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Variability and correlation studies of yield and yield attributing characters in finger millet [*Eleusine coracana* (L.) Gaertn.]

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ABSTRACT

A field experiment was carried out to estimate the correlation coefficient for eight quantitative characters *viz.*, days to heading, days to maturity, plant height, number of effective tillers per plant, number of fingers per earhead, weight of earhead per plant, 1000 grain weight and grain yield per plant in 18 genotypes of finger millet which were sown in a randomized block design with three replications under six environments. The six environments under which the genotypes were tested appear to be quite diverse. The environmental effects were highly significant for all the eight quantitative characters and constituted major part of the total variation. The genotypes showed low coefficient of variation for days to heading, days to maturity, fingers per earhead and 1000 grain weight, moderate coefficient of variation for plant height and effective tillers per plant where as high coefficient of variation found for earhead weight per plant and grain yield per plant. The study showed that grain yield per plant had positive and significantly correlated with earhead weight per plant followed by effective tillers per plant and 1000 grain weight which revealed that these characters were the major contributors to grain yield per plant. These characters can be considered as criteria for selection to improve the grain yield per plant in finger millet.

Key words: Coefficient of variation, correlation, environment, finger millet, grain yield

INTRODUCTION

Finger millet [*Eleusine coracana* (L.) Gaertn. 2n=4x=36] belongs to the family Poaceae and is an important staple food in parts of eastern and Central Africa and India. It is also known as African millet, ragi, mandia, nachani, nagali, kelvaragu, and koovasagu. Finger millet is very adaptable to a wide range of environmental and climatic conditions, thrives at higher elevations compared to other tropical cereals, significantly tolerates salinity, and is relatively resistant to waterlogging (Dida et al., 2008). It is intensively grown in Karnataka, Tamil Nadu, Maharashtra, Andhra Pradesh, Odisha, Bihar, Gujarat, Uttarakhand, and Himachal Pradesh with a total production of 2.2 million tonnes from an area of 2.5 million hectares (Sapkal et al. 2019).

Grain yield is a polygenic controlled complex character with low to moderate heritability owing to environmental effects and also greatly influenced by many interrelated component traits, which are also mostly polygenic and the direct selection for yield is often not much effective (Das and Baisakh, 2019). Thus the correlation between yield and other component traits would be of key consideration for all crop breeders. Sardar and Behera (2017) emphasized the importance of indirect selection for yield through component traits governed by genes with additive effect and strong correlation with yield. This necessitates a thorough knowledge of the nature of the relationship prevalent between contributory characters and grain yield and the extent of genetic variability (Mahanthesha et al., 2017). Therefore, identifying

the characters which are closely related and have contributed to yield becomes highly essential. Correlation would give a better insight into the cause and effect relationship between different pairs of characters by Venkatesan et al. (2004). Correlations between yield and other characters are useful in selecting the desired plant type in designing an effective breeding program for improvement of grain yield. The estimates of correlation coefficients mostly indicate the inter-relationships of the characters and useful for breeders in selecting genotypes possessing groups of desired traits. Therefore, the present investigation was undertaken to study the performance of different genotypes and correlation of the yield attributing characters with the grain yield in six different environments.

MATERIALS AND METHODS

The experimental materials consisting of 18 genetically diverse genotypes of finger millet were evaluated at six environments and in a randomized complete block design in three replications with a spacing of 25 cm between rows and 10 cm between plants respectively, at each environment (Research farm, Orissa University of Agriculture and Technology, Bhubaneswar). The recommended package of practices was followed to raise a healthy crop. Ten competitive plants were selected at random from each replication and observations were recorded on eight quantitative traits *viz.*, days to heading and days to maturity, plant height, effective tillers per plant, number of fingers per head, earhead weight per plant, 1000 grain weight and grain yield per plant.

During cropping season, various meteorological observations i.e. rainfall, minimum and maximum temperature, relative humidity during morning and afternoon, and duration of sunshine hour of each environment were daily recorded for undertaking a comparative study between its effect on grain yield and other yield attributing characters.

The data for different characters were statistically analyzed by using analysis of variance technique described by Panse and Sukhatme (1985). The significance of the mean sum of the square for each character was tested against the corresponding error degrees of freedom. Correlation coefficients between grain yield and other yield attributing characters in different environments were worked out as per Snedecor and Cochran (1967), Singh and Chaudhary (1977) and Nadarajan and Gunasekaran (2014).

RESULTS AND DISCUSSION

Perusal of the data presented in Table 1. revealed that analysis of variance for eight characters indicated that the genotypes used in the present studies were significantly different. The effects due to the environment were highly significant for all the eight characters. In respect to G×E interaction, the effects were highly significant for days to heading, days to maturity, plant height, earhead weight per plant, 1000 grain weight, and grain yield per plant. The observed meteorological data of different environments are presented in Table 2.

The mean observations varies from 72.3-82.3 for days to heading, 91.1-119.6 for days to maturity, 61.7-98.7 cm for plant height, 2.44-3.40 for effective tillers per plant, 6.32-6.79 for fingers per earhead, 6.79-15.42 g earhead weight per plant, 2.23-2.71 g for 1000 grain weight and 4.03-11.48 g for grain yield per plant across the environments (Table 3). A high coefficient of variation (CV) was observed for grain yield per plant followed by earhead weight per plant. Moderate value of CV observed in plant height and effective tillers per plants. In the remaining traits the coefficient of variability was relatively small (< 10.0). The result indicated that there is a significant role of environmental factors and among all quantitative characters, the grain yield per plant and earhead weight per plant are highly influenced by climate. Among different environmental conditions the environment-3 condition i.e. on an average 31.5/ 19.70ºC temperature (max. and min.) with a longer sunshine period i.e. 9.2 hours having the relative humidity of about 88 % in the morning and 35 % in the afternoon found to be optimum for higher grain yield among the six diverse environments. It was observed that the temperature above 32ºC is adversely affecting the grain yield.

Table 1. Analysis of variance for different characters in finger millet

Sl.No.	Characters	Environments	Genotypes	G×E	Error
1	Days to heading	766.075**	55.191**	7.568**	2.407
2	Days to maturity	5552.500**	24.838**	5.609**	2.530
3	Plant height	7527.450**	252.544**	53.776**	8.823
4	Effective tiller per plant	7.964**	0.453**	0.184	0.139
5	Fingers per earhead	1.920**	0.398**	0.165	0.132
6	Earhead weight per plant	532.733**	3.516**	4.678**	1.596
7	1000 grain weight	2.153**	0.037**	0.018**	0.003
8	Grain yield per plant	383.143**	2.358*	3.277**	1.213

* , ** Significance at 5% and 1% level, respectively

Table 2. Meteorological observations of different environment during the cropping season

Environments	Rainfall (mm)	Temperature (ºC)		Relative humidity (%)		Sunshine (Hour)
		min	max	Morning	Afternoon	
E1	1173.0	24.94	32.86	89.20	71.60	6.44
E2	541.5	21.48	31.52	87.38	58.58	7.74
E3	89.0	19.75	31.55	88.00	35.00	9.20
E4	165.5	22.65	35.80	87.80	39.30	8.95
E5	833.2	25.00	32.74	91.80	71.40	5.80
E6	634.1	22.83	32.43	92.80	63.30	6.98

Table 3. Mean and coefficient of variation for yield and yield attributing characters under six environment

Sl. No.	Environments→	E1	E2	E3	E4	E5	E6	Over all mean	SE	CV
	Characters ↓	Mean	Mean	Mean	Mean	Mean	Mean			
1	Days to heading (days)	82.3	79.8	81.1	81.8	77.4	72.3	79.1	1.5	4.8
2	Days to maturity (days)	119.6	117.6	109.5	111.2	91.1	108.1	109.5	4.1	9.3
3	Plant height (cm)	83.0	61.7	82.3	84.5	98.7	82.0	82.0	4.8	14.4
4	Effective tiller per plant	2.73	3.18	3.40	2.44	2.54	2.62	2.82	0.16	13.63
5	Fingers per earhead	6.32	6.45	6.49	6.67	6.32	6.79	6.50	0.98	2.90
6	Earhead weight per plant	8.23	13.02	15.43	6.79	11.40	11.27	11.03	1.28	28.49
7	1000 grain weight (g)	2.36	2.33	2.71	2.23	2.60	2.48	2.66	0.08	8.05
8	Grain yield per plant (g)	6.31	10.05	11.48	4.03	8.50	8.18	8.71	1.09	32.57

Table 4. Correlation coefficient of yield attributing characters with yield under different environments

Sl. No.	Characters	Environments					
		E1	E2	E3	E4	E5	E6
1	Days to heading	-0.299	-0.093	0.149	-0.776**	-0.097	0.532*
2	Days to maturity	-0.184	-0.044	0.148	-0.617**	-0.262	-0.131
3	Plant height	-0.187	0.580*	0.125	-0.572**	0.206	0.152
4	Effective tiller per plant	0.249	0.714**	0.229	0.601**	0.401	0.580*
5	Fingers per earhead	0.045	0.416	0.197	0.085	0.198	-0.192
6	Earhead weight per plant	0.909**	0.875**	0.826**	0.953**	0.955**	0.948**
7	1000 grain weight	0.275	0.394	0.698**	0.064	0.271	0.201

Correlated characters are of interest for three chief reasons, firstly in connection with the genetic cause of correlation through the linkage and pleiotropic action of genes, secondly in connection with the change brought about by selections. It is important to know, how the improvement of one character will cause simultaneous changes in other characters and thirdly in connection with natural selection. In the present study, the correlation coefficients estimated between grain yields per plant with all other characters are presented in Table 4. The pattern of association varied greatly in different environments. The correlation coefficient of grain yield varies from -0.776 to 0.532 with days to heading, -0.617 to 0.148 with days to maturity, -0.572 to 0.580 with plant height, 0.229 to 0.714 with effective tillers per plant, -0.192 to 0.416 with number of fingers per head, 0.826 to 0.955 with earhead weight per plant and 0.064 to 0.698 with 1000 grain weight under different environment. It exhibited a highly significant positive correlation in all the environments condition with earhead weight per plant ranging from 0.826 to 0.955. All characters except the number of fingers per head and 1000 grain weight were shown a significant correlation in the 4th environment having maximum temperature and lower rainfall of which days to heading, days to maturity, and plant height exhibited a negative significant correlation with the grain yield. In many environment, days to heading and days to maturity found a negative correlation with yield. All other characters i.e. plant height, effective tillers per plant, number of fingers per head, earhead weight per plant, 1000 grain weight were found a positive correlation with the grain yield per plant.

The study showed grain yield per plant had a negative correlation with days to heading and days to maturity. Similarly, Bezaweletaw et al. (2006) found finger millet grain yield per plant to be significantly negative correlation to days to heading and days to maturity. The grain yield per plant had a positive and significant correlation with earhead weight per plant in all environments. Similar results were reported by Ganapathy et al.(2011) and Haradari et al. (2012). In all six environments, the number of effective tillers per plant recorded a positive correlation with grain yield per plant effective tillers per plant and in three environments, the value is significantly positive. This is in accordance with the findings of Anantharaju and Meenakshiganesan (2005), Anuradha et al. (2013) and Jyothsna et al. (2016). Grain yield per plant had positively correlated with the 1000- seed weight in all environments. Similar results were reported by John (2006). Therefore, any improvement of these characters would result in a substantial increment in grain yield of finger millet.

In the present investigation, the earhead weight per plant, effective tillers per plant, and 1000-grain weight shown a positive direct effect on grain yield per plant of which only the earhead weight per plant found significantly positive associated with grain yield per plant in all environment whereas effective tillers per plant and 1000 grain weight shown a significantly

positive association with grain yield per plant in few environments. This revealed that although these characters were the major contributors to grain yield per plant but earhead weight per plant influenced the grain yield more than any of the other characters. Hence, it would be worth to lay more emphasis on this character in the selection and hybridization program to improve the productivity in finger millet.

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