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ASSESSMENT OF GENETIC VARIABILITY AMONG FINGER MILLET LOCAL GERMPLASM COLLECTED FROM DIVERSE CLIMATE

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ABSTRACT:

A study was undertaken to determine the extent of genetic variability for grain yield and ten other quantitative and qualitative characters, interrelationship of these characters and cause and effect relationship of grain yield with other characters in 40 local germplasm of finger millet. High genotypic coefficient and phenotypic coefficient of variation was recorded for grain iron content followed by grain yield per plant, number of tillers per plant, number of productive tillers per plant, main earhead length, number of fingers per earhead, grain calcium content, 100 ml volume weight of grain. High heritability coupled with high genetic advance was recorded in grain yield per plant, 100 ml volume, which indicated the predominance of additive gene effects. Improvement in these characters could be exercised by simple selection due to fixable additive gene effects. The grain yield per plant was positively and significantly correlated with number of tillers per plant, number of productive tillers per plant, main earhead length, number of fingers per plant. The high magnitude of direct effect of number of tillers per plant, number of productive tillers per plant, main earhead length, number of fingers per earhead along with highly significant correlation in the desirable direction towards grain yield per plant indicated the true and perfect relationship between grain yield and these characters suggesting direct selection based on these character would help in selecting the high yielding genotypes in finger millet.

Key word: - *GCV, PCV, heritability, genetic advance, correlation, direct effect.*

INTRODUCTION:

Millet is a collective term referring to a number of small seeded annuals grasses that are cultivated as grain crops, primarily on marginal lands in dry areas in temperate, subtropical and tropical regions. Finger millet, (*Eleusine coracana*), is also known as African millet, ragi, nachani, nagali. Finger millet (*Eleusine coracana* (L.) Gaertn.), is one among highly utilized belong to family Poaceae and it ranks 4th in the importance of world. Finger millet is originated from Ethiopia. It is allopolyploid with chromosome number 2n=4x=36 and evolved from a cross between two diploid species *Eleusine indica* (AA) and *Eleusine floccifolia* or *Eleusine tristachya* (BB) as genome contributors (Hiremat and Salimath, 1992). Finger millet is mostly self-pollinating with some amount of cross pollination (1%) mediated by wind (Jansen and Ong, 1996, Purseglove, 1972). It is important staple food in parts of eastern and Central Africa and India. Finger millet is very adaptable to a wide range of environmental and climatic conditions, thrives at higher elevations than most other tropical cereals and tolerates salinity better than moist cereals. It is important cereal in Karnataka. It is intensively grown in Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, Gujarat, Maharashtra and in the hilly regions of Uttar Pradesh, Himachal Pradesh with a total area of 2.5 million hectares and 2.2 million tons of production.

The basic information on the existence of genetic variability in a population and relationship between different traits is essentially for any successful plant breeding programme. Genetic improvement through conventional breeding approaches depends mainly on the availability of diverse germplasm and presence of enormous genetic variability. The characterization and evaluation are important pre-requisite for effective utilization of germplasm and also to identify source of useful genes. An insight into the nature and magnitude of genetic variability present in the gene pool is of immerse value for starting any systematic breeding programme because the presence of considerable genetic variability in the base material ensure better chances of evolving desirable plant type. Hence, an attempt was made to estimate the extent of variation for yield contributing traits in 40 genotypes by studying the genetic parameter like genetic variability, heritability, genetic advance, correlation and path analysis and genetic diversity.

MATERIALS AND METHODS:

The experimental materials consisting forty germplasm of finger millet collected from Dhule, Nandurbar, Jalgaon, Nashik, Ahmednagar, Pune, Satara and Kolhapur districts of Maharashtra. The experiment was laid out in RBD with three replications at Department of Botany, College of Agriculture, Dhule (M.S.) during Kharif 2017. By adopting a spacing of 22.5 cm between rows and 10 cm between plants respectively, at recommended package of practices were followed to raise good and healthy crop stand. Data were collected on eleven yield and yield contributing characters viz., days to 50% flowering, days to maturity, plant height (cm), number of tillers per plant, number of productive tillers per plant, main eahead length (cm), number of fingers per earhead, 100 ml volume weight, grain yield per plant (g) and qualitative characters viz., grain iron content (mg/100 g), grain calcium content (mg/100 g).

The mean of five plants was subjected to statistical analysis. The data for different characters were statistically analyzed for significance by using analysis of variance technique described by Panse and Sukhatme (1985).The adapted design was Randomized Block Design (RBD) with three replications. The significance of mean sum of square for each character was tested against the corresponding error degrees of freedom using "F" Test (Fisher and Yates, 1967). The components of variances were used to estimate genetic parameters like phenotypic and genotypic coefficient of variation (PCV and GCV) as per the formula given by Burton and De Vane (1953). Heritability in broad sense was calculated according to the formula given by Allard (1960) and expressed in percentage. Genetic advance was estimated by using Burton (1953). Correlation between eleven characters was estimated according to the method given by Singh and Chaudhary (1977). Direct and indirect effects were estimated as described by Dewey and Lu (1959). Statistical analysis was done by using WINDOSTAT program.

RESULTS AND DISCUSSION:

Analysis of variance revealed significant differences among genotypes for all the characters. Studies of genetic variability exhibited high phenotypic and genotypic coefficients of variation, heritability and genetic advance as percent of mean for the traits viz., Genetic advance as a per cent of mean was observed highest for grain iron content followed by grain yield per plant. Whereas, it was found medium for number of tillers per plant, number of productive tillers per plant, main earhead length, number of fingers per earhead, 100 ml volume weight, grain calcium content while low estimates of GA observed for plant height, days to 50 per cent flowering and days to maturity indicating simple selection can be practiced for improvement of these characters. It shows that the presence of variability and choice of material is appropriate.

Improvement of economic characters like yield through selection is conditioned by the nature and magnitude of variability existing in such populations. However, the phenotypic expression of complex character like yield is a combination of genotype, environment and their interaction. This indicates the need for partition of overall variability into heritable and non-heritable components with the help of appropriate statistical techniques. Possibility of achieving improvement in any crop plants depends largely on the magnitude of genetic variability. Phenotypic variability expressed by a genotype or a group of genotypes in any species can be partitioned into genotypic and environmental components. The genotypic component being the heritable part of the total variability, its magnitude for yield and its component characters influence the selection strategies to be adopted by the breeders
Coefficients of variation studies indicated that the estimates of PCV were slightly higher than the corresponding GCV estimates for all the characters, indicating that the characters were less influenced by the environment. Therefore, selection for the improvement of these traits. The difference between GCV and PCV values was more for grain calcium content, plant height indicating that selection based on phenotypic observation may not be very effective for these traits (Table 1). The GCV and PCV were high for number of tillers per plant, number of productive tillers per plant, main earhead length, number of fingers per earhead and grain yield per plant showing greater scope for selection for improvement of these characters. Similar results obtained to John *et al.,* (2006), Bedis *et al.,* (2006), Priyadharshini *et al.,* (2011), Lule *et al.,* (2012), Reddy *et al.,* (2013), Karad *et al.,* (2013 Wolie *et al.,* (2013), Suryanarayana *et al.,* (2014) Jyosthana *et al.,* (2016), and Mahanthesha *et al.,* (2017). High heritability coupled with high genetic advance reveals the presence of lesser environmental influence and prevalence of additive gene action in their expression (Panse, 1957). Lower values of genetic advance indicate the prevalence of narrow range of variability, high G X E interaction (non-additive gene action). In the present investigation high heritability coupled with high genetic advance as per cent of mean was observed for grain iron content, grain yield per plant, number of productive tillers per plant and main earhead length suggesting that these characters are govern by additive genes and phenotypic selection for these characters may be effective. Previously similar results were reported by Ganapathy *et al.,* (2007). Prabhu *et al.,* (2008) Karad *et al.*, (2013). Auti *et al.,* (2017). High heritability with low genetic advance or low heritability with low genetic advance is observed for any given character, presence of non-additive gene action may be suspected.

High heritability with low genetic advance was observed for number of pods per cluster, 100 seed weight, pod length and number of seeds per pod. This indicates non-additive gene action and selection in early genotypes for such traits may not be effective. Genotypic coefficient of variation (GCV) along with heritable estimates would provide a better picture of the amount of genetic advance to be expected by phenotypic selection (Burton, 1953). It is suggested that genetic gain should be considered in conjunction with heritability estimates (Johnson *et al.,* 1955). Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone (Table 1). In conclusion, the material chosen differed in their genotypic make up as evidenced by the significant differences among them in respect of all the quantitative characters studied. Phenotypic coefficients of variations estimate were slightly higher than the genotypic coefficients of variation for all the trait, indicating low environmental influence on the expression of all the traits.

The correlation coefficients at both genotypic and phenotypic levels estimated between grain yields per plant with all other characters are presented in Table 2 and 3 respectively. In the present investigation, the genotypic correlation coefficients were higher than the phenotypic correlation coefficients as observed by Johnson *et al.,* (1955). This might have occurred due to genes governing two traits were similar and the environmental conditions pertaining to the expression of these traits might have small and similar effects.

Grain yield exhibited highly significant positive correlation with all other characters except plant height, 100 ml volume weight, grain calcium content suggesting dependency of yield on these characters (Table 2 and 3). The highest association of yield was with days to 50 per cent flowering (0.847) followed by days to maturity (0.831), number of productive tillers per plant (0.831), number of tillers per plant (0.796), main earhead length (0.677), number of fingers per earhead (0.468). While grain yield per plant showed non-significant positive genotypic correlation with grain iron content (0.106). But, it showed non-significant negative genotypic correlation with 100 ml volume weight (-0.172), grain calcium content (-0.130) and plant height (-0.041). These results are in accordance with the findings of Rao (1992), Ramakrishna *et al.,* (1996), Gowda (1996), Ramakrishna *et al.,* (1996), Mahto *et al.,* (2000), Chaudhari and Bedis *et al.,* (2006) and Gowda *et al.,* (2008), Ganapathya *et al.,* (2011).

The path coefficients at both genotypic and phenotypic levels estimated between grain yield per plant and yield contributing characters and qualitative characters were carried out by using correlation coefficient.

The results obtained are presented in Table 4 and 5, respectively. The characters which emerged as the major component of grain yield per plant in path coefficient analysis (Table 4 and 5) was exerted by days to 50% flowering followed by number of tillers per plant, main earhead length and number of fingers per earhead which had highest direct effects on grain yield per plant at genotypic level. At phenotypic level number of productive tillers per plant recorded maximum direct effect on grain yield per plant. This is in accordance with the findings of Anuradha *et al.,* (2013), Kumar (2014), Jyothsna *et al.,* (2016).

In general, correlation and path analysis carried concluded that the number of tillers per plant, number of productive tillers per plant, main earhead length, number of fingers per ear head influenced the grain yield more than any of the other characters. Hence, it would be worthwhile to lay more emphasis on these characters in selection programme to improve the grain yield in finger millet.

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Table.1: Parameters of genetic variability for different characters in finger millet

Sr. No	Characters	General Mean	σ2 g	σ2p	σ2 e	GCV (%)	PCV (%)	ECV (%)	h2 (BS %)	GA	GA as % of mean
1	Days to 50 per cent flowering	93.43	87.72	104.15	16.42	10.02	10.92	4.33	84.23	17.70	18.95
2	Days to maturity	134.04	119.31	154.58	35.27	8.14	9.27	4.43	77.18	19.76	14.74
3	Plant height (cm)	102.23	123.21	168.65	45.44	10.85	12.70	6.59	73.05	19.54	19.11
4	No. of tillers/plant	5.60	2.45	2.76	0.30	27.95	29.66	9.91	88.83	3.04	54.27
5	No. of productive tillers/plant	5.17	2.03	2.24	0.21	27.57	28.96	8.87	90.61	2.79	54.06
6	Main earhead length (cm)	8.78	3.75	4.03	0.27	22.06	22.84	5.94	93.24	3.85	43.88
7	No. of fingers/ earhead	7.03	2.20	2.57	0.37	21.10	22.82	8.69	85.48	2.82	40.18
8	100 ml volume weight	76.78	215.84	230.70	14.85	19.13	19.78	5.02	93.56	29.27	38.12
9	Grain yield/plant (gm)	20.16	68.98	73.03	4.05	41.18	42.37	9.98	94.45	16.62	82.44
10	Grain iron content (mg/100 gm)	4.65	6.49	6.56	0.06	54.71	55.00	5.64	98.95	5.22	112.12
11	Grain calcium content (mg/100 gm)	308.05	3733.89	4288.64	554.75	19.83	21.25	7.64	87.06	117.45	38.12

Table 2: Genotypic Correlation coefficient for eleven characters in Finger millet.

	Characters	1	2	3	4	5	6	7	8	9	10	11
1.	Days to 50 percent flowering	1.000	0.992**	0.055	0.732**	0.774**	0.592**	0.442**	-0.124	-0.055	-0.201*	0.847**
2.	Days to maturity		1.000	0.084	0.749**	0.795**	0.577**	0.386**	-0.202*	-0.183*	-0.164	0.831**
3.	Plant height			1.000	0.112	0.112	0.127	-0.297**	-0.240**	0.199*	0.283**	-0.041
4.	No. of tillers /plant				1.000	0.998**	0.630**	0.295**	-0.252**	0.224**	-0.027	0.796**
5.	No. of productive tillers/plant					1.000	0.669**	0.310**	-0.222*	0.213**	-0.033	0.831**
6.	Main earhead length						1.000	0.030	-0.164	0.169	-0.114	0.677**
7.	No. of fingers /earhead							1.000	-0.147	-0.061	-0.150	0.468**
8.	100 ml volume weight								1.000	0.111	0.062	-0.172
9.	Grain iron content									1.000	0.425**	0.106
10.	Grain calcium content										1.000	-0.130
11.	Grain yield per plant											1.000

*, ** Indicates significance at 5% and 1% level, respectively

Table 3: Phenotypic Correlation for eleven characters in Finger millet

	Characters	1	2	3	4	5	6	7	8	9	10	11
1	Days to 50 percent flowering	1.000	0.803**	0.027	0.625**	0.675**	0.513**	0.384**	-0.130	-0.058	-166	0.776**
2	Days to maturity		1.000	0.082	0.593**	0.629**	0.531**	0.276**	-0.194*	-0.154	-0.155	0.710**
3	Plant height			1.000	0.085	0.088	0.116	-0.226*	-0.217*	0.186*	0.221*	-0.016
4	No. of tillers /plant				1.000	0.917**	0.586**	0.261**	-0.236**	0.208*	-0.040	0.704**
5	No. of productive tillers/plant					1.000	0.593**	0.76**	-0.200*	0.198*	-0.029	0.759**
6	Main earhead length						1.000	0.020	-0.165	0.168	-0.114	0.629**
7	No. of fingers /earhead							1.000	-0.129	-0.052	-0.125	0.410**
8	100 ml volume weight								1.000	0.101	0.074	-0.165
9	Grain iron content									1.000	0.397**	0.099
10	Grain calcium content										1.000	-0.108
11	Grain yield per plant											1.000

*, ** Indicates significance at 5% and 1% level, respectively.

Table 4: Genotypic path co-efficient for eleven characters in finger millet

	Characters	1	2	3	4	5	6	7	8	9	10	11
1	Days to 50 per cent flowering	**0.675**	0.670	0.037	0.494	0.523	0.400	0.298	-0.084	-0.037	-0.136	0.847**
2	Days to maturity	-0.200	**-0.201**	-0.017	-0.151	-0.160	-0.116	-0.077	0.040	0.037	0.033	0.831**
3	Plant height	-0.005	-0.008	**-0.102**	-0.011	-0.011	-0.013	0.030	0.024	-0.020	-0.029	-0.041
4	No. of tillers / plant	0.479	0.491	0.073	**0.655**	0.658	0.413	0.193	-0.165	0.147	-0.018	0.796**
5	No. of productive tillers / plant	-0.310	-0.318	-0.045	-0.4024	**-0.400**	-0.268	-0.124	0.089	-0.085	0.013	0.831**
6	Main earhead length	0.153	0.149	0.033	0.163	0.173	**0.258**	0.007	-0.042	0.043	-0.029	0.677**
7	No. of fingers / earhead	0.064	0.056	-0.043	0.043	0.045	0.004	**0.146**	-0.021	-0.009	-0.022	0.468**
8	100 ml volume weight	0.002	0.003	0.004	0.004	0.003	0.002	0.002	**-0.017**	-0.002	-0.001	-0.172
9	Grain iron content	-0.0005	-0.001	0.001	0.002	0.002	0.001	-0.0006	0.001	**0.009**	0.003	0.106
10	Grain calcium content	-0.011	-0.009	0.015	-0.001	-0.001	-0.006	-0.008	0.003	0.023	**0.055**	-0.130

Residual effect = (0.4022) Bold values indicated direct effect

*, ** Indicates significance at 5% and 1% level, respectively.