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Genetic variability studies for yield and nutritional traits in foxtail millet (*Setaria italica* (L.) Beauv.)

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Abstract
The present study was carried out to assess the nature and magnitude of genetic variability for yield and quality related traits in 76 genotypes of foxtail millet, carried at Agricultural college farm, Bapatla during *kharif*, 2019-2020. The analysis of variance revealed presence of significant differences for all the triats under study, indicating that the genotypes under study were genetically diverse for most of the traits. 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 the characters under study. Most of the traits *viz.*, SCMR at grain filling stage, plant height, panicle length, number of productive tillers/plant, 1000 grain weight, protein, calcium, iron, zinc, copper, manganese, antioxidant activity and grain yield per plant recorded moderate PCV and GCV. High variability and high heritability coupled with high genetic advance as per cent of mean was observed for characters *viz.*, plant height, panicle length, number of productive tillers per plant, SCMR at grain filling stage, zinc content, copper content, iron content, manganese content, protein content, calcium content, antioxidant activity and grain yield per plant indicating the predominance of additive gene action. Hence, direct phenotypic selection may be useful with respect to these traits for further improvement in foxtail millet breeding programmes.

Keywords: foxtail millet, genetic advance, heritability and variability

Introduction
Foxtail millet is one of the oldest and important ethnic small millet crop cultivated for food, hay, pasture and grain. The naming of this taxon evolved as this millet is having panicles resembling foxtail in appearance that are long with soft, long and erect hairs. It is a short day C_4 crop with wide adaptability in diverse agro-ecologies of the tropics and is cultivated without supplementary irrigation by small scale farmers. Besides it plays an important role in the dietary needs as it is nutritionally superior and is miles ahead compared to widely promoted cereals in terms of proteins, minerals and vitamins (Sapkota *et al.*, 2016) [10]. The millet contains protein (10-12%), fat (4.7%), carbohydrate (69.95%), minerals (Fe, Zn, K, Ca, Mn and Mg), antioxidants, phytochemicals, vitamins with low glycemic index (Murugan and Nirmalakumari, 2006) [8].

Genetic variability is the basis for any breeding programme as it is important for any population to adopt to the inevitable changes in the environment and helps to promote the survival of the species. As creation of variability being the essence of any plant breeding programme, any approach adopted strategically to create variation plays an important role in reaching the targets. For this, knowledge on the magnitude of variability present in a crop species for different traits is important, as it provides the basis for effective selection. It is also a pre requisite before initiating any breeding programme aimed at improving yield and quality characters under consideration.

Heritability measures the relative amount of the heritable portion of variability. But as heritability is also influenced by environment, the information on heritability alone fails to indicate response to selection and may not help in pin pointing characters enforcing selection. The heritability estimates along with genetic advance will be more reliable in formulating suitable and effective breeding methods. Heritability gives the information on the magnitude of inheritance of quantitative traits, while genetic advance will be helpful in formulating suitable selection procedures (Johnson *et al.*, 1955) [5].

Material and Methods
The present study on 71 foxtail millet genotypes including five checks was carried out during *Kharif*, 2019 at Agricultural College Farm, Bapatla, and Andhra Pradesh. The experiment was carried out in Augumented Randomised Complete Block Design (ARCBD).

All the recommended package of practices and need based plant protection measures were taken up to raise a healthy crop. The data was collected on five randomly selected plants per genotype for 18 metric traits *viz.*, days to 50% flowering, plant height, panicle length, number of productive tillers per plant, days to maturity, 1000 grain weight, SCMR at vegetative stage, SCMR at flowering stage, SCMR at grain filling stage, iron, zinc, copper, manganese, protein, calcium, magnesium, antioxidant activity and grain yield per plant. However, days to 50 per cent flowering and days to maturity was recorded on plot basis. PCV, GCV values were classified as described by Sivasubramanian and Menon (1973) [12]. Heritability in the broad sense was categorised as per the classification given by Johnson *et al.*, (1955) [5].

Results and discussion

Genetic variability, Heritability and Genetic advance

In the present study, analysis of variance revealed significant differences among the genotypes (Table 1). It also indicated considerable amount of variation in experimental material providing an opportunity for plant breeder to undertake breeding procedures *via* hybridization. The estimates of mean, range, PCV, GCV, heritability (h^2 bs) and genetic advance as per cent of mean (GAM) for foxtail millet genotypes were presented in Table 2 and Table 3.

In general wide range of variation provides an ample scope for selection of superior and desirable genotypes (Reddy *et al.*, 2013). For days to 50% flowering, the values ranged from 31.00 days (SiA 3222) to 52.00 days (SiA 4038) with a mean of 47.00 days. The genotype SiA 3222, was early in flowering compared to other genotypes including five checks indicating the importance of this genotype as parent in development of short duration varieties. The mean values for plant height varied from 89.00 cm (SiA 4059) to 154.00 cm (SiA 4034) with a mean of 114.26 cm. Plant height is a significant growth attribute directly linked with productive prospective of plant in terms of forage yield suggesting their suitability as fodder. The panicle length ranged from 10.60 cm (SiA 3995, SiA 4006, SiA 3700, SiA 4074) to 22.40 cm (SiA 4015) with a mean of 13.67 cm. In general, with increase in panicle length there is a chance of good exertion during anthesis time, aiding in better pollination. This helps in better seed set, seed filling and is represented through a positive increase in seed yield and seed weight. The range for number of productive tillers per plant was between 1.0 (SiA 3222) and 5.00 (SiA 4015, SiA 3292, SiA 3295, SiA 4044) with a mean of 3.00. This character directly contributes to higher yields owing to the fact that there will be substantial increase in panicle number. The mean values for days to maturity varied from 60.00 days (SiA 3222) to 87.00 days (SiA 3399) with a mean of 79.00 days. The genotype SiA 3222 with low days to 50 % flowering and days to maturity can be used in crop improvement programme especially in drought environmental conditions as it helps to escape drought due to early maturity. The mean values of test weight ranged from 2.10 g (SiA 3334) to 3.73 g (Prasad-check) with a mean of 2.82 g. The genotype SiA 4015 (3.7g) is on par with check Prasad. The SCMR at vegetative stage varied from 28.70 (SiA 3288) to 48.90 (SiA 3666, SiA 4008) with a mean of 41.34. At flowering stage, variation ranged from 35.90 (SiA 4019) to 55.90 (SiA 3666, SiA 4032) with a mean of 46.36. At grain filling stage, SCMR values ranged from 18.90 (SiA 3414) to 32.40 (SiA 4122) with a mean of 24.65. The highest SCMR readings at flowering and maturity stages indicate that such genotypes can be tested under moisture stress conditions for their stay green trait or terminal drought tolerance (Thippeswamy *et al.*, 2018) [14]. Zinc content values ranged from 1.60 mg/100g (SiA 3399, SiA 4034) to 3.60 mg/100g (Sri Lakshmi-check) with a mean of 2.46 mg/100g. The genotype SiA 4051 (3.51 mg/100g) is on par with the check, Sri Lakshmi, Copper content varied from 0.89 mg/100g (SiA 4104) to 3.00 mg/100g (SiA 4044) with an overall mean of 1.56 mg/100g. The iron content varied from 2.32 mg/100g (SiA 3350, SiA 3379) to 4.50 mg/100g (SiA 3690) with overall mean of 3.02 mg/100g. Iron is an important component of blood haemoglobin and prevents anaemic condition. The variation in mean values of seed manganese content, which is an important trace element for many vital functions ranged from 0.80 mg/100g (SiA 4147) to 2.45 mg/100g (SiA 3222) with a mean of 1.54 mg/100g. The mean values of protein content (%), which helps to fight against diabetes and cardiovascular diseases showed a wide range from 8.05 g/100g (SiA 3286, SiA 3383 and SiA 4024) to 17.85 g/100g (SiA 3295) with a mean of 10.56 g/100g. Calcium content showed a range of variation from 15.65 mg/100g (SiA 3282) and 33.20 mg/100g (SiA 4051) with an overall mean of 23.94 mg/100g. Magnesium content ranged from 71.75 mg/100g (Prasad, Sri Lakshmi-checks) to 84.30 mg/100g (SiA 3292) with a mean of 77.65 mg/100g. Antioxidant activity showed a range of variation from 32.44 (SiA 4031) to 67.00 (SiA 4015) with a mean of 46.69. Varieties with high antioxidant activity will have low glycemic index which helps in prevention of diabetes and cardiovascular diseases. Further they also help to neutralise the action of free radicals attacking human cells. Grain yield per plant showed a range of mean values from 9.20 g (SiA 3334) to 18.70 g (SiA 3292) with over all mean of 12.21 g.

In the present study the phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits under study. The difference between phenotypic coefficient of variance (PCV) and genotypic coefficient of variance (GCV) was less for all traits except test weight and protein content indicating the low effect of environment and greater role of genetic factors on the expression of the traits and also providing higher scope for improvement. The values of phenotypic co-efficient of variation varied from 3.03 to 18.50 per cent. The highest magnitude of phenotypic coefficient of variation was recorded by copper content (18.50 %) followed by iron content (17.37 %) and number of productive tillers per plant (16.27%). The lowest phenotypic coefficient of variation was recorded in magnesium content (3.03 %). The values of genotypic coefficient of variation obtained in respect of various yield and yield contributing characters ranged from 2.89 to 17.61 per cent. The highest magnitude of genotypic coefficient of variation was recorded by copper content (17.61 %) and lowest for magnesium content (2.89 %). These results were similar with Amarnath *et al.* (2018) [1] and Kumar *et al.* (2019) [7].

Moderate PCV and GCV values were recorded by plant height, panicle length, number of productive tillers per plant, SCMR at grain filling stage, zinc content, copper content, iron content, manganese content, protein content, calcium content, antioxidant activity and grain yield per plant. This indicates the existence of comparatively moderate variability for these traits, which could be exploited for improvement through selection in advanced generations. Similar results were reported by Brunda *et al.*, (2014) [3], Shingane *et al.*, (2017) [11] and Amarnath *et al.*, (2018) [1].

The heritability values for different yield and yield contributing characters ranged from 60.25 to 97.91 per cent. Highest heritability was observed for antioxidant activity and lowest was recorded for test weight. These results were similar with Jadhav *et al.* (2015) [4], Smita *et al.* (2016) [13],

Kavya *et al.* (2017) [6], Amarnath *et al.* (2018) [1] and Kumar *et al.* (2019) [7].

Genetic advance as per cent of mean ranged from 5.56 to 34.52 per cent. Copper content (34.52 per cent) recorded the highest genetic advance followed by iron content (33.88 per cent), number of productive tillers per plant (32.24 per cent), calcium content (31.84 per cent), grain yield per plant (30.72 per cent), panicle length (27.66 per cent), zinc content (27.37 per cent), manganese content (26.86 per cent), protein content (25.91 per cent), antioxidant activity (24.32 per cent), SCMR at grain filling stage (23.03 per cent), and plant height (20.46 per cent). High genetic advance indicated that these characters are governed by additive genes and selection will be rewarding for improvement of these traits. Moderate genetic advance as per cent of mean was recorded for SCMR at flowering stage (14.35 per cent), SCMR at vegetative state (14.05 per cent) and days to 50 % flowering (13.21 per cent) while days to maturity (9.88 per cent) and magnesium content (5.56 per cent) recorded low genetic advance as per cent of mean. These findings were in accordance with those of Ayesha *et al.*, (2019) [2] and kumar *et al.* (2019) [7].

Moderate to high variability and high heritability coupled with high genetic advance as per cent of mean was observed for characters *viz.*, plant height, panicle length, number of productive tillers per plant, SCMR at grain filling stage, zinc content, copper content, iron content, manganese content, protein content, calcium content, antioxidant activity and grain yield per plant indicating the predominance of additive gene action. Hence, direct phenotypic selection may be useful with respect to these traits for improvement in foxtail millet.

High heritability coupled with moderate genetic advance was observed in case of days to 50 % flowering, test weight, SCMR at flowering stage, SCMR at vegetative stage revealing the role of additive and non-additive gene action. The remaining traits *viz.*, days to maturity and magnesium content showed moderate to high heritability and moderate to low genetic advance indicating the operation of non-additive gene action. These traits may be exploited through heterosis breeding, cyclic hybridization, biparental mating and diallele selective mating systems.

Table 1: Analysis of variance for 18 morpho-physiological and biochemical characters in foxtail millet (*Setaria italica* (L.) Beauv

S. No	Source of variation	d.f	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	Number of productive tillers perplant	Days to maturity	Test weight (g)	SCMR at vegetative stage	SCMR at flowering stage	SCMR at grain filling stage
			Mean sum of squares								
1	Block	3	1.383	9.378	0.553	0.034*	0.980	0.080	2.374	1.430	0.388
2	Entries	75	12.738**	271.899**	7.685**	0.296**	18.743**	0.173**	16.222**	15.446**	10.433**
3	Checks	4	20.000**	390.425**	43.452**	0.244**	8.425**	0.756**	47.850**	20.219**	9.882**
4	Varieties	70	12.504**	169.811**	5.094**	0.300**	18.819**	0.096*	14.503**	14.705**	10.606**
5	Checks *Vs.* Varieties	1	0.116	6943.987**	45.935**	0.202**	54.715**	3.210**	10.045	49.745**	0.513
6	Error	12	0.633	6.260	0.465	0.009	0.526	0.033	2.290	0.774	0.545

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

S. No	Source of variation	d.f	Zinc content (mg/100g)	Copper content (mg/100g)	Iron content (mg/100g)	Manganese content (mg/100g)	Protein content (%)	Calcium content (mg/100g)	Magnesium content (mg/100g)	Antioxidant activity (mg AAE/100g)	Grain yield per plant (g)
			Mean sum of squares								
1	Block	3	0.022	0.097**	0.002	0.136**	0.601	0.123	0.933	2.017	1.904**
2	Entries	75	0.332**	0.107**	0.459**	0.035*	5.826**	18.137**	10.722**	43.894**	4.547**
3	Checks	4	0.105**	0.181**	1.663**	0.066**	2.825*	7.017**	15.550**	124.413**	8.039**
4	Varieties	70	0.150**	0.103**	0.331**	0.303**	2.909**	18.102**	6.809**	39.406**	4.329**
5	Checks *Vs.* Varieties	1	13.974**	0.091**	4.709**	5.443**	222.050**	65.101**	265.292**	35.960**	5.865**
6	Error	12	0.011	0.008	0.014	0.009	0.401	0.402	0.517	0.666	0.082

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

Table 2: Mean Performance for all the characters under study in 76 genotypes of foxtail millet (*Setaria italica* (L.) Beauv.)

S N	Genotype	DTF	PH (cm)	PL (cm)	NPT	DTM	TW (g)	SCMR at VS	SCMR at FS	SCMR at GFS	Zn (mg/ 100g)	Cu (mg/ 100g)	Fe (mg/ 100g)	Mn (mg/ 100g)	Pr (%)	Ca (mg/ 100g)	Mg (mg/ 100g)	AOA (mg AAE/ 100g)	GYPP (g)
1	SiA 3222	31.00	106.00	14.70	1.00	60.00	2.48	40.60	42.00	30.01	2.80	1.90	3.20	2.45	13.40	31.10	72.40	51.61	9.48
2	SiA 3282	47.00	109.00	15.40	3.00	82.00	2.90	43.70	44.50	20.80	2.44	1.50	2.48	1.42	10.20	15.65	81.20	53.33	14.50
3	SiA 3284	46.00	109.00	15.20	3.00	83.00	2.51	39.10	43.70	21.30	3.10	1.24	2.40	1.50	11.32	20.00	76.50	44.58	12.30
4	SiA 3286	49.00	117.00	13.00	3.00	76.00	2.85	45.20	47.50	28.70	2.43	1.56	4.30	1.76	8.05	23.00	83.20	44.44	10.60
5	SiA 3287	46.00	122.00	14.40	3.00	76.00	2.58	43.20	48.40	31.70	1.90	1.87	2.60	1.43	9.80	32.00	72.90	47.16	10.70
6	SiA 3288	45.00	113.00	14.60	3.00	83.00	2.68	28.70	39.10	26.50	2.45	1.45	2.43	1.42	10.34	24.00	78.40	54.84	10.90
7	SiA 3289	42.00	115.00	13.30	3.00	76.00	2.60	42.20	43.50	23.80	2.40	1.50	2.87	1.76	9.10	20.00	73.40	45.85	10.96
8	SiA 3290	48.00	127.00	16.00	3.00	80.00	2.87	40.60	44.10	21.70	2.60	1.56	3.40	1.52	10.45	20.00	76.00	44.44	11.20
9	SiA 3291	39.00	117.00	13.00	3.00	71.00	2.96	43.60	49.30	30.70	2.60	1.65	2.89	1.78	8.60	17.00	75.40	45.93	10.70
10	SiA 3292	46.00	123.00	18.60	5.00	72.00	3.45	44.50	48.30	28.00	3.01	1.73	3.10	1.60	12.60	28.00	84.30	58.66	18.70
11	SiA 3293	49.00	125.00	17.40	3.00	81.00	2.81	43.80	48.50	20.90	1.90	1.59	3.60	1.54	10.43	19.00	77.40	42.36	12.43
12	SiA 3294	45.00	96.00	13.60	3.00	83.00	2.92	36.40	45.10	25.20	2.10	1.20	3.20	1.24	9.30	18.00	76.50	42.26	11.02
13	SiA 3295	47.00	90.00	10.80	5.00	77.00	2.80	41.40	44.50	22.80	2.90	2.10	3.10	2.20	17.85	30.00	83.20	54.56	15.40
14	SiA 3328	52.00	110.00	12.50	3.00	79.00	3.10	45.10	47.90	21.40	2.40	1.54	2.43	1.43	9.80	20.00	76.80	53.59	14.20
15	SiA 3330	45.00	93.00	13.50	3.00	80.00	2.80	41.40	47.10	21.10	2.50	1.42	2.35	1.42	11.20	28.00	81.30	47.05	10.90
16	SiA 3334	47.00	123.00	10.90	2.00	77.00	2.10	35.50	46.20	23.90	2.70	1.62	3.50	1.48	9.98	27.00	75.40	45.85	9.20
17	SiA 3350	48.00	123.00	14.60	3.00	79.00	2.55	43.00	52.70	23.80	2.86	1.30	2.32	1.52	11.34	26.00	77.60	44.57	12.10

S N	Genotype	DTF	PH (cm)	PL (cm)	NPT	DTM	TW (g)	SCMR at VS	SCMR at FS	SCMR at GFS	Zn (mg/ 100g)	Cu (mg/ 100g)	Fe (mg/ 100g)	Mn (mg/ 100g)	Pr (%)	Ca (mg/ 100g)	Mg (mg/ 100g)	AOA (mg AAE/ 100g)	GYPP (g)
18	SiA 3379	48.00	105.00	13.80	3.00	77.00	2.99	46.00	46.40	26.60	2.10	1.56	2.32	1.30	9.45	24.00	74.40	47.16	12.90
19	SiA 3383	48.00	107.00	10.80	3.00	74.00	3.27	37.20	46.40	19.80	2.50	1.40	2.50	1.70	8.05	25.00	81.20	42.03	14.60
20	SiA 3395	48.00	111.00	12.40	2.00	80.00	2.80	41.60	43.40	26.80	1.80	1.90	2.60	1.64	8.43	24.00	77.80	42.01	11.00
21	SiA 3399	48.00	115.00	12.60	3.00	87.00	2.37	47.20	51.20	26.70	1.60	1.74	2.60	1.50	8.70	23.00	78.90	40.94	10.80
22	SiA 3414	50.00	117.00	16.10	3.00	85.00	2.69	39.80	47.10	18.90	1.90	1.73	2.40	1.42	9.28	21.00	76.00	42.08	10.50
23	SiA 3416	46.00	117.00	11.80	3.00	79.00	2.92	39.90	40.40	22.10	1.70	1.50	2.68	1.21	8.75	20.00	77.80	47.13	12.60
24	SiA 3420	48.00	131.00	12.40	3.00	80.00	2.65	41.50	46.50	21.80	2.40	1.20	2.60	1.30	8.90	28.00	80.54	54.82	9.65
25	SiA 3422	51.00	107.00	10.80	3.00	79.00	3.00	38.50	43.80	22.50	2.10	1.74	2.70	1.20	8.65	24.00	78.50	52.90	13.60
26	SiA 3427	51.00	151.00	16.40	3.00	80.00	2.66	39.60	41.60	21.50	2.30	1.30	3.70	1.01	8.23	23.00	79.60	52.28	11.65
27	SiA 3551	47.00	106.00	12.80	3.00	79.00	2.90	34.40	45.60	19.55	2.30	1.73	2.70	1.42	9.40	25.40	78.50	47.16	12.50
28	SiA 3570	46.00	110.00	13.60	3.00	81.00	2.78	42.10	49.20	20.80	2.65	1.60	3.20	1.60	10.15	23.70	81.20	45.93	11.60
29	SiA 3666	51.00	111.00	14.00	3.00	82.00	2.54	48.90	55.90	21.50	2.56	1.73	4.30	1.42	12.25	24.50	75.60	54.53	10.50
30	SiA 3690	49.00	108.00	13.80	3.00	80.00	2.60	41.70	48.50	28.00	2.50	1.30	4.50	1.23	8.50	31.50	76.54	53.59	10.80
31	SiA 3700	40.00	102.00	10.60	2.00	76.00	2.46	42.70	50.10	30.70	2.30	1.23	3.40	1.54	12.95	32.60	81.40	44.57	9.70
32	SiA 3988	41.00	112.00	12.00	3.00	76.00	2.76	44.50	42.10	21.30	2.10	1.73	3.10	1.42	9.98	23.80	77.50	43.31	10.60
33	SiA 3995	47.00	124.00	10.60	3.00	85.00	2.86	36.50	43.00	27.70	2.43	0.93	2.60	1.23	10.67	26.00	80.40	54.87	11.10
34	SiA 4003	45.00	105.00	11.60	3.00	79.00	2.94	32.90	45.90	28.90	1.90	1.73	2.60	1.42	13.65	22.10	74.90	50.61	12.10
35	SiA 4006	46.00	101.00	10.60	3.00	79.00	2.44	38.00	41.60	23.60	2.40	1.54	2.80	1.50	10.76	22.50	75.20	42.01	9.70
36	SiA 4008	44.00	113.00	13.60	3.00	77.00	2.75	48.90	49.00	24.70	2.40	1.35	3.50	1.23	11.73	23.50	76.50	49.72	10.50
37	SiA 4009	49.00	105.00	13.00	3.00	78.00	2.94	44.50	48.60	28.70	2.50	1.38	2.40	1.20	9.98	22.40	75.40	40.75	12.30
38	SiA 4015	45.00	106.00	22.40	5.00	73.00	3.70	41.20	45.20	23.40	2.60	1.52	2.50	1.54	9.80	24.50	79.50	67.00	17.54
39	SiA 4016	48.00	120.00	11.90	3.00	77.00	2.85	41.40	43.80	21.50	2.50	1.73	2.60	1.23	11.76	21.60	80.40	42.03	11.60
40	SiA 4019	52.00	102.00	11.70	4.00	72.00	3.10	42.60	35.90	22.08	1.80	1.80	3.20	1.84	8.40	23.70	75.40	35.78	13.43
41	SiA 4022	47.00	108.00	15.80	3.00	72.00	3.18	36.30	47.30	24.50	2.80	1.73	4.30	1.60	8.58	18.50	82.70	49.74	14.50
42	SiA 4024	50.00	95.00	15.00	4.00	84.00	3.15	44.50	48.10	27.90	2.64	1.60	2.70	1.52	8.05	19.60	78.57	35.63	14.30
43	SiA 4029	47.00	107.00	10.80	3.00	76.00	3.25	34.30	42.40	23.10	1.80	1.73	2.40	1.42	8.58	19.50	74.80	34.37	14.60
44	SiA 4031	48.00	102.00	11.00	3.00	79.00	2.85	42.70	47.10	20.78	2.60	1.50	3.50	1.74	10.68	19.80	79.80	32.44	12.20
45	SiA 4032	50.00	116.00	12.20	3.00	81.00	2.97	45.60	55.90	30.80	2.70	0.98	4.30	1.32	9.28	20.70	77.80	44.65	12.90
46	SiA 4034	47.00	154.00	16.00	3.00	77.00	2.60	46.80	49.20	23.60	1.60	1.55	3.50	1.54	11.73	20.50	79.80	43.31	10.50
47	SiA 4037	46.00	102.00	12.60	3.00	78.00	2.92	42.50	46.50	22.20	2.80	1.50	2.70	1.21	11.03	20.00	75.80	44.57	13.10
48	SiA 4038	52.00	110.00	12.60	2.00	81.00	2.80	42.10	44.60	25.90	1.70	1.38	2.80	1.80	11.38	32.00	75.80	47.13	12.30
49	SiA 4043	48.00	115.00	11.20	3.00	79.00	2.52	41.40	48.00	26.90	1.80	1.73	2.50	1.34	10.40	27.00	76.90	45.98	9.80
50	SiA 4044	49.00	116.00	20.00	5.00	79.00	3.23	40.90	43.40	24.03	3.20	3.00	2.60	1.87	9.63	24.00	78.90	49.72	18.60
51	SiA 4046	46.00	98.00	15.20	3.00	80.00	2.70	42.40	50.60	25.10	2.50	1.60	2.80	1.50	10.85	21.00	74.60	48.59	14.32
52	SiA 4051	46.00	114.50	17.00	4.00	77.00	3.50	41.70	44.60	26.30	3.21	2.50	3.40	1.87	11.23	33.20	77.90	38.85	17.78
53	SiA 4053	47.00	105.40	17.60	2.00	85.00	2.85	43.40	45.60	22.40	1.87	1.50	3.20	1.32	9.60	20.00	78.70	44.75	13.23
54	SiA 4059	46.00	89.00	17.90	3.00	74.00	3.56	45.10	53.30	30.80	3.20	2.20	3.60	1.80	11.23	20.00	81.80	50.97	15.67
55	SiA 4069	42.00	129.00	12.80	3.00	84.00	2.90	41.00	42.60	23.60	2.40	1.56	2.45	1.60	9.45	21.30	76.50	46.03	12.50
56	SiA 4071	43.00	107.00	17.80	3.00	76.00	2.50	41.70	43.40	22.60	2.30	1.12	2.40	1.78	8.70	23.40	79.30	52.25	9.80
57	SiA 4072	44.00	103.00	11.40	3.00	82.00	2.59	42.10	45.60	22.50	2.60	1.74	2.50	1.42	8.75	24.60	74.30	40.90	9.90
58	SiA 4073	46.00	96.00	12.20	3.00	79.00	2.78	41.90	46.10	20.80	2.45	1.73	2.60	1.40	8.40	23.50	79.40	46.77	11.60
59	SiA 4074	51.00	107.00	10.60	3.00	73.00	2.76	42.40	50.20	21.40	2.40	1.65	3.40	1.42	12.08	24.50	81.20	50.97	11.50
60	SiA 4104	48.00	130.00	11.00	3.00	80.00	2.86	37.70	42.50	23.90	2.56	0.89	3.20	1.78	8.58	31.60	75.60	38.60	12.40
61	SiA 4108	49.00	148.00	21.00	3.00	84.00	2.96	39.30	47.60	27.60	2.50	1.38	2.50	1.44	10.87	31.60	77.60	55.00	13.50
62	SiA 4111	40.00	150.00	15.60	3.00	72.00	2.81	42.30	47.80	24.70	2.10	1.30	3.70	1.78	8.23	32.60	75.60	52.38	12.10
63	SiA 4113	50.00	119.00	12.80	3.00	76.00	2.17	37.90	42.60	24.40	2.65	1.38	2.65	1.84	10.98	32.00	77.90	42.97	10.50
64	SiA 4122	46.00	107.00	13.00	3.00	77.00	2.14	41.20	43.90	32.40	2.34	1.73	4.30	1.40	12.25	21.00	76.50	48.85	11.30
65	SiA 4135	51.00	104.00	12.40	3.00	72.00	2.57	42.70	47.40	27.30	3.00	1.20	2.65	1.52	9.80	25.00	81.20	39.52	11.20
66	SiA 4143	46.00	119.00	13.45	3.00	84.00	2.52	48.40	49.40	26.10	2.60	1.40	2.64	1.20	10.85	26.00	79.50	52.43	9.87
67	SiA 4147	38.00	113.00	14.76	3.00	84.00	2.63	31.40	48.80	25.60	2.20	1.73	2.65	0.80	11.38	27.00	78.90	47.18	9.60
68	SiA 4161	46.00	113.00	11.00	3.00	80.00	2.33	40.90	42.40	24.70	2.60	1.30	2.40	1.78	12.40	21.70	79.50	56.28	12.00
69	SiA 4164	49.00	105.00	14.20	3.00	78.00	2.50	42.00	54.80	23.40	2.10	1.50	3.20	1.60	10.15	21.50	76.50	33.22	10.50
70	SiA 4166	49.00	118.00	16.80	3.00	84.00	2.55	43.60	54.80	26.20	2.54	1.40	3.50	1.70	12.60	21.50	75.60	43.60	11.20
71	SiA 4168	48.00	113.00	13.00	2.00	82.00	2.65	42.70	49.80	26.40	2.40	1.73	3.20	1.43	12.34	26.00	78.50	49.87	10.23
72	Surya-nandi	45.00	131.00	13.85	4.00	81.00	2.79	38.83	43.16	24.20	3.27	1.31	2.53	2.09	14.54	23.30	76.00	49.23	11.93
73	PS-4	49.00	125.00	11.07	3.00	81.00	3.65	38.60	42.88	23.45	3.20	1.23	3.68	1.99	14.35	22.15	74.25	38.84	10.93
74	Prasad	44.00	132.00	18.28	3.00	82.00	3.73	43.08	47.03	27.13	3.40	1.70	3.85	2.24	15.08	23.05	**71.75**	43.74	11.25
75	Sri Lakshmi	49.00	131.00	14.18	3.00	81.00	2.85	37.10	47.28	25.73	3.60	1.68	4.22	2.12	13.47	21.68	**71.75**	52.61	10.18
76	SiA 3085	46.00	151.00	18.95	3.00	78.00	3.22	45.33	43.13	23.60	3.25	1.53	3.40	2.08	13.00	19.98	75.25	41.93	13.91
	Overall mean	46.68	114.26	13.67	3.04	79.00	2.82	41.34	46.36	24.65	2.46	1.56	3.02	1.54	10.56	23.94	77.65	46.69	12.21
	CV %	7.31	11.99	17.08	17.50	5.40	12.09	9.10	8.27	12.98	17.98	19.41	19.55	18.63	17.87	17.37	3.56	13.55	15.77
	CD at 5 %	1.23	3.85	1.05	0.15	1.12	0.28	2.33	1.35	1.14	0.16	0.14	0.19	0.14	0.98	0.98	1.11	1.26	0.44

DTF- Days to 50 per cent flowering, PH- Plant height, PL- Panicle length, NPT- Number of productive tillers per plant, DTM- Days to maturity, TW-Test weight, SCMR at VS- SCMR at vegetative stage, SCMR at FS- SCMR at flowering stage, SCMR at GFS- SCMR at grain filling stage, Zn- Zinc content, Cu- Copper content, Fe- Iron content, Mn- Manganese content, Pr- Protein content, Ca- Calcium content, Mg- Magnesium content, AOA- Antioxidant activity, GYPP- Grain yield per plant.
Note: Bold figures are minimum and maximum values

Table 3: Estimates of genetic parameters for grain yield and quality components in foxtail millet (*Setaria italica* (L.) Beauv.)

S. No	Character	Range		Mean	Heritability (Broad sense) (%)	Coefficient of variation		Genetic advance	Genetic advance as % of mean
		Minimum	Maximum			PCV (%)	GCV (%)		
1	Days to 50% flowering	31.00	52.00	46.68	93.78	6.84	6.63	6.17	13.21
2	Plant height	89.00	154.00	114.26	95.46	10.40	10.17	23.09	20.46
3	Panicle length	10.60	22.40	13.67	88.90	15.11	14.24	3.74	27.66
4	No. of productive Tillers per plant	1.00	5.00	3.04	96.20	16.27	15.96	0.98	32.24
5	Days to maturity	60.00	87.00	78.70	96.55	4.97	4.88	7.77	9.88
6	Test weight	2.10	3.73	2.82	60.25	10.38	8.05	0.35	12.88
7	SCMR at vegetative stage	28.70	48.90	41.34	81.10	8.41	7.57	5.82	14.05
8	SCMR at flowering stage	35.90	55.90	46.36	93.54	7.45	7.20	6.67	14.35
9	SCMR at grain filling stage	18.90	32.40	24.65	93.69	11.93	11.55	5.67	23.03
10	Zinc content	1.60	3.60	2.46	91.09	14.58	13.92	0.66	27.37
11	Copper content	0.89	3.00	1.56	90.57	18.50	17.61	0.54	34.52
12	Iron content	2.32	4.50	3.02	94.65	17.37	16.90	1.01	33.88
13	Manganese content	0.80	2.45	1.54	84.23	15.48	14.21	0.40	26.86
14	Protein content	8.05	17.85	10.56	83.41	15.08	13.77	2.67	25.91
15	Calcium content	15.65	33.20	23.94	97.25	15.90	15.68	7.66	31.84
16	Magnesium content	71.75	84.30	77.65	90.74	3.03	2.89	4.41	5.56
17	Antioxidant activity	32.44	67.00	46.69	97.91	12.06	11.93	11.38	24.32
18	Grain yield per plant	9.20	18.70	12.21	97.67	15.27	15.09	3.76	30.72

PCV- Phenotypic coefficient of variation; GCV- Genotypic coefficient of variation

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