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Genetic variability studies on yield and quality characters in finger millet [*Eleusine coracana* (L.) Gaertn.]

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ABSTRACT

The present investigation was carried out to assess the nature and magnitude of genetic variability of nineteen yield attributing traits in 35 finger millet germplasm. The experiment was laid out in Randomized Complete Block Design at Agricultural college farm, Bapatla during *Kharif*, 2021. The analysis of variance showed highly significant differences among the genotypes for all the characters studied, indicating the presence of adequate variability. Further, coefficient of variation studies indicated that the estimates of GCV were lesser than the corresponding PCV values for all the traits indicating the influence of environment on expression of these characters and therefore phenotypic selection will be misleading. High PCV and GCV were recorded for grain iron, zinc and manganese contents indicating the existence of high variability. High heritability, along with high expected genetic advance as percent of mean, was observed for number of leaves per main tiller, finger width, test weight, grain iron, zinc and manganese contents implying that these traits were under probable control of additive gene effects and simple selection is sufficient to improve these traits.

Key words: *Expected genetic advance, Finger millet, GCV, Grain micronutrients content, Heritability, PCV and Variability.*

Finger millet (*Eleusine coracana* (L.) Gaertn.) is one of the most important small millets grown in eastern and southern Africa. Finger millet is very nutritious with good quality protein, minerals, dietary fibres and vitamins. The grains are known for having 5-30 times higher calcium content than that of other cereals (National Research Council, 1996). Hence, it serves as a subsistence and food security crop that is especially important for its nutritive and cultural value. For improvement of finger millet, study on genetic variability of important traits responsible for grain yield is essential.

Knowledge on heritability and genetic advance of the character indicate the scope for the improvement of a trait through selection. However, to carry out effective selection, the information on available genetic variation among finger millet genotypes, the nature of component traits on which selection would be effective and the influence of environmental factors on each trait need to be known (Jaleta *et al*., 2011). Hence, heritability estimates along with genetic advance are helpful in predicting the genetic gain under selection (Johnson *et al.*, 1955). Hence, the present study aims at determining the heritable and non-heritable variation of yield and its contributing traits.

Material and Methods

In the present investigation, 35 finger millet genotypes were evaluated at Agricultural college farm, Bapatla, Andhra Pradesh during *kharif*, 2021. Genotypes were sown in Randomized Complete Block Design in three replications with a spacing of 22.5 × 10 cm per each entry. Each genotype was grown in 2 rows of 3 m length. Fertilizers, 50-40-25 NPK kg/ha and need based plant protection measures were taken to raise a healthy crop. Observations were recorded on various quantitative characters *viz*., days to 50% flowering, plant height, flag leaf length, flag leaf width, leaves per main tiller, ear length, finger length, fingers per ear, finger width, tillers per plant, productive tillers per plant, days to maturity and test weight. The quality parameters *viz*., grain iron content, grain zinc content, grain calcium content, grain manganese content, grain copper content and grain yield per plant were estimated as per Tandon (1999) for grain iron, zinc, manganese, copper and Jackson (1967) for grain calcium content.

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). Heritability and genetic advancement were categorized into low, medium and high as per Johnson *et al.*, (1955).

Results and Discussion

In the present study the analysis of variance revealed significantly high differences among the genotypes for all the traits under study are presented in Table 1, which indicates the presence of sufficient variability and provide scope for exploitation of characters for further selection in breeding program. The mean, range of variation and the estimate of genetic parameters such as heritability in broad sense, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and expected genetic advance as per cent of mean are presented in Table 2.

The variation for number of days taken to 50% flowering ranged from 58 days to 85 days with a mean of 67.99 days. Plant height ranged from 51.80 cm to 109.50 cm with a mean of 79.86 cm. The flag leaf length varied from 24.20 cm to 45.20 cm with a mean of 36.45 cm. The variation for flag leaf width ranged from 0.62 cm to 1.34 cm with a mean of 0.96 cm. The range of variation for leaves per main tiller varied from 7.20 to 14.60 and with a mean of 10.41.

Ear length varied from 5.92 cm to 11.87cm with a mean of 8.46 cm. The variation in finger length ranged from 4.83 cm to 9.80cm with a mean of 7.22 cm. In an ear, number of fingers ranged from 4.00 to 8.40 with a mean of 6.48. The variation in finger width ranged from 0.46 cm to 1.17 cm and with a mean of 0.81 cm. The range of variation for number of tillers per plant varied from 1.60 to 4.00 with a mean of 2.46. Productive tillers per plant ranged from 1.00 to 3.00 with a mean of 1.63. Days to maturity is another important character having a variation ranging from 90 days to 115 days with a mean of 103.60 days. Test weight on the other hand has shown a variation ranging from 1.42 g to 4.05 g with a mean of 2.26 g.

The grain iron content of the studied genotypes ranged from 0.69 mg to 7.34 mg with a mean of 3.49 mg. Similarly it was 0.71 mg to 5.32 mg for grain zinc content with a mean of 2.68 mg, 0.00 mg to 2.39 mg for grain manganese content with a mean of around 1.36 mg, 0.07 mg to 0.27 mg for grain copper content with a mean of 0.16 mg, 137.00 mg to 529.00 mg for grain calcium content with a mean of 334.30 mg and 8.28 g to 25.42 g for grain yield per plant with a mean of around 14.61 g.

The experimental material had wide range of variability and favourable mean performance for most of the traits studied and these possible combinations could be exploited for simultaneous improvement of grain yield and other yield attributing traits.

The PCV was higher in magnitude than the magnitude of GCV for all the traits, indicating the presence of influence of environment on the expression of these traits. High estimates of PCV and GCV were observed for grain iron (39.73, 35.01), zinc (35.01, 28.76) and manganese (34.01, 29.56) contents, respectively. This meant that genotypes had a great deal of intrinsic variability, making them more useful for selection. Likewise, high estimates of variability were also reported by Gopal *et al*. (2021) for grain iron, zinc and manganese contents which corroborates with the findings of the present study.

High to moderate co-efficient of variation was observed for productive tillers per plant (25.87, 17.82), grain copper content (24.69, 18.63), grain yield per plant (24.06, 17.95), grain calcium content (23.44, 16.69) and finger width (20.03, 15.66). Similar findings were observed in the studies of Udamala *et al*. (2020) for productive tillers per plant; Aralikatti and Chaturvedi (2020) for grain yield per plant; Bhavsar *et al*. (2020) for grain calcium content and Arunprabhu *et al*. (2008) for finger width.

Among the studied traits, test weight (19.58, 15.26), leaves per main tiller (15.07, 13.35), fingers per ear (15.07, 11.57) and finger length (14.38, 11.26) had moderate PCV and GCV values indicating moderate genetic variability for these characters. Whereas, moderate PCV to low GCV was observed for tillers per plant (19.65, 8.09); ear length (14.18, 9.53); plant height (14.82, 8.71); flag leaf length (12.19, 6.74) and flag leaf width (12.64, 5.84) indicating the existence of less amount of variation among the genotypes which is in agreement with the findings Gopal *et al*. (2021) for test weight; Mahanthesha *et al*. (2017) for leaves per main tiller; Divya *et al*. (2022) for fingers per ear, finger length and plant height; Sao *et al*. (2016) for tillers per plant; Anuradha *et al*. (2017) for ear length; Anuradha *et al*. (2020) for flag leaf length and flag leaf width. Low GCV and PCV was noticed for days to 50% flowering (7.78, 7.32) and days to maturity (4.39, 4.00) indicating a limited range of variability for these traits, limiting the possibilities for effective selection. Similar kind of findings were also reported Divya *et al*. (2022) for days to 50% flowering and days to maturity.

The proportion of variability transferred from parent to offspring could be studied by calculating heritability parameters. Heritability estimates ranged from 16.96 (Tillers per plant) to 88.52 (Days to 50% flowering). Heritability estimates coupled with expected genetic advance as per cent of mean indicates the probable mode of gene action and assist in choosing an appropriate breeding methodology. High heritability coupled with high expected genetic advance as per cent of mean was observed for leaves per main tiller (78.49, 24.37), grain iron (77.65, 63.56), manganese (75.54, 52.93) contents, finger width (61.16, 25.23), test weight (60.75, 24.51) and grain zinc (67.49, 48.67) content, indicating the presence of additive gene action and scope for genetic improvement through simple selection for these traits. Such results were also indicated: by Gopal *et al*. (2021) for grain iron, manganese, zinc contents and test weight; and by Udamala *et al*. (2020) for finger width.

High heritability and moderate expected genetic advance as per cent of mean was observed for days to 50% flowering (88.52, 14.19) and finger length (61.30, 18.16), whereas, days to maturity recorded high heritability (82.80) and low expected genetic advance as percent of mean (7.49) indicating the operation of both additive and non additive gene action and simple selection is ineffective. Such results were also reported by Divya *et al*. (2022) for days to 50% flowering; Anuradha *et al*. (2020) for finger length; and Gopal *et al*. (2021) for days to maturity.

Moderate heritability and high expected genetic advance as percent of mean were reported for grain copper content (56.93, 28.96), grain yield per plant (55.65, 27.58), grain calcium content (50.71, 24.48) and productive tillers per plant (47.46, 25.29) revealing the operation of both additive and non additive gene action and simple selection is ineffective; moderate heritability coupled with moderate expected genetic advance as percent of mean was observed for fingers per ear (58.96, 18.30), ear length (45.20, 13.20) and plant height (34.57, 10.55) indicating the presence of non additive gene action and improvement through simple selection is not rewarding. These findings are in conformity with Lule *et al*. (2012) for grain yield per plant; Dhanalakshmi *et al*. (2013) for productive tillers per plant; Singamsetti *et al*. (2018) for fingers per ear; Anuradha *et al*. (2017) for ear length; Wolie *et al*. (2013) for plant height; and Gopal *et al*. (2021) for grain copper and calcium content for high genetic advance.

Moderate heritability and low expected genetic advance as percent of mean was recorded by flag leaf length (30.65, 7.69). While, flag leaf width (21.38, 5.56) and tillers per plant (16.96, 6.86) recorded low heritability and low expected genetic advance as percent of mean, indicating the operation of non additive gene action in governing the inheritance of this character. These results are in consonance with Bezaweletaw *et al*. (2006) for flag leaf width; Sao *et al*. (2016) for tillers per plant for low heritability and Anuradha *et al*. (2020) for flag leaf length for moderate heritability.

Analysis of variance revealed substantial differences among genotypes for all the traits with sufficient variability and scope for selecting suitable genotypes. In the current study it is clear that grain iron, zinc and manganese contents had high variability among the genotypes. The traits, leaves per main tiller, finger width, test weight, grain iron, zinc and manganese contents had high heritability, genetic advance as percent of mean and these may be controlled by additive gene action, hence simple selection among genotypes with respect to these traits would be effective.

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Table-1. Analysis of variance for grain yield and quality characters in finger millet in Bapatla location

Source of Variations	d. f	Days to 50% flowering	Plant height	Flag leaf length	Flag leaf width	Leaves per main tiller	Ear length	Finger length
		Mean sum of squares						
Treatments	34	77.578 **	237.011 **	31.8633 **	0.021 *	6.331 **	2.743 **	2.402 **
Replications	2	14.657 *	219.093 *	51.442 *	0.022	0.208	0.409	0.279
Error	68	3.216	91.694	13.699	0.011	0.530	0.789	0.418

Source of Variations	d. f	Fingers per ear	Finger width	Tillers per plant	Productive tillers per plant	Days to maturity	Test weight	Seed iron content
		Mean sum of squares						
Treatments	34	2.077 **	0.058 **	0.314 *	0.347 **	55.094 **	0.436 **	4.919 **
Replications	2	2.287 *	0.002	0.426	0.074	12.686 *	0.231 *	0.228
Error	68	0.391	0.010	0.195	0.094	3.568	0.077	0.431

Source of Variations	d. f	Seed zinc content	Seed manganese content	Seed copper content	Seed calcium content	Grain yield per plant
		Mean sum of squares				
Treatments	34	2.066 **	0.536 **	0.003 **	12368.996 **	26.107 **
Replications	2	0.626	0.729 **	0.004 **	658.295	7.075
Error	68	0.286	0.052	0.001	3026.962	5.480

* Significant at 5% level ** Significant at 1% level

Table-2. Estimates of variability, heritability and expected genetic advance as per cent of mean for grain yield and quality components in finger millet

S.No.	Character	Mean	Range		Coefficient of Variation		Heritability (broad sense) (%)	Expected Genetic advance as % of mean
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Days to 50% flowering	67.99	58.00	85.00	7.78	7.32	88.52	14.19
2	Plant height (cm)	79.86	51.80	109.50	14.82	8.71	34.57	10.55
3	Flag leaf length (cm)	36.45	24.20	45.20	12.19	6.74	30.65	7.69
4	Flag leaf width (cm)	0.96	0.62	1.34	12.64	5.84	21.38	5.56
5	Leaves per main tiller	10.41	7.20	14.60	15.07	13.35	78.49	24.37
6	Ear length (cm)	8.46	5.92	11.87	14.18	9.53	45.20	13.20
7	Finger length (cm)	7.22	4.83	9.80	14.38	11.26	61.30	18.16
8	Fingers per ear	6.48	4.00	8.40	15.07	11.57	58.96	18.30
9	Finger width (cm)	0.81	0.46	1.17	20.03	15.66	61.16	25.23
10	Tillers per plant	2.46	1.60	4.00	19.65	8.09	16.96	6.86
11	Productive tillers per plant	1.63	1.00	3.00	25.87	17.82	47.46	25.29
12	Days to maturity	103.60	90.00	115.00	4.39	4.00	82.80	7.49
13	Test weight (g)	2.26	1.42	4.05	19.58	15.26	60.75	24.51
14	Grain iron content (mg/100g)	3.49	0.69	7.34	39.73	35.01	77.65	63.56
15	Grain zinc content (mg/100g)	2.68	0.71	5.32	35.01	28.76	67.49	48.67
16	Grain manganese content (mg/100g)	1.36	0.00	2.39	34.01	29.56	75.54	52.93
17	Grain copper content (mg/100g)	0.16	0.07	0.27	24.69	18.63	56.93	28.96
18	Grain calcium content (mg/100g)	334.30	137.00	529.00	23.44	16.69	50.71	24.48
19	Grain yield per plant (g)	14.61	8.28	25.42	24.06	17.95	55.65	27.58

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

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