Assessment of Genetic Variability for Yield and Yield Attributing Traits in Finger Millet (*Eleusine coracana* L. Gaertn.)

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Abstract: ***The experimental material for the genetic variability comprised of 50 indigenous genotypes of finger millet collected from All India Co-ordinated Research Project on Small Millets ZARS, Kolhapur. The experiment was conducted in Randomized Block Design (RBD) with three replications. The data on 13 quantitative traits were recorded to assess the magnitude of genetic variability, heritability and genetic advance for yield and yield contributing traits. The GCV and PCV both were observed to be high for protein content, length of finger, grain yield per plant , ear weight per plant, iron content,. Thus, these characters provide good source of variation and hence can be used in crop improvement programme in finger millet. High heritability estimates were obtained for almost all the characters. Therefore, there is scope for improvement of iron content, days to maturity, 1000-seed weight, protein content, days to 50 per cent flowering and length of finger. Based on per se performance of genotypes KOPU-1179, KOPN-1174, KOPN-1166, KOPN-1180 and KOPN-1172 were found promising for yield and yield attributing traits and can be used as potential parent in future crop improvement.***

Keywords: Finger millet, variability, genotypes, coefficient of variance, heritability and genetic advance

1. Introduction

Finger millet (*Eleusine coracana* L. Gaertn.) is an allotetraploid belonging to the family poaceae and the genus *Eleusine.* Finger millet is also known as *Ragi* or *Nachani* and common name 'Finger millet' is derived from the finger-like branching of the panicle. In India, finger millet is cultivated over a wide range of agro climatic conditions almost in all states like Karnataka, Maharashtra, Uttarakhand, Tamil Nadu, Andhra Pradesh, Gujarat, Jharkhand, Bihar and Orisa. In India, finger millet cultivated since ancient time and is serving as a food for working class and rank third among millet after sorghum and pearl millet. This crop is well known for its exceptionally high calcium (Ca) content having about 0.34% in whole seeds as compared with 0.01–0.06% in most other cereals (Gupta *et al.* 2017). Finger millet is important but underutilized crops in tropical and semiarid regions of the world due to their greater resistance to pests and diseases, good adaption to a wide range of environment and their good yield of production, can withstand significant levels of salinity, resistant to water logging, drought tolerant, requires little inputs during growth. The achievement of this crop in plant breeding programme is largely depends upon the genetic variability available in breeding population and the efficiency of selection technique.

The present investigation is conducted to estimate the magnitude of difference for yield contributing traits in 50 indigenous genotypes of finger millet by studying the genetic parameters like phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance, which may contribute to formulation of suitable selection indices for improvement in this crop.

2. Materials and Methods

The experimental material for the genetic variability comprised of 50 indigenous genotypes of finger millet [*Eleusine coracana* L. Gaertn.], collected from All India Co-ordinated Research Project on Small Millets ZARS, Kolhapur. A piece of land selected for experiment was brought to fine tilth by ploughing followed by harrowing. The experiment was conducted at Botany Farm, College of Agriculture, Pune during *kharif,* 2018 by following Randomized Block Design (RBD) with three replications. Each entry was represented by single rows of 5.0 meter length with spacing of 30 cm between the rows and 10 cm between plants. Two border rows along the length of each replication were grown to avoid the border effects. The recommended dose of 50:40:25 NPK (kg/ha) was applied at the time of sowing. All other recommended cultural practices were carried out to raise a good crop. The observations were recorded on five randomly selected plants from each treatment in each replication for all 13 quantitative traits and the average of these five plants was worked out for the statistical computation and further used for the genetic diversity study.

The data were subjected to mean performance for 13 traits. Estimates of GCV and PCV were estimated as per formula given by Burton and Devane (1953). Heritability in broad sense was calculated as per the formula given by Allard (1960). Genetic advance was expressed by using the formula suggested by Johnson *et* al. (1955).

3. Results and Discussion

The mean performances of 50 indigenous genotypes of finger millet for 13 traits were presented in Table 1. Range of variability, estimates of genotypic and phenotypic coefficient of variation, heritability percentage in broad sense, genetic advance and genetic advance as per cent of mean were presented in Table 2. In a crop improvement programme, efficiency of selection of suitable parents depends on the amount of genetic variability present in a crop. The extent of variability in a crop population for a character is assessed by measuring genotypic and phenotypic coefficients of variation. The role of genetic factors in expression of phenotype is indicated by heritability. The expected genetic gain from selection in a population is calculated by working out the genetic advance. The efficiency of selection is best obtained by calculating the heritability along with genetic advance.

In the present investigation, among 50 genotypes KOPN-1181 exhibited highest *per se* performance for days to 50 per cent flowering and days to maturity, while the genotype KOPN-1179 exhibited highest *per se* performance for number of productive tillers per plant. The genotype KOPN-1172 exhibited highest *per se* performance for plant height. The genotype KOPN -1166 recorded highest *per se* performance for length of finger. The genotype KOPN-1179 recorded highest *per se* performance for grain yield per plant. The genotype KOPN-1180 recorded for highest performance for 1000-seed weight. The genotype KOPN-1181 exhibited desirable *per se* performance for days to 50 per cent flowering, while the genotype KOPN-1168 was earliest to mature.

It was observed that the estimates for genotypic coefficients of variation (GCV) were lower than the phenotypic coefficients of variation (PCV) for all the characters studied. The character number of days to maturity exhibited lowest GCV (7.36%) as well as PCV (7.45%), followed by plant height, days to 50 per cent flowering, fodder yield per plant and harvest index, while the character protein content had highest GCV (20.47%) as well as PCV (20.87%), followed by length of finger, grain yield per plant, number of fertile tillers, ear weight per plant, iron content, number of fingers per ear and 1000-seed weight. The highest difference between GCV and PCV values was observed for fodder yield per plant (5.71%), followed by grain yield per plant (3.36%) and ear weight per plant (3.22%), while number of days to maturity (0.09%), iron content (0.12%) and 1000 -seed weight (0.14%) exhibited lowest difference between GCV and PCV estimates. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all characters. This indicates the effect of environmental factors on these characters. These results were in confirmation with the earlier findings of Dhamdhere *et al.* (2011), Karad and Patil (2013) and Lad *et al.*(2018).

The characters protein content, length of finger, grain yield per plant, number of fertile tillers, ear weight per plant and iron content showed higher estimates of GCV and PCV. This shows presence of large variation in the genotypes for these characters. Therefore, simple selection can be obtained for the improvement of these characters. The estimates of GCV and PCV were highest for protein content, length of finger, grain yield per plant. These results were in conformation with the findings of Priyadharshini *et al*. (2011). Similar, results were obtained by Ulaganathan and Nirmalakumari (2014) for grain yield per plant and fertile tiller per plant. The estimates of GCV and PCV were high for fertile tillers per plant and length of finger. These results were in confirmation with the findings of Wolie and Dessalegn (2011).

The estimates of heritability (b.s.) ranged from 37.01 to 98.07 %. The lowest heritability was observed in case of fodder yield per plant (37.01 %), followed by plant height (59.11 %), ear weight per plant (62.66 %) and harvest index (64.85 %). The highest heritability was observed for iron content (98.07 %), followed by 1000-seed weight (97.80 %), days to maturity (97.50 %), protein content (96.28 %), number of days to 50 per cent flowering (95.15 %) and length of finger (90.13 %).

High heritability along with high genetic advance gives the best efficiency for selection. The high heritability was observed for iron content, 1000 - seed weight, days to maturity, protein content, days to 50 per cent flowering and length of finger, which indicates the least influence of environment on these characters. In present investigation, high heritability with high genetic advance was observed for days to maturity, iron content, days to 50 per cent flowering and plant height. Similar, findings were reported by Kadam *et al*.(2009) for 1000-seed weight and Karad and Patil (2013) for plant height.

The character number of days to maturity (16.42 days) showed highest genetic advance, followed by iron content (13.42 ppm), number of days to 50 per cent flowering (12.46 days), plant height (11.57 cm) and harvest index (4.50 %). The lowest genetic advance was observed for number of fertile tillers per plant (0.46), 1000-seed weight (0.65 g), number of fingers per ear (1.38 %), protein content (2.03 %), grain yield per plant (2.37 g), length of finger (2.40 cm), ear weight per plant (2.61 g) and fodder yield per plant (3.00 g).

The character protein content (41.39%) showed highest genetic advance as per cent of mean, followed by length of finger (35.27%), grain yield per plant (29.38%), fertile tillers per plant (25.22%), iron content (24.86%), 1000-seed weight (24.23%), fingers per ear (22.51%), ear weight per plant (19.94%), days to 50 per cent flowering (17.49%), harvest index (14.99), days to maturity (14.97%), plant height (13.00%) and fodder yield per plant (11.11%). Similar, findings were reported by Priyadharshini *et al*. (2011) for protein content, fertile tillers per plant, length of finger and grain yield per plant and Mahanthesha *et al.* (2017) for fertile tillers per plant, length of finger and grain yield per plant.

4. Conclusion

In the present investigation genotypes KOPN-1179, KOPN-1174, KOPN-1166, KOPN-1162, KOPN-1178, KOPN-1176, KOPN-1160, KOPN-1181, KOPN-1182 and KOPN-1184 were found promising and having desired *per se* performance for yield components and can be used as potential parents in future crop improvement programme. The GCV and PCV both were observed to be high for protein content, length of finger, grain yield per plant , ear weight per plant, iron content,. Thus, these characters provide good source of variation and hence they are useful in crop improvement programme in finger millet. High heritability estimates were obtained for almost all the characters indicated less influence of environmental effects. Therefore, there is ample scope for improvement of iron content, days to maturity, 1000-seed weight, protein content, days to 50 per cent flowering and length of finger.

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Table 1: Mean performance of 50 genotypes of finger millet for 13 characters

S.No.	Genotypes	Days to 50% flowering (No.)	Days to maturity (No.)	Fertile tillers per plant (No.)	Plant height (No.)	Length of finger (cm)	1000 seed weight (g)	Ear weight per plant (g)	Fingers per ear (No.)	Fodder yield per plant (g)	Harvest Index (%)	Protein content (%)	Iron content (ppm)	Grain yield per plant (g)
1	KOPN-113	67	106	1.73	95.47	6.27	2.68	11.83	6.6	29	26.2	4.01	45.53	7.37
2	KOPN-1138	65	105	1.73	90.45	6.35	2.37	12.08	6.2	27.73	26.83	4.84	42.2	7.34
3	KOPN-1139	70.33	114	1.53	91.47	6.69	2.72	12.14	6.3	27.37	26.7	4.39	57.27	7.25
4	KOPN-1140	70	113	1.67	87.28	5.49	2.34	13.04	7.2	26.45	30.67	4.83	54.27	8.02
5	KOPN-1141	74.67	113.33	1.6	88.08	4.95	3.05	13.15	5.6	25.36	30.7	6.31	46.53	7.8
6	KOPN-1142	65	104.67	1.67	87.65	6.2	2.23	12.99	7.17	25.64	32.2	5.16	56.07	8.09
7	KOPN-1143	69.33	107.33	2.07	98.22	7.93	2.71	14.32	6.2	29.45	32.43	3.46	49.73	9.58
8	KOPN-1144	71.33	111	1.87	96.61	8.61	2.73	15.02	6.33	29.21	30.9	3.03	49.13	9.18
9	KOPN-1145	69.33	103.67	1.87	97.6	9.07	3.08	12.23	6.7	22.78	25.8	4.63	55.53	5.68
10	KOPN-1146	70.67	104.33	2.33	86	6.64	3.06	15.17	6.27	29.53	31.63	4.78	49	9.26
11	KOPN-1147	72.67	116	1.53	92.22	8.04	2.64	14.1	5.5	29.28	29.73	6.25	56.47	9.04
12	KOPN-1148	77	118	1.67	92.4	7.62	3.08	13.46	4.73	27.23	30.6	4.6	59.4	8.28
13	KOPN-1149	70.33	101.33	1.47	96.6	8.24	3.07	13.73	5.53	27.31	27.97	6.34	61.87	7.54
14	KOPN-1150	70.33	105.67	1.73	84.51	5.69	2.23	11.39	6.33	25.44	28.53	3.33	58	7.19
15	KOPN-1151	69	119.33	1.93	76.03	5.99	2.23	13.03	5.37	26.73	28.1	5.24	43.4	7.2
16	KOPN-1152	75.33	106	1.73	101.01	8.79	2.15	14.13	6	28.6	26.8	4.25	56.67	7.59
17	KOPN-1153	76.67	108.33	1.87	77.23	5.87	2.75	13.04	6	27.56	31.13	5.35	53.6	8.11
18	KOPN-1154	78	119	1.47	84.26	5.67	2.34	11.65	6.6	24.66	30.48	5.23	52.6	7.24
19	KOPN-1155	69	107.33	1.87	83.84	6.28	2.66	12.78	5.53	25.4	28.4	4.39	64.27	7.39
20	KOPN-1156	78.33	117.67	1.93	88.19	7.46	2.31	12.22	5.4	23.89	28.9	6.23	46.07	6.3
21	KOPN-1157	71.33	11.67	1.87	97.58	6.24	2.67	10.52	6.2	22.09	29.3	4.57	65.53	6.32
22	KOPN-1158	78	118	1.4	98.53	7.11	2.73	11.84	6.57	27.7	27.27	6.28	54.8	7.91
23	KOPN-1159	75.67	118.67	1.87	98.4	8.45	2.68	14.35	7.47	29.63	31.03	5.19	59.4	9.16
24	KOPN-1160	75.33	119	1.67	95.96	8.46	2.75	15.17	8.27	30.16	33.33	4.22	45.4	10.15

25	KOPN-1161	68.67	8	1.67	71.92	6.2	2.37	12.1	6.5	28.31	22.97	6.35	42.53	6.69
26	KOPN-1162	70	102	1.8	92.93	7.76	3.07	13.25	8.27	25.23	29.07	4.55	55.47	7.61
27	KOPN-1163	65.33	101.67	1.67	85.01	6.83	2.75	10.69	6.83	21.53	28.67	4.94	62.53	6.29
28	KOPN-1164	66	103.33	1.67	98.33	5.69	3.08	11.62	6.57	25.69	26.03	5.2	59.8	6.55
29	KOPN-1165	65.33	103.33	1.8	87.01	6.27	2.76	11.59	5.43	24.53	26.9	3.67	44.93	6.45
30	KOPN-1166	64.67	102	1.73	102.33	10.05	2.37	14.8	6.83	28.49	30.5	5.35	47.6	8.2
31	KOPN-1167	64.33	101.67	1.47	91.41	6.08	2.85	14.99	5.8	26.8	31.4	4.26	54.53	8.39
32	KOPN-1168	56.67	97	1.73	86.43	8.61	2.35	10.81	4.9	23.49	26.33	4.35	59.6	6.54
33	KOPN-1169	76.33	118.33	1.87	83.49	5.42	2.75	10.85	5.4	23.18	27.8	4	63.73	6.58
34	KOPN-1170	77.67	116.33	1.47	91.8	6.75	2.3	11.54	6.43	23.37	29.57	6.28	62.2	6.58
35	KOPN-1171	74.33	111.33	1.93	97.43	6.4	2.25	11.37	6.4	23.47	31.53	3.7	54.47	7.43
36	KOPN-1172	74.67	115	1.87	68.77	5.29	2.75	8.72	6.83	19.42	26.87	6.04	59.53	5.39
37	KOPN-1173	70.33	108.33	1.93	94.56	9.23	3.13	13.38	5.4	28.44	32	4.17	53.53	9.15
38	KOPN-1174	86	131.67	1.87	78.89	4.93	3.21	15.36	5.7	29.24	34.67	3.95	58.73	10.17
39	KOPN-1175	87.33	136.33	1.47	66.63	5.69	2.31	10.71	5.8	25.21	26.1	4.24	42.8	6.54
40	KOPN-1176	78.33	104.67	2.27	75.15	6.14	2.66	16.05	5.5	31.09	36.6	5.95	49.53	10.85
41	KOPN-1177	71.33	108.67	2.2	87.35	7.03	3.1	16.1	6	32.18	33.3	6.15	53.53	10.41
42	KOPN-1178	67.33	103.67	2.13	93.19	6.43	2.34	14.16	6.2	31.05	33.33	6.36	65.07	10.13
43	KOPN-1179	76.33	115.33	2.47	92.41	7.48	3.21	16.16	7	34.65	36.37	6.3	64.2	11.36
44	KOPN-1180	72	108.67	2.07	93.98	7.25	3.21	13.44	5.4	29.48	33.8	5.36	49.8	10.19
45	KOPN-1181	54	94.33	1.93	88.12	6.41	3.06	16.14	5.47	28.29	33.1	4.34	57.33	9.66
46	KOPN-1182	59	99	2.2	88.67	8.24	3.03	16.28	6.87	31.16	33.93	3.1	56.07	10.3
47	KOPN-1183	71.33	107	2.4	83.74	5.72	3.14	12.67	4.6	26.5	32.47	3.21	53	8.89
48	KOPN-1184	73.33	107	2.47	86.61	5.48	3.09	14.71	5.97	30.35	32.8	6.38	50.6	9.96
49	KOPN-1185	73.67	104.33	1.67	89.06	5.47	2.75	13.34	6.4	25.04	30.13	6.13	43.2	7.1
50	KOPN-1186	69	105	1.8	89.11	5.51	2.75	12.12	5.57	25.55	29.07	4.26	52.87	7.61
	Mean	71.26	109.65	1.83	89	6.81	2.72	13.13	6.16	27	30.02	4.91	54	8.08
	C.V. %	1.97	1.18	7.41	6.83	5.97	1.78	9.44	5.88	11.57	6.65	4.02	1.71	11.21
	C. D. 5%	2.27	2.09	0.22	9.85	0.66	0.08	2.01	0.59	5.06	3.24	0.32	1.49	1.47
	C. D. 1%	3	2.77	0.29	13.04	0.87	0.1	2.66	0.78	6.7	4.28	0.42	1.98	1.94
	S.E.	0.81	0.75	0.08	3.51	0.23	0.03	0.72	0.21	1.8	1.15	0.11	0.53	0.52

Table 2: Genetic parameters of genetic variability in 50 genotypes of finger millet for 13 traits

Sr. No.	Character	Range	Mean	GCV (%)	PCV (%)	h^2 % (b.s.)	Genetic advance	Gen. adv. as % of mean
1	Days to 50% flowering (No.)	54.00 - 87.33	71.26	8.7	8.92	95	12.46	17.49
2	Days to maturity (No.)	94.33 - 136.33	109.65	7.36	7.45	97	16.42	14.97
3	Fertile tillers per plant (No.)	1.40 - 2.47	1.83	13.87	15.73	77	0.46	25.22
4	Plant height (cm)	66.63 - 102.33	88.99	8.21	10.68	59	11.57	13
5	Length of finger (cm)	4.93 - 10.05	6.81	18.03	18.99	90	2.4	35.27
6	1000-seed weight(g)	2.15 - 3.21	2.71	11.89	12.03	97	0.65	24.23
7	Ear weight per plant (g)	8.72 - 16.28	13.13	12.23	15.45	62	2.61	19.94
8	Fingers per ear (No.)	4.60 - 8.27	6.16	12.14	13.48	81	1.38	22.51
9	Fodder yield per plant (g)	19.42 - 34.65	27	8.87	14.58	37	3	11.11
10	Harvest Index (%)	22.97 - 36.60	30.02	9.03	11.22	64	4.5	14.99
11	Protein content (%)	3.03 - 6.38	4.91	20.47	20.87	96	2.03	41.39
12	Iron content (ppm)	42.20 - 65.53	53.99	12.18	12.3	98	13.42	24.86
13	Grain yield per plant (g)	5.39 - 11.36	8.08	17.06	20.42	69	2.37	29.38