Genetic Variability for Yield and Yield Related Traits in Fingermillet [*Eleusine coracana* (L.) Gaertn] Genotypes

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Abstract

The present study aims to reveal the existence of genetic variability and importance of some quantitative traits in the 105 fingermillet genotypes. The objectives were to assess the variability, heritability, and genetic advance for yield and 12 yield component characters. Highly significant mean sum of squares due to genotypes and wide range of variability were noticed among the genotypes for all the characters studied. Phenotypic coefficient of variation was higher than the corresponding genotypic coefficient of variation for all the characters studied. High values for phenotypic and genotypic coefficients were recorded for single plant grain yield and productive tillers per plant, indicating that more variability is present in the genotypes for these characters. All the characters recorded high heritability in the present study indicated that these characters were relatively less influenced by environmental factors and phenotypic selection would be effective for the improvement of these characters. All the characters recorded high heritability coupled with high genetic advance except days to 50 per cent flowering, finger width and days to maturity which indicated that these characters were governed by additive genes and selection would be effective for improvement of such characters. Since there is significant variability observed in all the fingermillet genotypes, this could be used for genetic improvement through selection and hybridization.

Key words: Fingermillet, genetic variation, heritability and genetic advance.

Introduction

Finger millet (*Eleusine coracana* (L.) Gaertn) is an important cereal crop amongst the small millets and third in importance among millets, in the country in area and production after sorghum and pearl millet. It is cultivated mostly as a rainfed crop in India for its valued food grains and its adaptability to wide range of geographical areas and agro-ecological diversity, mostly countries in Africa and Asia. In India, it is cultivated on 1.8 million ha with a production of 2.19 million tonnes and average productivity of 1489 kg per ha. Major finger millet growing states in India are Karnataka followed by Uttrakhand, Maharashtra, Tamil Nadu, Andhra Pradesh, Orissa, Gujarat, Jharkhand and Bihar (Directorate of Economics and Statistics, GOI, 2010-11). Fingermillet is an important cereal because of its excellent storage properties and the nutritive value of the grains. It is also a good source of mineral nutrients like Calcium, Iron, Phosphorus, Zinc and Potassium. In India, the fingermillet area has decreased from 2.5 million ha in late 1980s to 1.8 million ha during 2011. The fingermillet area is being replaced by other comparable and competing crops such as maize and soybean. Considering the increased demand for finger millet for food purposes and decreasing area under this crop due to competing crops, there is an immediate need for genetic enhancement of fingermillet productivity.

The basic information on the existence of genetic variability and diversity in a population and the relationship between different traits is essential 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 the important pre-requisites for effective utilization of germplasm and also to identify sources of useful genes. An insight into the nature and magnitude of genetic variability present in the gene pool is of immense value for starting any systematic breeding programme because the presence of considerable genetic variability in the base material ensures better chances of evolving desirable plant type. Hence, an attempt was made to estimate the extent of variation for yield contributing traits in 105 fingermillet genotypes 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.

Materials and Methods

Thirteen yield contributing characteristics were taken to assess the magnitude of heritable variability for 105 genotypes of fingermillets. The study was conducted at Department of Millets, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore during *rabi*, 2011-2012. For evaluation and characterization, these germplasm accessions were grown in randomized complete block design with three replications. Observations were recorded from five randomly selected competitive plants in each accession for 13 quantitative characters *viz.,* plant height (cm), flag leaf sheath length (cm), flag leaf sheath width (cm), flag leaf blade length (cm), flag leaf blade width (cm), productive tillers, finger number, finger length (cm), finger width (mm), days to maturity, thousand grain weight (g) and single plant grain yield (g) as per the descriptors for *Eleusine coracana* (IBPGR, 1985) except days to 50 per cent flowering. Days to 50 per cent flowering was noted on single row basis. Phenotypic and genotypic variances were estimated according to the formula given by Lush (1940). Phenotypic and genotypic coefficients of variability were computed according to the method suggested by Burton (1952). Heritability in broad sense was calculated as per the formula given by Allard (1960). Range of heritability was categorized as suggested by Johnson *et al*. (1955). Genetic advance was expressed as per cent of mean by using the formula suggested by Johnson *et al.* (1955). Traits were classified as having high, moderate or low genetic advance as per the method suggested by Johnson *et al.* (1955).

Results and discussion

Genetic variability studies provide basic information regarding the genetic properties of the population based on which breeding methods are formulated for further improvement of the crop. These studies are also helpful to know about the nature and extent of variability that can be attributed to different causes, sensitivity of crop to environment, heritability of the character and genetic advance. The analysis of variance showed a wide range of variation and significant differences for all the characters under study, indicating the presence of adequate variability for further improvement. The genotypic mean square values were highly significant for all quantitative traits, implying that the genotypes tested were highly variable (Table 1). The estimates of mean, range, phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance as percent of mean are presented in table 2.

In general, PCV was higher than GCV for all the characters under study. The values for phenotypic coefficients of variation ranged from 6.72 to 29.48 per cent. The values for genotypic coefficients of variation obtained for various yield and yield attributing characters ranged from 6.53 to 28.93 per cent. The coefficients of variation at phenotypic (PCV) and genotypic (GCV) levels were high for single plant grain yield and productive tillers per plant indicating that this character is more variable in the germplasm. There is a great scope for improvement of this character by direct selection among the genotypes. Similar reports were earlier reported by Dagnachew Lule *et al*. (2012), Nirmalakumari *et al*. (2010) and Kebere bezaweletaw *et al*. (2006) for single plant grain yield. Moderate PCV and GCV was recorded for thousand grain weight followed by flag leaf blade length, finger number per panicle, flag leaf sheath length, finger length, flag leaf sheath width, plant height and flag leaf blade width. These observations are in agreement with the earlier reports of Dagnachew Lule *et al*. (2012) for thousand grain weight, Ganapathi *et al*. (2011) for plant height, finger number and finger length and Kebere Bezaweletaw *et al*. (2006) for thousand grain weight, finger number and plant height. The lowest PCV and GCV were recorded for days to 50 per cent flowering, finger width and days to maturity. These results are in accordance with Dagnachew Lule *et al*. (2012), Ganapathi *et al*. (2011) and Kebere Bezaweletaw *et al*. (2006). Moderate to low variability of these characters indicated the need for improvement of base population. However, for majority of the traits the environmental coefficients of variation (ECV) estimates were lower than both genotypic and phenotypic coefficients of variations. This implied that the environmental role was less for the expression of such characters (Singh and Narayana, 1993).

The genotypes under study showed high heritability values for all the characters under study. Estimates of heritability ranged from 63.95 to 96.27 per cent. Single plant grain yield (96.27 %) recorded highest heritability followed by days to maturity (94.33 %), days to 50 per cent flowering (93.64 %), productive tillers per plant (90.07 %), flag leaf blade length (84.59 %), finger length (82.19 %), flag leaf blade width (80.68 %), flag leaf sheath width (80.49 %), plant height (79.50 %), thousand grain weight (77.37 %), finger width (76.85 %), flag leaf sheath length (74.96 %) and finger number per panicle (63.95 %). Similarly high heritability for all the characters studied was reported by Ganapathi *et al*. (2011), for plant height by Dagnachew Lule *et al.* (2012), for days to 50 per cent flowering by Dhagate *et al*, (1972) and for thousand grain weight by Abraham *et al.* (1989). Heritability which is the heritable portion of phenotypic variance is a good index of transmission of characters from parents to offspring (Falconer, 1960).

Genetic advance as per cent of mean ranged from 13.06 to 58.47 per cent. Single plant grain yield (58.47 %) recorded the highest genetic advance followed by productive tillers per plant (44.45 %), flag leaf blade length (32.05 %), thousand grain weight (29.70 %), finger length (24.81 %), flag leaf sheath length (24.32 %), flag leaf sheath width (23.35 %), plant height (22.53 %), flag leaf blade width (21.66 %) and finger number per panicle (20.77). High genetic advance indicated that these characters are governed by additive genes and selection will be rewarding for improvement of these traits. Moderate GAM was recorded for days to 50 per cent flowering (18.50 %) followed by finger width (14.08 %) and days to maturity (13.06 %). Similarly Moderate GAM was reported by Dagnachew Lule *et al.* (2012) for days to 50 per cent flowering, finger width and days to maturity indicated that these characters are governed by non additive genes. High heritability coupled with high genetic advance was observed for single plant grain yield, productive tillers per plant, flag leaf blade length, thousand grain weight, finger length, flag leaf sheath length, flag leaf sheath width, plant height, flag leaf blade width and finger number per panicle indicated non additive gene action and high genotype x environment interaction.

It is concluded that genetic variability present in the population is mainly used for varietal improvement of future breeding programmes. High coefficients of variation were observed for single plant grain yield indicating that this character is more variable in the germplasm. There is a great scope for improvement of this character by direct selection among the genotypes. High heritability coupled with high genetic advance was observed for single plant grain yield suggested that these characters may be successfully used as selection criteria in improving grain yield.

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Table 1. Analysis of variance for 13 characters in 105 fingermillet genotypes

Character	Mean sum of squares		
	Replication (df = 2)	Genotype (df = 104)	Error (df = 208)
Days to 50 per cent flowering	24.669**	125.825**	2.786
Plant height (cm)	123.338*	355.261**	28.121
Productive tillers per plant	2.007*	13.627**	0.483
Flag leaf sheath length (cm)	3.114*	6.990**	0.701
Flag leaf sheath width (cm)	0.0156*	0.049**	0.004
Flag leaf blade length (cm)	20.216*	88.130**	5.046
Flag leaf blade width (cm)	0.016*	0.048**	0.004
Finger number per panicle	21.954**	5.046**	0.798
Finger length (cm)	1.315*	4.727**	0.318
Finger width (mm)	0.260	1.887**	0.172
Days to maturity	11.131*	133.063**	2.613
Thousand grain weight (g)	0.671**	0.502**	0.045
Single plant grain yield (g)	57.672**	232.544**	2.966

* Significant at P =0.05 ** Significant at P =0.01

Table 2. Estimates of variability, heritability and genetic advance as per cent of mean for 13 characters in 105 fingermillet genotypes

Character	Range		Mean	PCV (%)	GCV (%)	h^2(BS) (%)	GAM
	Min.	Max.					
Days to 50 per cent flowering	58.40	80.18	68.99	9.59	9.28	93.64	18.50
Plant height (cm)	61.22	106.01	85.14	13.76	12.26	79.50	22.53
Productive tillers per plant	5.59	12.83	9.21	23.96	22.74	90.07	44.45
Flag leaf sheath length (cm)	8.11	14.17	10.62	15.75	13.64	74.96	24.32
Flag leaf sheath width (cm)	0.75	1.22	0.97	14.08	12.63	80.49	23.35
Flag leaf blade length (cm)	20.18	43.28	31.11	18.39	16.91	84.59	32.05
Flag leaf blade width (cm)	0.81	1.32	1.04	13.03	11.70	80.68	21.66
Finger number per panicle	6.86	13.41	9.44	15.76	12.61	63.95	20.77
Finger length (cm)	7.00	12.45	9.13	14.65	13.29	82.19	24.81
Finger width (mm)	7.30	12.36	9.70	8.89	7.80	76.85	14.08
Days to maturity	89.76	114.36	100.99	6.72	6.53	94.33	13.06
Thousand grain weight (g)	1.61	3.29	2.38	18.63	16.39	77.37	29.70
Single plant grain yield (g)	15.12	45.39	30.24	29.48	28.93	96.27	58.47