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Genetic variability for quality traits in finger millet (*Eleusine coracane* (L.) Gaertn

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Abstract
Forty Finger millet genotypes were sown during kharif 2004 at Dr. B.S.K.K.V., Dapoli. Mean protein content among the 40 genotypes was recorded as 8.6% and range as 6.41 to 11.55% rich. Protein genotypes could be identified as OEB 101 (11.55%), ACPR (11.08%), RAU-8 (10.85), OEB-22 (10.85%), VR-708 (10.61), MR-33 (10.50%), VL-149 (10.15) and OEB-65(9.21).
The genotypes DPI-20114, VL-326, L-48, L-112, OEB-22, VL-315, VL-322, RAU-8, OEB 101, GPU-58 and VR 847 were found to be superior for albumin and globulin combination. Desirable genotypes for higher globulin and lower prolamine content were identified as DPI-201l4, L-112, VL-315 and VL-322.
Mean calcium content was recorded as 362.33 mg/100g and range was recorded as 186.67 to 600.00 mg/100g. Most promising genotypes L-48 and ACPR-l, contains highest calcium (600 mg/100g). Other calcium rich genotypes could be identified as OEB-l0l (586.67), VR-849 (546.67), ACPR-2 (533.33), VR-847 (520.00), OEB-56 (570.00) and PES 110 (493.33).
The genotype DPI-20132 (28.00 MG/100G g) contains highest iron content over all the genotypes. General mean and range for the population was recorded as 14.99 mg/100g and 7.50 to 28.00 mg/100g respectively. However, more iron content was recorded in the genotypes VL-149 (26.33), L-48 (25.00), DPI-20119 (22.66), GPU-56 (22.63) and GPU-57 (20.26).
Higher genetic advance component with high heritability was recorded for the character calcium content indicated additive gene action for expression of this character.

Keywords: Finger millet, variability, protein, calcium, iron, genetic advance

Introduction
Finger millet is the most important crop among millets having out standing properties as subsistence food crop in drought prone region of South Asia and East Africa. In India if is grown in all states like Uttar Pradesh, Himachal Pradesh, Karnataka, Maharashtra, Andra Pradesh, Gujrat, Bihar and Orisa. It contributes nearly 50% of small millet produce of India and occupying an area of 14.22 million hectares [1].
In Maharashtra Finger-millet occupies an area of 145 thousand hectares with an average annual grain production of 851 thousand tonnes. It is mainly cultivated in Thane, Raigad, Ratnagiri, Sindhudarga, Dhule, Jalgaon, Nasik, Ahmednagar, Pune, Satara and Kolhapur district. It is taken as major kharif crop next to rice in Konkan region. It serve as staple food for large number of people in Konkan region who consume, it in the form of unleavened bread and soupe, locally called as Ambil [4]. Among urbanite problem of malnutrition such as obesity, heart diseases and dibetes melliatus are ever increasing for which, finger millet can be better suitable staps cereal grain than any other of the refined cereal such as rice or wheat [12].
The nutritine value of finger millet is better than that of rice and equal to that of wheat. Finger millet has protein content nearer to 7.00 to 10.50 per cent [5] comparable with that of other important varieties of cereals.
In addition, finger millet possesses exceptionally high calcium (261 to 430 mgll 00 g), phosphorus (200-327 mg/ 100 gm) and substantial Iron [6].
Along with quantitative achievement in food production, improvement of nutrititional quality of cereal is important since cereal grain occupy a dominant part in the poor peoples diet, contributing 70 percent of calories in most cases along with significant amount of protein and other nutrients [2].
Improvement in any crop depends upon the extent of genetic variability present. The present study was undertaken to estimate genetic variability for quality character in finger millet (*Eleusine coracana* (L.) Greretn).

However, finger millet is nutri cereal but no attention was given to identify nutritionally superior genotype for Konkan people in general and tribal in particular. Who are suffers of malnutrition.

Materials and Methods

To study the genetic variability for forty finger millet genotypes were sown during the kharif, 2004 on the experimental farm of Department of Agril. Botany Dr. Balasaheb Sawant Konkan Krishi Viyapeeth, Dapoli. These forty genotypes are from various centres all over India. Seed of these genotypes harvested and quality characters like protein, albumin, globulin prolamine, glutelin, calcum and iron content were studied by applying scientific chemical analysis procedure for each parameters.

Protein content

The fat free oven dried 60 mesh floor sample of 0.5 g was digested with 15 ml of cone. H2S04 using 1 g catelyst mixture K2S04: CUS04 (in 10: 1 proportion respectively. Out of 50 ml sample prepared 5 ml sample transferred to distillation unit for estimation of nitrogen by micro kjeldahl method (AOAC, 1945).

Protem fractions (Albumin, globulin, prolamine, glutelin)

The protein in 1.0 g defatted oven dried 60 mesh ragi flour was fractioned into albumin, globulin, prolamine and glutelin by modified Mendel Osbome method as described by Nagy' *et al*. (1941).

Calcum content (mg/l00 g)

The calcium content in samples of various ragi genotypes were determined by titrimetrically employing the methods of Chang and Bray (1951).

The calcium content was calculated by employing the following formula. Calcium content (mg 100g) = AxCxExl00xO.02xl000
FxG

Where

A = Volume o fEDTA required
C = Normality of EDTA (0.01 N)
E = Total volume of sample solution (50 ml)
F = Volume of sample solution taken for titration (5 ml)
G = Weight of four sample (0.5g)

Iron content (mg / 100 g)

Aliquat digested in diacid mixture for calcium estimation used for estimation iron content on Atomic Absorption Spectrophotometer (Varian A.A., 1475). Obtained reading in AAS were recorded and iron content (mg/100g) was calculated by using following formula Iron content (mg/100 g) = Axl00xl00

Where A is reading on atomic absorption machine after subtracting the blank reading.

Statistical analysis

Analysis of variance was done by using technique outlined by Panse and Sukhatme (1954).

Results and Discussion

In present investigation defatted oven dried seeds were taken for chemical analysis for determination of various quality characters in finger millet. Standard procedures were followed.

Mean performance

Protein content

Data presented in Table 1 indicated that the general mean and range for protein content was found to be 8.67 per cent and 6.41 to 11.55 per cent respectively, which indicates wide range of found to variability among the genotypes. The protein content in finger millet varied from 8.0 per cent in Godavari to 12.1 per cent in C-157) [14]. The white grain types had highest protein (11.5%) than brown grain (8.97%) [17].

Genotypic variation indicated that the genotypes OEB 101 (11.55), ACPR 2 (11.08), RAU 8 (10.85), OEB 22 (10.85), VR 108 (10.61), MR 33 (10.50), VL 149 (10.15) and OEB 65 (9.21) recorded significantly higher protein content over the general mean (8.59). The genotype Dapoli has recorded protein content at par to that of general mean (Table 1).

Protein fraction

Sufficient amount of protein fractions are present in the seed of finger millet. Albumin is one of the important protein fraction which contributes to the diet of human being. High albumin content is desirable in the finger millet genotypes. Data presented in table indicated that general mean and range was found be 1.22 per cent and 0.61 to 1.85 per cent respectively.

Significantly higher albumin content was noticed in the genotypes OEB 101 (1.81), VL 847 (1.81), DPI 20114 (1.64), VL-326(1.64), OEB-22 (1.64), VL-322 (1.64), RAU-8 (1.64), VR- 708 (1.64), DM-1 (1.64), GPU-58 (1.64) and MR-33 (1.64) over general mean of 1.22%.

Venkana Babu *et al*. (1987) reported that albumin content varied from 0.7 to 1.0 per cent,- globulin from 1.0 to 1.5 percent in finger millet.

Mean globulin content was recorded as 1.23% and range was found to 0.61 to 1.85 percent. Significantly higher globulin content was recorded in the genotypes L-112 (1.85), RAU-8 (1.85) and VR-22 (1.85) than general mean of the population (1.23%).

High prolamine protein fraction was found to be poor source of lysine and sulphur containing amino acids. Finger millet genotypes with lower prolamine content were found to be desirable genotypes. General mean for prolamine content was recorded as 4.00 per cent and range was found to be 2.67 to 5.36 per cent, which indicated wide range of variability for prolamine content. Similar results were report by [15].

Significantly lower prolamine was found among the genotypes DPI-20132 (3.49), VL- 322(3.49), GPU-57 (3.09), HR-374 (3.09), DPI-20114 (2.88), OEB-71 (2.88) and VR-849 (2.88) over the general mean of the population (4.42%).

Glutelin is also one of the important protein fraction as that of albumin and globulin. Data presented in Table 1 indicated that the general mean and range for glutelin content was recorded as 3.64 per cent and 2.67 to 4.73 percent respectively. Genotypic performance shows that L-221 (4.73), VR-708 (4.75), DM-7 (4.73), GPU -56 (4.73), RAU-8 (4.32), PR-202 (4.32), LJM (4.32), ACPR-2 (4.11), OEB-56 (4.11), DM-4 (4.11), VR-822 (4.11) and MR-33 (4.11) were found to be rich souce of glutelin. Similar result in finger millet for glutelin content reported [9].

Considering the composition of protein fraction of the finger millet genotypes, DPI-20114, VL-326, L-48, L-112, OEB-22, VL-315, VL-322, RAU-8, OEB-I0l, GPU-58 and VR-847 were four: d to be superior for albumin and globulin combination, while genotypes DPI- 20114, L-112, VL-315, and VL-322 were found to be most desirable genotypes for higher albumin, globulin and lower prolamine content.

Calcium content

Finger millet is important minor millet which contains higher amount of calcium in its grain. In present study general mean and range was recorded as 362.33 mg/100g and 186.67 to 600.00 rug/ l00g respectively. The mineral composition of hybrids/varieties of ragi from Maharashtra, Andra Pradesh and Karnataka States and reported that calcium content varies from 259 to 520 mg/100 g in finger millet grains [9]. Significantly higher calcium was noticed in the genotypes L-84 (600.00), ACPR-1 (600.00), OEB-101 (586.67), VR-849 (546.67), ACPR-2 (533.33), VR-847 (520.00), OEB-56 (520.00), PES-110 (493.33), GPU-56 (466.67), OEB-71 (453.35), L-221 (413.33) and OEB-22 (413.33) over the general mean of 362.33 mg/100 g. Shukla *et al*. (1985b) recorded 331.80 to 542.46 mg/100g calcium content in finger millet varieties like PR-202, HR-374 and Co-9 (Table 1).

Iron content

Finger millet grains also contains high amount of iron which is important constituent of blood haemoglobin. Data presented in Table 1 indicated that general mean and range for iron content was recorded as 14.99 mg/100 g and 7.50 to 28.00 mg/100 g respectively. Significantly higher iron content was observed in the genotypes DPI-20 132 (28.00), VL-149 (26.23), L-48 (25.50), DPI-20114 (22.66), GPU-56 (22.63), GPU-57 (20.26), VR-768 (19.20), L-84 (19.00), VR-768 (19.10), L-84 (19.00), VR-315 (18.50), RAU-8 (18.50), ACPR-1 (17.96), VR-708 (17.63), OEB-I0l (17.76), VL-322 (16.66), DM-l (16.03) and VR-847 (16.00) than the general mean (14.99 mg/l00g). These genotypes could be used in breeding programme as a rich source of iron. Iron content varied fro 3.40 to 22.8 mg/l00g in different finger millet varieties [9].

Similarly iron content varied from 19.00 to 20.00 mg/lOOg in nine cultivars of finger millet from Bhubaneshwar [11].

Genotypic coefficient of variation (GCV)

Higher genotypes coefficient of variation was observed for the characters calcium content (37.99), iron content (34.30), globulin content (32.28%), albumin content (28.58), while prolamine content (17.18), glutetin content (18.17) and protein content (14.18) recorded moderate genotypic co-efficient of variation. The characters which recorded the maximum genotypic coefficient of variation are of most important and suggested their ability to express themselves over the different environmental condition.

Phonotypic Coeffia of variation (PCV)

Higher Phonotypic coeffia of variation (PCV) was recorded for the characters globulin content (39.56), calcium content (38.76), albumin content (36.34) and iron content (34.48) while moderate phenotypic coefficient of variation (PCV) was observed in characters prolamine content (18.37), glutelin content (17.60) and protein content (14.46). Higher GCV and pcv of the characters indicated high amount of variation among the genotypes. There was not much different between gcv end pcv for these traits suggesting minimum role of the environments in the manifestation of these characters.

Heritability

Data presented in Table 2 indicated that the characters protein content (96.1), prolamine content (86.7), glutelin content (84.4), calcium content (96.1) and iron content (99.0) recorded higher heritability estimates, indicating full expression of these traits with rmrumum environmental effect while albumin (61.9) and globulin content (66.0) have recorded moderate heritability indicated comparatively less expression of trait.

Table 1: Mean performance of finger millet genotypes for different quality characters.

Sr. No.	Genotype	Protein content (%)	Albumin (%)	Globulin	Prolamine (%)	Glutelin (%)	Calcium (mg/100g)	Iron I (mg/100g)
1		8.98	1.64	1.64	2.88	3.49	240.00	22.66
2		8.17	0.81	1.43	3.49	3.26	226.67	28.00
3		8.28	1.02	0.81	4.94	3.49	600.00	17.96
4		11.08	1.23	0.61	4.11	4.11	533.33	22.83
5		8.98	1.64	1.64	4.73	2.67	213.33	8.53
6		8.86	1.43	1.64	4.11	3.09	373.30	25.50
7		7.00	1.23	1.85	2.67	3.49	306.67	9.03
8		8.75	0.61	1.43	4.11	4.73	413.33	9.03
9		6.88	0.81	1.02	2.88	3.49	226.66	12.40
10		10.15	1.02	0.61	4.73	4.32	213.33	14.43
11		10.85	1.64	1.64	4.73	3.49	413.33	15.50
12		9.21	1.23	1.23	3.90	4.11	200.00	8.73
13		6.41	0.61	0.81	2.88	3.90	453.33	14.50
14		8.28	0.81	0.81	4.73	3.49	186.67	14.83
15		8.75	0.61	0.61	5.35	3.26	200.00	9.70
16		8.16	0.81	1.64	4.11	4.11	533.33	26.23
17		8.16	1.43	1.64	2.88	2.88	333.33	9.50
18		8.28	1.64	1.02	3.49	3.26	400.00	16.66
19		8.05	1.23	1.02	4.11	2.67	386.67	18.50
20		6.88	1.02	1.23	3.09	3.09	213.33	14.36
21		10.85	1.64	1.81	4.11	4.32	400.00	18.50
22		10.61	1.64	0.61	3.90	4.73	613.33	17.63
23		8.86	1.02	1.02	4.11	4.73	373.33	7.50
24		11.55	1.81	1.64	5.36	3.49	586.67	16.76
25		8.98	1.64	0.61	4.11	3.26	360.00	16.03
26		8.75	1.23	1.02	4.11	4.73	466.67	22.63
27		7.11	0.61	1.64	3.09	2.67	200.00	20.20
28		8.63	1.64	1.64	3.90	3.09	226.67	13.06
29		8.98	1.02	1.85	4.32	4.11	213.33	13.10

30		8.63	1.81	1.64	4.11	3.49	520.00	16.00
31		6.88	1.02	0.61	2.67	3.26	546.67	11.83
32		8.75	1.23	1.64	4.94	3.73	213.33	19.10
33		8.86	1.02	0.81	4.73	4.32	400.00	10.00
34		6.88	1.64	1.02	4.11	2.88	493.33	11.56
35		8.28	1.02	1.02	3.90	3.50	600.00	19.00
36		8.63	1.23	0.61	4.11	4.32	280.00	13.73
37		7.93	1.02	1.64	4.12	2.88	520.00	10.36
38		7.93	1.02	1.64	4.11	3.26	333.33	9.50
39		10.50	1.64	1.02	4.31	4.11	226.67	11.23
40		8.98	0.61	1.23	3.91	4.11	213.33	13.10
	G. M.	8.67	1.20	1.23	4.00	3.64	362.33	14.99
	S. E + Range	6.41-11.55	0.61 -1.85	0.61-1.85	2.67 - 5.36	2.67 - 4.73	18G-600	7.50 -28.00
	S. E +	0.14	1.15	0.16	0.15	0.14	16.0	0.29
	CD AT 5%	0.39	0.43	0.44	0.42	0.40	44.4	0.82

Table 2: Variability, heritability, genetic advance genotypic coefficient of variation (gcv) and phenotypic coeffia of variation) (PVC) of different finger millet genotypes for quality characters.

Sr. No.	Character	Range	Grorad Mean	GCV	PVC	Heritability	Genetic Advance	Genetic advance as% of mean
1	Protein content (%)	6.41-11.55	8.47	14.18	14.46	96.1	2.48	29.2
2	Albumin content (%)	0.61-1.85	1.20	28.58	36.34	61.9	0.56	46.6
3	Globulin content (%)	0.61-1.85	l.23	32.28	39.56	66.0	0.67	54.4
4	Prolamine content (%)	2.67-5.36	4.00	17.11	18.37	86.7	1.30	32.5
5	Glutelin content (%)	2.67-4.73	3.64	16.17	17.60	84.4	1.11	30.4
6	Calcium content (mg/100g)	186.67- 600.00	362.33	37.99	38.76	96.1	277.95	76.7
7	Iron content (Mg/100g)	7.50-28.00	14.99	34.30	34.48	99.0	10.54	70.3

Genetic advances

The utility of heritability estimate can be judged trnely when it is used in conjuction with the genetic advance. Higher genetic advance was recorded for the characters calcium content (277.76) and iron content (10.54). High genetic advance components with high heritability was recorded for the characters calcium content) and iron content indicated additive gen action for expression of these characters and selection may be effective in breeding programme while selecting genotypes.

Selection of genotypes for high protein, calcium and iron content with desirable combination of protein fraction could be beneficial for enhancing the poor peoples diet particularly tribal people living in Konkan and other tribal areas of India. finger millet is also good SOU1ce of calcium and iron which are important minerals in human diet, child malnutrition in tribal area could be minimized by supplementing finger millet biscuits through integrated Child Development Schemes of Central/State Government.

Genotypes OEB-IOl and ACPR-2 are good protein source genotypes. For calcium content L-48 and ACPR-l were identified as superior genotypes, while iron rich genotypes were identified as DPI-20132 and VL-149.

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