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Blast Screening and Genetic variability Studies for Yield and Yield Contributing Characters in Foxtail Millet (*Setaria italica* L.)

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ABSTRACT: The goal of the current study was to evaluate the extent of genetic variability for yield and yield-contributing features among 64 foxtail millet genotypes. Analysis of variance (ANOVA) results for 19 characters showed significant genotype differences for each character, indicating a high level of variability. Characters such as plant height, panicle length, panicle width, flag leaf blade length, flag leaf blade width, number of productive tillers per plant, weight of five panicles, seed calcium content, seed phosphorous content, seed iron content, seed zinc content, seed copper content, seed manganese content, seed protein content, and grain yield per plant showed moderate to high variability, high heritability, coupled with high genetic advance as percent of mean. In light of these qualities, direct phenotypic selection thereby significantly increases grain output. To determine the illness reactivity against blast disease, all 64 genotypes were put through a disease screening process. Thirty genotypes demonstrated a moderately resistant reaction (MR), compared to seven genotypes that displayed resistance (R). Five genotypes showed the susceptible reaction (S), 17 showed the moderately susceptible (MS), and five showed the highly susceptible reaction (HS). These blast resistant accessions can be used as donor parents in hybridization programmes to create disease-resistant, high-yielding cultivars in the future.

Keywords: Blast, Foxtail millet, Genetic advance, Heritability, Variability.

INTRODUCTION

Foxtail millet (*Setaria italica* (L.)) is an annual, C4 autogamous crop that is adapted to temperate, sub-tropical, and tropical Asia. It is grown on marginal and sub-marginal tracts all over the world. Additionally, it can withstand pests and diseases and is cultivated in soils with insufficient nutrients (Hirano *et al*., 2011). Leucine and methionine, beta carotene, minerals like Ca, Fe, K, Mg, and Zn; antioxidants; dietary fibre; phytochemicals; vitamins (thiamine, riboflavin, and niacin); and low glycemic index are all good sources of quality proteins in grains, which are necessary for a balanced human diet (Murugan and Nirmalakumari 2006). It is a calming, simple-to-digest food that is non-glutinous, unlike buckwheat and quinoa, and does not produce acids. The 100% amylopectin and starch found in some foxtail millet types is more easily absorbed than maize starch.

The potential productivity of the crop is not fully used due to inadequate research on and use of the germplasm for foxtail millet. In general, genetic, physiological, and agronomic variables are blamed for low productivity. The potential production of crops in India is hampered by various factors. Numerous pathogens also damage foxtail millet, causing a number of diseases, the most destructive of which is blast. When the blast is significant, there is a 30–40% yield loss (Nagaraja *et al*., 2007). When the weather is humid, the sickness manifests itself severely, especially when there is a dense plant cover. In small millets, fungicide application is uncommon. Thus, the crop experiences significant losses as a result of the blast. Therefore, it is crucial to produce genotypes resistant to blast. The experimental material's high genetic diversity aids in the choice of desired genotypes. Along with genetic diversity, understanding heritability and genetic advance aids breeders in selecting the best breeding techniques. The amount of genetic gain anticipated from selection would be better understood if genetic variability and heritability estimates were combined. Therefore, understanding the genetic diversity, heritability, and genetic progress of the genetic material at hand is essential.

MATERIALS AND METHODS

The field study was carried out in Kharif 2020 at the Agricultural College Farm, Bapatla, Andhra Pradesh, which is situated in the Agro Climatic Zone of Andhra Pradesh, India, at an altitude of 5.49 metres above mean sea level, 15° 54' latitude, and 80° 25' longitude, and about 8 km from the Bay of Bengal. Black cotton soils make up the terrain. The experimental site had a pH of

7.2. In a square lattice design with two replications, the genotypes were assessed. Each genotype was grown in a three-row, three-meter-long plot with a 30 cm by 10 cm space between the rows. Five randomly chosen plants each replication was observed for grain yield, plant height, flag leaf blade length, and flag leaf blade width, panicle length, panicle width, number of productive tillers per plant, weight of five panicles, harvest index, seed calcium content, seed phosphorous content, seed iron content, seed zinc content, seed copper content, seed manganese content and seed protein content. Days to 50% flowering, days to maturity and test weight were recorded on plot basis.

In order to find tolerant or resistant genotypes, a total of 64 genotypes of foxtail millet were evaluated against blast disease during Kharif, 2020. The 64 genotypes were sowed in two rows of three metres each to evaluate the incidence of blast on various genotypes. The rows were spaced 30 cm apart by 10 cm. For every ten rows, one Sri Lakshmi susceptible check was seeded. In the experimental plot, no steps were made to protect plants from blast, facilitating the spread of the illness. When documenting the disease severity at weekly intervals from 25 DAS through harvesting, the entries' response to blast disease was evaluated using the established disease scale (AICRP on Small Millets, 2016), which is listed below (Table 1). Disease reaction for blast disease in foxtail millet is categorized into five classes are presented in the Fig. 1.

Table 1: Standard evaluation system for leaf blast in foxtail millet [*Setaria italica* (L.)].

Score	Description	Reaction
1	Small brown specks of pinhead size without sporulating center.	R
2	Small roundish to slightly elongated, necrotic grey spots, about 1-2 mm in diameter with a distinct brown margin and lesions are mostly found on the lower leaves.	MR
3	Lesion type is the same as in scale 2, but significant numbers of lesions are on the upper leaves.	MR
4	Typical sporulating blast lesions, 3mm or longer, infecting less than 2% of the leaf area.	MS
5	Typical blast lesions infection 2-10% of the leaf area.	MS
6	Blast lesions infection 11-25% of the leaf area.	S
7	Blast lesions infection 26-50% of the leaf area.	S
8	Blast lesions infection 51-75% of the leaf area.	HS
9	More than 75% of the leaf area affected.	HS

R = Resistant; MR = Moderately Resistant; MS = Moderately susceptible; S = Susceptible: HS = Highly Susceptible

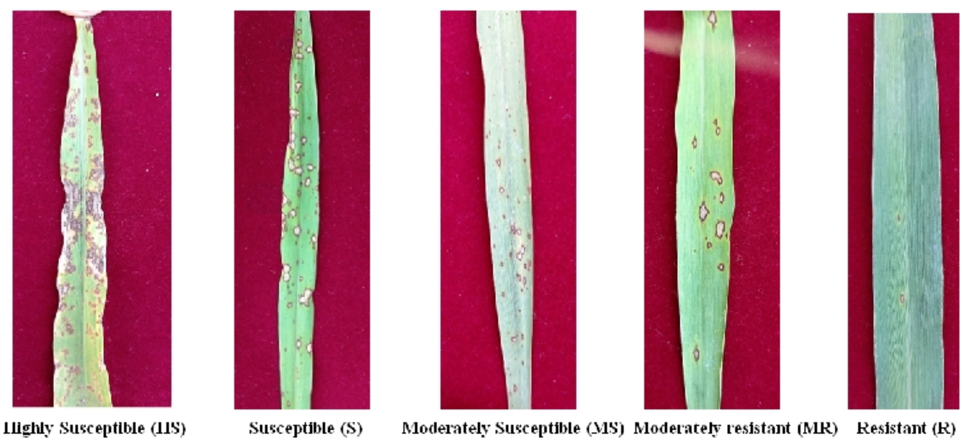

Fig. 1. Genotypes showing highly susceptible (HS), susceptible (S), moderately susceptible (MS), moderately resistant (MR), resistant (R), disease reaction for blast disease in foxtail millet [*Setaria italica* (L.)].

RESULTS AND DISCUSSION

Analysis of variance in the current study revealed important variations in the genotypes (Table 3). Additionally, it showed that the experimental material had a significant level of variety, giving plant breeders the chance to use hybridization in breeding processes. Tables 2 and 4 provide the estimates of mean, range, PCV, GCV, heritability (h^2 bs), and genetic advance as a percentage of mean (GAM) for foxtail millet genotypes.

In general, wide range of variation provides an ample scope for selection of superior and desirable genotypes. Days to 50% flowering ranged from 33 days (SiA 3222) to 63 days (SiA 3287) with a mean of 50.50 days. The genotype SiA 3222 was early in flowering compared to other genotypes including three checks indicating importance of this genotype as parent in development of short duration varieties. The mean value for plant height ranged from 77.6 cm (SiA 3222) to 162.2 cm (SiA 3223) with a mean of 133.20 cm. Plant height is a significant growth attribute directly linked with the productive properties of plant in terms of forage yield suggesting their suitability as a fodder. The flag leaf length ranged from 26.4cm (SiA 4193) to 40.7cm (SiA 3159) with a mean of 32.46cm. Flag leaf play a major role in synthesis and translocation of photo assimilates to the seeds and ultimately affecting grain yield. The flag leaf width ranged from 1.71 cm (Srilakshmi) to 3.10 cm (SiA 3156) with a mean of 2.16 cm. The panicle length ranged from 9.67 cm (SiA 3289) to 27 cm (SiA 2670) with a mean of 19.65 cm. In general, with increase in panicle length there is a chance of good exertion during anthesis time, aiding in better pollination. This could result in better seed set, seed filling and is represented through a positive increase in seed yield and seed weight in foxtail millet. The variation for panicle width ranged from 1.12 cm (SiA 3222) to 3.00 cm (SiA 3449) with a mean of 1.69cm.More number of productive tillers would contribute to the higher yields owing to the fact that there will be substantial increase in panicle number so the genotype SiA 3318 can be used as a parent compared to checks in future hybridization programmes. The weight of five panicles ranged from 11.25 g (SiA 3501) to 30.20 g (SiA 3222) with a mean of 18.51 g which is also an important yield contributing character. The test weight ranged from 2.30 g (SiA 3287) to 3.30 g (SiA 4029) with a mean of 2.89 g. The harvest index ranged from 30.34% (SiA 3281) to 46.30% (SiA 1135) with a mean of 39.97%. The seed calcium content ranged from 16.21 mg/100g (SiA 3641) to 35.20 mg/100g (SiA 2677) with a mean of 25.79 mg/100g. Calcium helps in building strong bones and teeth and its deficiency leads to osteoporosis. The variation for seed phosphorous content ranged from 0.08 mg/100g (Suryanandi) to 0.35mg/100g (SiA 2703) with a mean of 0.20 mg/100gm. Seed iron content ranged from 1.35 mg/100g (SiA 2853) to 4.45 mg/100g (SiA 58) with a mean of 3.01 mg/100g. It is an important component of blood hemoglobin and prevents anemic condition. The seed zinc content ranged from 0.93 mg/100g (SiA 2107) to 3.80 mg/100g (SiA 1827) with a mean of 2.49 mg/100g. The seed copper content ranged from 0.95 mg/100g (SiA 3223, SiA 3159) to 2.10 mg/100g (SiA 2677) with a mean of 1.52 mg/100g. This nutrient plays an important role in sustaining energy levels, preventing premature aging and helps in balancing hormones. The seed manganese content ranged from 0.72 mg/100g (SiA 1135) to 2.99 mg/100g (SiA 58) with a mean of 1.74 mg/100g. Manganese is an important trace mineral needed for many vital functions including nutrient absorption, production of more digestive enzymes and bone development. The seed protein content ranged from 6.26 g/100g (SiA 3287) to 13.08 g/100g (SiA 3571) with a mean of 9.22 g/100g. Foxtail millet protein characterization suggested its possible use as supplementary protein source to most cereals because it is rich in lysine. Grain yield per plant ranged from 6.54 g (SiA 4193) to 22.49 g (SiA 1827) with a mean of 13.44 g.

The phenotypic coefficient of variation (PCV) in the current study was larger than the genotypic coefficient of variation (GCV) for all the traits examined. All traits showed a smaller gap between phenotypic coefficient of variance (PCV) and genotypic coefficient of variance (GCV), indicating that genetic factors play a larger role in determining how those traits are expressed than environmental factors do. This gap also suggests that there is more room for improvement.

Phenotypic co-efficient of variation values ranged from 7.61 to 28.38%. Seed phosphorus content had the highest phenotypic coefficient of variation (28.38%), followed by seed manganese content (28.13%), and panicle width (26.75%). Days to maturity had the lowest phenotypic coefficient of variation (7.61%). The genotypic coefficient of variation found for different yield and yield contributing characteristics ranged from 4.40 to 27.70%. Seed phosphorus content had the highest genotypic coefficient of variation (27.70%), while days to maturity had the lowest (4.40%). The findings from Anuradha *et al*. (2019); Srilatha *et al*. (2020) were comparable.

The genetic advance as a percentage of the mean ranged from 5.24% to 55.68%. The highest genetic advance was seen in seed phosphorous (55.68%), which was followed by seed manganese (55.59%), panicle width (51.63%), seed iron (50.5%), seed zinc (50.5%), grain yield per plant (45.77%), weight of five panicles (41.94%), number of productive tillers per plant (40.26%), seed copper (38.00%), seed calcium (37.78), seed protein (31.26%), flag leaf blade width (25.72%), and panicle length (24.6%). These results were consistent with those of Kumar *et al.* (2019); Ayesha *et al*. (2019c).

Characters such as plant height, panicle length, panicle width, flag leaf blade width, number of productive tillers per plant, weight of five panicles, seed calcium content, seed phosphorus content, seed iron content, seed zinc content, seed copper content, seed manganese content, seed protein content, and grain yield per plant showed moderate to high variability, high heritability, coupled with high genetic advance as percent of mean Kavya *et al*. (2017a); Banu *et al*. (2017); Harish *et al*. (2022) reported similar findings.

In the present study, seven genotypes *viz*., SiA 1135, SiA 3292, SiA 3318, SiA 3399, SiA 3595, SiA 4193 and Suryanandi showed resistant (R) reaction with a disease score of 0.0 to 1.0 on disease rating scale. These genotypes can therefore be used as donors for development of blast resistant lines.Further, 30 genotypes *viz*., SiA 1493, SiA 2566, SiA 2670, SiA 2703, SiA 2846, SiA 2853, SiA 3287, SiA 3288, SiA 3289, SiA 3294, SiA 3347, SiA 3443, SiA 3449, SiA 3457, SiA 3505, SiA 3527, SiA 3540, SiA 3616, SiA 3702, SiA 3703, SiA 3891, SiA 4029, SiA 4036, SiA 4042, Krishnadevaraya, SiA 4184, SiA 4195, SiA 3223, SiA 3222 and SiA 3085 showed moderately resistant (MR) reaction with a disease rating of 1.1 to 3.0. The genotypes SiA 179, SiA 1827, SiA 2107, SiA 2677, SiA 2711, SiA 2755, SiA 3420, SiA 3467, SiA 3571, SiA 3641, SiA 3666, SiA 3669, SiA 3670, SiA 3801, SiA 3818, SiA 3982 and SiA 4197 however, exhibited moderately susceptible (MS) reaction with the disease score in the range of 3.1 to 5.0. Five genotypes *i.e*., SiA 3281, SiA 3291, SiA 3469, SiA 4063 and SiA 3159 were noticed to be susceptible (S) with the disease score of 5.1 to 7.0. Remaining five genotypes *viz*., SiA 58, Srilakshmi, SiA 3501, SiA 4023 and SiA 3156 showed highly susceptible (HS) reaction with a disease score of 7.1 to 9.0. Similar results were reported by Muniratnam *et al*. (2015); Rajesh *et al*. (2019) (Table 5 and 6). The genotypes SiA 1135, SiA 3449, SiA 2670, SiA 2703, SiA 2853, SiA 3289, SiA 3291, SiA 3294, and SiA 3443 had grain yields that were comparable to the high yielding check, Krishnadevaraya (17.34g), and they were found to be resistant to moderately resistant for the blast disease, indicating their potential in the breeding programme intended to develop high yielding and blast tolerant foxtail millet (Table 7).

Table 2: Mean performance of 64 foxtail millet [*Setaria italica* (L.)] genotypes for all the characters under study.

Sr. No.	Genotype	DFF	PH	FLBL	FL BW	PL	PW	PTPP	DM	WFP	TW	HI	Ca	P	Fe	Zn	Cu	Mn	Protein	GYPP
1.	SiA 58	45.0	147.9	36.2	2.07	20.55	2.80	4.30	76.0	16.07	2.93	41.43	20.57	0.26	4.45	3.20	1.31	2.99	11.6	14.16
2.	SiA 179	52.0	134.0	36.1	2.45	22.35	2.73	3.60	84.0	20.45	2.55	43.38	28.25	0.20	4.30	2.91	1.04	0.88	12.4	14.57
3.	SiA 1135	48.0	140.9	33.8	1.82	21.45	2.05	4.35	78.5	20.00	3.09	46.31	27.10	0.20	4.08	2.80	1.90	0.72	9.75	16.75
4.	SiA 1493	53.0	136.2	35.0	2.05	20.35	1.55	4.10	85.5	19.35	2.84	45.12	25.05	0.23	3.88	1.80	1.40	1.60	9.75	15.80
5.	SiA 1827	44.5	128.3	32.0	1.91	18.45	1.57	5.00	74.5	21.55	3.01	45.14	29.78	0.22	3.09	3.80	1.30	2.49	9.05	22.49
6.	SiA 2107	53.0	132.0	31.4	1.88	20.40	1.71	3.90	85.0	17.85	2.99	32.97	25.25	0.24	3.10	0.93	1.20	1.95	8.55	13.10
7.	SiA 2566	45.0	150.1	32.1	1.99	22.00	1.68	4.20	74.0	19.45	3.02	45.14	34.05	0.25	3.78	0.99	1.73	0.97	9.23	14.15
8.	SiA 2670	53.0	142.1	35.2	2.19	27.00	1.69	5.40	86.0	16.25	2.99	37.77	30.52	0.23	2.90	2.50	1.70	1.43	9.75	16.13
9.	SiA 2677	47.0	140.2	31.6	2.14	21.40	1.81	4.00	78.0	13.15	2.83	36.20	35.20	0.27	2.94	2.50	2.10	1.60	8.08	10.66
10.	SiA 2703	45.5	138.8	31.9	2.18	19.80	2.40	5.00	73.0	18.30	2.88	44.11	32.52	0.35	3.00	3.10	1.60	2.11	7.31	17.45
11.	SiA 2711	51.0	132.9	34.0	2.35	22.95	2.16	4.70	81.5	23.30	2.79	43.49	30.15	0.20	2.81	2.01	1.70	2.00	7.50	20.23
12.	SiA 2755	47.0	141.2	31.6	1.95	22.20	2.64	4.00	79.0	20.25	3.22	40.99	34.45	0.25	3.90	3.15	1.51	1.40	9.04	14.64
13.	SiA 2846	54.0	122.0	34.1	2.08	20.90	1.79	3.15	88.0	20.10	2.67	37.32	29.75	0.23	2.88	2.50	1.60	2.01	7.65	11.25
14.	SiA 2853	48.0	138.0	35.1	2.21	24.60	2.29	4.08	78.5	21.40	2.79	38.78	30.00	0.19	1.35	1.04	1.30	2.01	8.34	17.20
15.	SiA 3281	56.0	150.3	31.5	1.77	20.20	1.43	2.85	88.5	22.80	2.39	30.34	30.10	0.20	1.81	2.10	1.74	1.90	10.2	13.38
16.	SiA 3287	63.0	146.5	34.4	2.02	20.35	1.90	4.00	91.5	11.25	2.30	42.59	32.50	0.23	2.60	1.90	1.90	1.50	6.26	9.74
17.	SiA 3288	48.0	132.8	33.4	2.42	21.55	2.31	3.00	80.5	17.50	3.03	30.52	26.52	0.28	2.51	2.45	1.49	1.45	8.53	10.24
18.	SiA 3289	36.0	130.5	29.5	2.77	9.67	1.47	5.00	72.0	17.70	2.72	33.59	20.16	0.26	2.90	2.40	1.50	1.75	9.75	17.19
19.	SiA 3291	53.0	123.0	32.3	2.03	18.30	1.74	4.10	81.0	18.45	2.92	42.14	19.24	0.28	2.84	2.60	1.66	1.80	12.0	15.23
20.	SiA 3292	53.0	107.0	32.7	2.26	19.10	2.03	2.70	82.5	18.80	2.58	43.01	28.01	0.24	3.10	3.00	1.80	1.60	10.4	9.61
21.	SiA 3294	48.0	120.9	34.4	2.46	15.75	1.40	4.90	78.5	17.55	3.09	40.81	22.18	0.29	3.20	2.10	1.21	1.25	10.8	17.36
22.	SiA 3318	51.0	145.7	33.1	1.85	22.15	2.29	5.60	85.0	19.35	2.75	43.66	30.18	0.18	2.51	1.81	1.50	1.50	6.43	21.64
23.	SiA 3347	51.5	111.6	34.4	2.38	18.95	1.52	4.15	83.5	14.50	2.76	40.67	20.18	0.21	2.80	2.00	1.80	1.60	8.06	11.07
24.	SiA 3399	49.0	127.1	33.1	2.29	17.40	1.34	3.60	79.5	16.70	2.74	35.73	30.00	0.30	3.10	2.71	1.10	2.53	8.89	11.17
25.	SiA 3420	53.0	123.1	36.3	1.91	18.80	1.45	4.40	88.0	16.65	2.68	45.25	25.15	0.22	2.63	2.40	1.20	1.30	9.04	14.17
26.	SiA 3443	53.0	150.5	30.2	2.27	20.95	1.48	3.30	90.5	28.30	2.99	42.61	19.63	0.22	2.10	3.00	1.80	1.61	7.62	18.25
27.	SiA 3449	51.0	128.0	30.2	1.91	20.15	3.00	4.25	81.0	23.15	3.00	40.48	30.18	0.14	2.19	2.31	1.91	1.31	9.74	19.36
28.	SiA 3457	48.0	118.5	27.2	1.81	20.85	1.30	2.55	79.0	18.35	3.23	43.17	20.08	0.16	4.05	1.50	1.86	2.10	9.75	9.45
29.	SiA 3467	55.0	112.6	29.3	1.90	20.20	1.18	3.60	88.0	17.50	2.84	43.30	20.12	0.15	4.03	2.50	1.50	2.40	10.4	12.24
30.	SiA 3469	53.0	106.8	29.4	2.05	17.55	1.28	3.80	90.0	15.50	2.89	43.38	25.20	0.22	4.20	3.10	1.84	2.60	9.55	11.34
31.	SiA 3501	49.5	137.7	36.5	2.09	23.25	2.28	5.30	80.0	11.25	2.79	40.76	24.01	0.20	1.48	2.50	1.03	2.49	8.14	11.66
32.	SiA 3505	52.5	146.6	30.8	2.32	22.15	1.72	3.70	83.0	23.10	3.11	36.26	17.15	0.19	1.50	2.10	0.99	1.80	10.6	16.07
33.	SiA 3527	52.5	146.6	30.8	2.33	22.14	1.73	3.71	83.0	23.10	3.11	36.22	17.15	0.19	1.50	2.11	0.99	1.80	10.7	16.07
34.	SiA 3540	55.0	151.4	32.9	2.40	21.25	2.03	3.65	88.0	24.45	2.72	42.03	28.36	0.17	2.60	2.10	1.45	2.10	12.4	16.69
35.	SiA 3571	51.0	128.4	32.4	2.25	21.40	2.01	3.05	82.5	18.50	3.10	40.28	32.15	0.22	2.51	3.30	1.36	1.40	13.1	10.56
36.	SiA 3595	52.0	139.5	31.8	2.40	20.95	1.41	2.30	84.0	21.65	2.98	32.41	19.11	0.23	3.20	1.60	2.01	1.60	12.2	10.14
37.	SiA 3616	53.0	139.8	34.5	2.58	21.55	1.39	2.95	84.5	22.20	3.01	43.50	18.25	0.25	2.80	1.80	1.90	1.80	10.6	12.53

Sr. No.	Genotype	DFF	PH	FLBL	FL BW	PL	PW	PTPP	DM	WFP	TW	HI	Ca	P	Fe	Zn	Cu	Mn	Protein	GYPP
38.	SiA 3641	48.0	144.9	29.3	1.88	20.60	1.40	2.95	79.0	21.60	2.96	30.38	16.21	0.20	3.60	2.50	1.45	2.00	8.87	11.43
39.	SiA 3666	52.0	129.2	37.5	2.47	18.60	1.47	3.30	80.0	16.45	2.81	33.60	22.40	0.15	4.30	2.60	1.90	1.43	9.54	10.62
40.	SiA 3669	53.0	127.3	31.1	1.95	18.10	1.27	3.70	85.0	19.55	3.23	42.90	26.10	0.20	2.93	2.10	1.25	2.50	7.33	14.42
41.	SiA 3670	50.0	131.7	32.0	2.38	17.60	1.42	2.75	81.0	21.70	2.96	45.44	28.07	0.13	2.50	3.80	1.27	2.49	8.54	12.05
42.	SiA 3702	53.0	135.6	32.5	2.02	18.35	2.04	3.50	84.0	19.20	2.93	32.91	24.15	0.17	2.88	2.10	1.60	1.60	8.04	13.47
43.	SiA 3703	52.0	136.7	30.7	1.88	16.40	1.27	4.55	82.5	13.50	2.76	40.50	28.20	0.12	2.50	2.50	1.50	1.40	7.17	12.28
44.	SiA 3801	55.5	145.0	39.8	2.16	16.40	1.17	4.50	89.0	12.35	3.03	35.95	28.15	0.16	2.50	2.15	1.06	1.50	9.06	10.93
45.	SiA 3818	50.0	138.7	32.2	2.22	17.85	1.29	3.70	81.5	15.20	2.75	37.39	26.32	0.19	3.20	2.01	1.40	1.56	8.02	11.22
46.	SiA 3891	52.5	143.7	30.6	2.02	20.20	1.20	2.95	81.0	19.30	3.10	43.99	30.20	0.21	2.49	2.24	1.15	1.95	8.70	11.56
47.	SiA 3982	53.0	104.0	30.1	2.11	20.20	1.79	4.85	85.0	12.35	2.78	45.33	20.16	0.15	4.07	3.15	1.60	2.10	8.85	12.23
48.	SiA 4023	51.0	139.9	36.5	2.23	20.40	1.39	3.50	80.0	14.80	3.00	40.92	31.11	0.26	3.61	2.10	1.80	2.01	10.8	10.14
49.	SiA 4029	50.0	117.0	30.7	1.92	15.15	1.54	3.77	81.0	13.35	3.34	43.23	28.16	0.23	2.45	3.10	1.05	1.40	9.65	9.88
50.	SiA 4036	52.5	141.0	32.8	2.08	18.80	1.21	4.53	85.0	17.50	2.88	38.19	24.15	0.15	3.53	2.10	1.66	1.50	8.89	13.86
51.	SiA 4042	53.5	134.9	30.9	1.79	19.60	1.25	4.85	85.0	12.70	2.51	33.29	28.20	0.18	2.60	2.50	1.76	1.60	8.18	12.30
52.	SiA 4063	53.0	127.6	32.2	1.95	14.45	1.24	4.75	84.0	11.70	2.99	44.78	32.02	0.10	3.80	2.50	1.85	1.50	7.13	11.25
53.	SiA 4184	51.0	143.5	31.8	1.95	21.59	1.35	3.50	82.0	23.05	2.94	41.63	20.20	0.10	2.60	1.80	1.70	2.21	9.75	16.36
54.	SiA 4193	48.0	116.8	26.4	2.16	19.00	2.02	4.50	78.0	14.10	2.82	34.88	21.05	0.18	3.50	2.90	1.59	2.10	9.05	6.54
55.	SiA 4195	52.0	138.8	38.5	3.00	20.60	1.90	4.95	85.0	20.05	2.67	41.96	28.02	0.18	4.03	2.60	1.60	1.50	8.03	16.54
56.	SiA 4197	57.0	131.2	31.0	1.90	18.55	1.67	4.03	92.0	19.50	2.75	37.28	32.02	0.12	2.48	2.50	2.03	0.93	9.46	15.80
57.	SiA 3156	47.0	134.7	27.3	3.10	17.85	1.36	2.47	79.5	19.00	3.09	38.64	28.02	0.22	2.53	3.01	1.23	0.88	10.6	9.62
58.	SiA 3223	49.0	162.2	31.7	2.05	18.15	2.05	1.65	80.0	29.00	2.88	33.13	22.01	0.11	2.45	3.10	0.95	0.94	8.04	9.77
59.	SiA 3159	51.0	156.1	40.7	3.01	22.00	1.60	4.70	82.0	15.15	2.68	41.17	20.14	0.14	2.58	3.20	0.95	1.01	7.66	15.50
60.	SiA 3222	33.0	77.6	31.7	2.74	15.55	1.12	2.70	60.5	30.20	2.77	43.00	32.02	0.12	3.03	2.80	1.90	2.45	10.3	11.54
61.	SiA 3085	47.0	105.8	29.9	2.04	17.30	1.26	3.50	78.0	16.05	3.11	44.33	20.13	0.12	3.46	3.23	1.54	2.09	8.01	10.28
62.	Srilakshmi	46.0	134.0	29.5	1.71	20.30	1.80	2.80	80.5	18.00	2.80	43.29	22.23	0.13	4.22	3.60	1.60	2.12	7.32	9.83
63.	Suryanandi	46.0	126.0	26.6	1.94	14.80	1.14	4.00	80.0	13.50	2.90	39.77	23.05	0.08	2.10	3.25	1.32	2.10	10.98	9.94
64.	Krishnadevaraya	54.0	149.9	32.8	2.06	20.30	1.22	4.25	84.0	20.30	3.06	39.22	20.14	0.23	3.96	3.20	1.90	1.40	8.87	17.34
	Mean	50.50	133.20	32.5	2.16	19.65	1.69	3.87	82.0	18.51	2.89	39.97	25.79	0.20	3.01	2.49	1.52	1.74	9.22	13.44
	C.V.	5.7	5.2	5.11	5.36	5.50	6.72	7.8i5	6.2	7.60	6.50	6.88	5.33	6.18	5.23	4.98	7.24	5.67	5.11	9.25
	S.E.	2.0	4.9	1.17	0.08	0.76	0.08	0.21	3.6	0.99	0.13	1.95	0.97	0.01	0.11	0.09	0.08	0.07	0.33	0.88
	C.D. 5%	5.7	13.9	3.32	0.23	2.16	0.23	0.61	10.2	2.81	0.37	5.50	2.75	0.02	0.31	0.25	0.22	0.20	0.94	2.49
	C.D. 1%	7.6	18.5	4.41	0.31	2.87	0.30	0.81	13.5	3.74	0.50	7.31	3.65	0.03	0.42	0.33	0.29	0.26	1.25	3.30

DFF= Days to 50% flowering, PH= Plant height (cm), FLBL= Flag leaf blade length (cm), FLBW= Flag leaf blade width (cm), PL= Panicle length (cm), PW= Panicle width (cm), PTP Productive tillers per plant, DM= Days to maturity, WF Weight of five panicles (g), TW= Test weight (g), HI= Harvest index (%), Ca= Seed calcium content 100g), P= Seed phosphorous content 100g), Fe= Seed iron content (mg/100g), Zn= Seed zinc content (mg/100g), Cu= Seed copper content (mg/100g), Mn= Seed manganese content (mg/100g), Protein= Seed protein content (g/100g), GYP Grain yield per plant (g).

Table 3: Analysis of variance for grain yield and quality components in foxtail millet (*Setaria italica* L.).

	DF	DFF	PH	FLBL	FL BW	PL	PW	PTPP	DM	WFP	TW	HI	Ca	P	Fe	Zn	Cu	Mn	Protein	GYPP
Replications	1	0.131	31.521	0.815	0.004	2.124	0.018	0.119	-0.011	0.081	0.002	0.7	0.076	0	0	0.004	0.001	0	0.044	0.087
Treatments (unadjusted)	63	38.624 **	423.049 **	16.721 **	0.183 **	14.164 **	0.394 **	1.396 **	52.003 **	33.914 **	0.079 **	37.735 **	50.157 **	0.006 **	1.159 **	0.789 **	0.191 **	0.471 **	4.539 **	22.080 **
Blocks within Replications (adj)	14	7.273	56.577	3.519	0.013	0.995	0.02	0.083	22.872	2.138	0.039	5.041	1.313	0	0.031	0.017	0.021	0.009	0.129	1.496
Intra block Error	49	8.511	46.401	2.534	0.014	1.22	0.011	0.095	26.854	1.933	0.034	8.293	2.054	0	0.023	0.015	0.010	0.010	0.248	1.561
Total	127	23.247	234.247	9.667	0.097	7.623	0.202	0.739	38.679	17.806	0.057	22.480	25.819	0.003	0.587	0.399	0.101	0.239	2.362	11.721

DFF= Days to 50% flowering, PH= Plant height (cm), FLBL= Flag leaf blade length (cm), FLBW= Flag leaf blade width (cm), PL= Panicle length (cm), PW= Panicle width (cm), PTP Productive tillers per plant, DM= Days to maturity, WF Weight of five panicles (g), TW= Test weight (g), HI= Harvest index (%), Ca= Seed calcium content 100g), P= Seed phosphorous content 100g), Fe= Seed iron content (mg/100g), Zn= Seed zinc content (mg/100g), Cu= Seed copper content (mg/100g), Mn= Seed manganese content (mg/100g), Protein= Seed protein content (g/100g), GYP Grain yield per plant (g).
*Significance at 5% level; **significance at 1% level

Table 4: Estimates of variability, heritability, genetic advance and genetic advance as percent of mean for grain yield and quality components in foxtail millet (*Setaria italica* L.).

Sr. No.	Character	Mean	Range		Coefficient of Variation		Heritability (Broad Sense)(%)	Genetic Advance 5%	Genetic Advance as % of Mean 5%
			Minimum	Maximum	GCV	PCV			
1.	Days to 50% flowering	50.50	33.00	63.00	7.72	9.58	64.90	6.47	12.80
2.	Plant height (cm)	133.20	77.60	162.20	10.27	11.53	79.40	25.11	18.85
3.	Flag leaf blade length (cm)	32.46	26.40	40.70	8.14	9.61	71.70	4.61	14.20
4.	Flag leaf blade width (cm)	2.16	1.71	3.10	13.44	14.47	86.30	0.56	25.72
5.	Panicle length (cm)	19.65	9.67	27.00	12.97	14.09	84.70	4.83	24.60
6.	Panicle width (cm)	1.69	1.12	3.00	25.89	26.75	93.70	0.87	51.63
7.	Productive tillers per plant	3.87	1.65	5.60	20.88	22.31	87.60	1.56	40.26
8.	Days to maturity	82.00	60.50	92.00	4.40	7.61	33.40	4.29	5.24
9.	Weight of five panicles (g)	18.51	11.25	30.20	21.58	22.88	89.00	7.77	41.94
10.	Test weight (g)	2.89	2.30	3.34	5.13	8.28	38.30	0.19	6.54
11.	Harvest index (%)	39.97	30.34	46.31	9.72	11.91	66.60	6.53	16.33
12.	Seed calcium content (mg/100g)	25.79	16.21	35.20	19.05	19.78	92.70	9.75	37.78
13.	Seed phosphorous content (mg/100g)	0.20	0.08	0.35	27.70	28.38	95.30	0.11	55.68
14.	Seed iron content (mg/100g)	3.01	1.35	4.45	25.04	25.58	95.80	1.52	50.50
15.	Seed zinc content (mg/100g)	2.49	0.93	3.80	25.00	25.49	96.20	1.26	50.50
16.	Seed copper content (mg/100g)	1.52	0.95al	2.10	19.66	20.95	88.10	0.58	38.00
17.	Seed manganese content (mg/100g)	1.74	0.72	2.99	27.55	28.13	95.90	0.97	55.59
18.	Seed protein content (g/100g)	9.22	6.26	13.08	15.94	16.74	90.70	2.88	31.26
19.	Grain yield per plant (g)	13.44	6.54	22.49	23.83	25.57	86.90	6.15	45.77

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

Table 5: Screening of foxtail millet genotypes against blast disease.

Sr. No.	Genotypes	Disease scoring scale (1-9 Scale)	S. No.	Genotypes	Disease scoring scale (1-9 Scale)
1.	SiA 58	8.2	33.	SiA 3501	8.2
2.	SiA 179	3.8	34.	SiA 3505	1.9
3.	SiA 1135	0.8	35.	SiA 3527	1.9
4.	SiA 1493	2.1	36.	SiA 3540	2.2
5.	SiA 1827	4.1	37.	SiA 3571	3.5
6.	SiA 2107	4.5	38.	SiA 3595	0.8
7.	SiA 2566	1.9	39.	SiA 3616	2.6
8.	SiA 2670	2.2	40.	SiA 3641	4.2
9.	SiA 2677	3.9	41.	SiA 3666	3.8
10.	SiA 2703	2.5	42.	SiA 3669	4.4
11.	SiA 2711	3.3	43.	SiA 3670	4.0
12.	SiA 2755	4.1	44.	SiA 3702	1.6
13.	SiA 2846	1.8	45.	SiA 3703	1.8
14.	SiA 2853	2.5	46.	SiA 3801	3.5
15.	SiA 3281	6.5	47.	SiA 3818	4.2
16.	Srilakshmi	8.6	48.	SiA 3891	1.5
17.	SiA 3287	1.9	49.	SiA 3982	4.0
18.	SiA 3288	2.2	50.	SiA 4023	8.9
19.	SiA 3289	2.4	51.	SiA 4029	1.9
20.	SiA 3291	6.4	52.	SiA 4036	1.9
21.	SiA 3292	0.8	53.	SiA 4042	1.8
22.	SiA 3294	1.7	54.	Krishnadevaraya	2.6
23.	SiA 3318	0.7	55.	SiA 4063	6.2
24.	SiA 3347	1.8	56.	SiA 4184	2.5
25.	SiA 3399	0.8	57.	SiA 4193	0.8
26.	SiA 3420	4.7	58.	SiA 4195	2.2
27.	Suryanandi	0.9	59.	SiA 4197	4.1
28.	SiA 3443	1.9	60.	SiA 3156	8.2
29.	SiA 3449	2.2	61.	SiA 3223	1.8
30.	SiA 3457	2.5	62.	SiA 3159	5.7
31.	SiA 3467	3.8	63.	SiA 3222	1.7
32.	SiA 3469	6.3	64.	SiA 3085	2.0

Table 6: Grouping of genotypes based on scoring for blast in foxtail millet [*Setaria italica* (L.)].

Score	Reaction	No. of genotypes	Genotypes
0.0-1.0	Resistant	7	SiA 1135, SiA 3292, SiA 3318, SiA 3399, SiA 3595, SiA 4193, Suryanandi.
1.1-3.0	Moderately resistant	30	SiA 1493, SiA 2566, SiA 2670, SiA 2703, SiA 2846, SiA 2853, SiA 3287, SiA 3288, SiA 3289, SiA 3294, SiA 3347, SiA 3443, SiA 3449, SiA 3457, SiA 3505, SiA 3527, SiA 3540, SiA 3616, SiA 3702, SiA 3703, SiA 3891, SiA 4029, SiA 4036, SiA 4042, Krishnadevaraya, SiA 4184, SiA 4195, SiA 3223, SiA 3222, SiA 3085.
3.1-5.0	Moderately susceptible	17	SiA 179, SiA 1827, SiA 2107, SiA 2677, SiA 2711, SiA 2755, SiA 3420, SiA 3467, SiA 3571, SiA 3641, SiA 3666, SiA 3669, SiA 3670, SiA 3801, SiA 3818, SiA 3982, SiA 4197.
5.1-7.0	Susceptible	5	SiA 3281, SiA 3291, SiA 3469, SiA 4063, SiA 3159.
7.1-9.0	Highly susceptible	5	SiA 58, Srilakshmi, SiA 3501, SiA 4023, SiA 3156.

Table 7: List of promising genotypes with desirable traits combination.

Sr. No.	Genotypes	GYPP	DR	Ca	Fe	Zn	Protein
1.	SiA 1135	16.75	R	27.10	4.08	2.80	9.75
2.	SiA 3318	21.64	R	30.18	2.51	1.81	6.43
3.	SiA 1493	15.80	MR	25.05	3.88	1.80	9.75
4.	SiA 2670	16.13	MR	30.52	2.90	2.50	9.75
5.	SiA 2703	17.45	MR	32.52	3.00	3.10	7.31
6.	SiA 2853	17.20	MR	30.00	1.35	1.04	8.34
7.	SiA 3289	17.19	MR	20.16	2.90	2.40	9.75
8.	SiA 3294	17.36	MR	22.18	3.20	2.10	10.83
9.	SiA 3443	18.25	MR	19.63	2.10	3.00	7.62
10.	SiA 3449	19.36	MR	30.18	2.19	2.31	9.74
11.	SiA 3505	16.07	MR	17.15	1.50	2.10	10.64
12.	SiA 3527	16.07	MR	17.15	1.50	2.11	10.65
13.	SiA 3540	16.69	MR	28.36	2.60	2.10	12.43
14.	SiA 4184	16.36	MR	20.20	2.60	1.80	9.75
15.	SiA 4195	16.54	MR	28.02	4.03	2.60	8.03
Checks							
16.	Suryanandi	9.94	R	23.05	2.10	3.25	10.98
17.	Krishnadevaraya	17.34	MR	20.14	3.96	3.20	8.87
18.	Srilakshmi	9.83	HS	22.23	4.22	3.60	7.32
C.D. 0.05		2.49		2.75	0.31	0.25	0.94

GYPP = Grain yield per plant (g), DR = Disease reaction, Ca = Seed calcium content (mg/100g), Fe = Seed iron content (mg/100g), Zn = Seed zinc content (mg/100g), Protein = Seed protein content (%), R = resistant, MR = moderately resistant, HS = highly susceptible and C. D = critical difference.

CONCLUSION

In the cases of days to 50% flowering, flag leaf blade length, and harvest index, high heritability together with moderate genetic advance were identified, illuminating the role of additive and non-additive gene action. The remaining parameters, including days to maturity and test weight, displayed moderate to low heritability and little genetic advance, showing the functioning of non-additive gene action. Therefore, these characteristics may be used through heterosis breeding, cyclic hybridization, bi-parental mating, and diallel selective mating systems.

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REFERENCES

Anonymous (2016). Proceedings of 27th Annual Group Meeting of AICRP on Small Millets, 2016. Held at Regional Agricultural Research Station, Tirupati.

Anuradha, N. and Patro, T. S. S. K. (2019). Genetic variability, heritability and genetic advance in foxtail millet breeding lines. *International journal of chemical studies, 7*(3), 2967-2969.

Ayesha, Md. and Babu, D. R. (2019). Genetic divergence studies in foxtail millet (*Setaria italic* (L.) Beauv.). *Electronic Journal of Plant Breeding, 10*(1), 18-29.

Banu, H., Gowda, J. and Nanjareddy, Y. A. (2017). Identification of elite germplasm at multilocational for nutritional quality parameters in foxtail millet (*Setaria italic* (L.) Beauv). *Green Farming, 8*(5), 1189-1192.

Harish, V. V. and Lavanya, G. R. (2022). Genetic Variability and Character Association Studies in Foxtail Millet (*Setaria italica* L.) for Grain Yield Characters. *International Journal of Environment and Climate Change, 12*(11), 2929-2938.

Hirano, R., Naito, K., Fukunga, K., Watanable, K. N., Ohsawa, R. and Kasawa, M. (2011). Genetic structure of landraces in foxtail millet (*Setaria italica* (L) P. Beauv.) revealed with transposon display and interpretation to crop evolution of foxtail millet. *Genome*, *54*, 498-406.

Kavya, P., Sujatha, M., Pandravada, S. R. and Hymavathi, T. V. (2017a). Variability studies in foxtail millet (*Setaria italic* (L.) Beauv). *International Journal of Current Microbiology and Applied Sciences, 6*(9), 955-960.

Kumar, G. P., Prasad, A. D., Reddy, C. V. C. M. and Sreenivasulu, K. N. (2019c). Genetic variability analysis for yield and nutritional traits in foxtail millet (*Setaria italic* (L.) Beauv). *International Journal of Current Microbiology and Applied Sciences, 8*(6), 2273-2279.

Munirathnam, P., Venkataramanamma, K. and Anusha, A. (2015). Evaluation of foxtail millet genotypes for blast and rust diseases under field conditions. *Current Biotica, 9*(3), 263-268.

Murugan, R. and Nirmalakumari, A. (2006). Genetic diversity in foxtail millet (*Setaria italic* (L.) Beauv). *Indian Journal of Genetics, 66*(4), 339-340.

Nagaraja, A., Kumar, J., Jain, A. K., Narasimhadu, Y., Raghuchander, T., Kumar B. and Gowda, B. H. (2007). Compendium of small millets diseases. Project Coordinator Cell, All India Coordinated Small Millets Improvement Project, UAS, GKVK Campus, Bengaluru, 80.

Rajesh, M., Sudha, A., Nirmalakumari, A. and Parasuraman, P. (2019). Identification of resistant sources for blast and rust in foxtail millet incited by *Pyricularia setariae* and *Uromyces setariae-Italica*. *International Journal of Current Microbiology and Applied Sciences, 8*, 1796-1800.

Srilatha, J., Haritha, T., Reddy, C.V.C.M. and Ramesh, D., (2020). Genetic variability studies for yield and nutritional traits in foxtail millet (*Setaria italica* (L.) Beauv.). *Journal of Pharmacognosy and Phytochemistry*, *9*(6), 596-600.

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