0.0429	0.149	0.117
	CD @ 5%	2.997	1.398	1.377	133.71	0.1208	0.421	0.33

Table 3: Estimates of genetic parameters in finger millet genotypes

Sr. No.	Characters	Range	Mean	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance (GA)	Genetic Advance as percent of mean (%)
1	Days to 50% flowering	53.33-93.33	72.14	14.38	14.48	98.58	21.22	29.41
2	Days to maturity	77.66-120.66	97.99	10.48	10.57	98.27	20.98	21.41
3	Plant Height (cm)	78.33-116.26	96.79	9.49	9.57	98.50	18.79	19.41
4	Panicle Length (cm)	6.09-12.48	8.01	23.77	25.21	88.89	3.70	46.18
5	Total no. of tillers	3.46-7	5.54	17.81	20.12	77.82	1.80	32.49
6	No. of Productive tillers	1.6-5.2	3.50	29.38	31.34	87.90	1.99	56.75
7	1000 seed wt (gm)	1.91-3.61	2.56	18.47	19.48	89.93	0.93	36.09
8	Yield/plant (gm)	3.52-7.11	5.31	17.87	19.63	82.91	1.78	33.53
9	Yield/plot (kg)	0.317-0.794	0.545	22.27	23.64	88.74	0.24	43.21
10	Yield/ha (qt)	8.8-22.07	14.91	21.60	23.09	87.50	6.21	41.62
11	Seed Germination%	63.33-95.66	85.56	8.43	8.70	93.84	14.39	16.81
12	Seedling Length (cm)	7.36-14.76	12.42	10.01	12.17	67.58	2.11	16.95
13	Seedling Dry wt (mg)	9.26-19.43	13.53	18.31	19.35	89.51	4.83	35.68
14	Vigour Index I	466-1363.13	1066.66	14.11	16.08	76.97	272.05	25.50
15	Vigour Index II	0.586-1.794	1.16	22.05	22.96	92.22	0.51	43.61
16	Protien Content%	6.92-8.75	7.59	7.43	8.18	82.55	1.06	13.90
17	Iron (mg/100g)	2.31-3.95	2.94	17.43	18.75	86.41	0.98	33.37

(PCV = Phenotypic coefficient of variation GCV = Genotypic coefficient of variation)

Conclusion
The present investigation revealed significant genetic variability among the forty finger millet genotypes for all studied traits. High genotypic and phenotypic coefficients of variation were observed for traits such as the number of productive tillers, panicle length, seed yield per plot, seed yield per hectare, and vigour index-II, indicating ample scope for selection. High heritability combined with high genetic advance as a percentage of the mean was recorded for several growth, yield and seed quality traits, including days to 50% flowering, days to maturity, panicle length, total and productive tillers, 1000 seed weight, seed yield per plant, seed yield per plot, seed yield per hectare, seedling dry weight, vigour index and iron content. This suggests the predominance of additive gene action and strong potential for effective genetic improvement through selection. Notably, genotypes IC369704, IC403069, IC403086 and IC369714 demonstrated superior performance for seed yield and other key traits, making them promising candidates for future breeding programs. These findings provide a valuable genetic foundation for improving yield and quality traits in finger millet, supporting the development of high-yielding, nutrient-rich varieties for sustainable agriculture and enhanced food security.

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