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Estimates of variability parameters for yield and its components in finger millet (*Eleusine coracana* L.)

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Abstract

The present experiment was laid out with 15 cultivars of finger millet in a Randomized block design in AKS University, Satna, during *Kharif* on July 2020. Data were collected on thirteen characters *viz.*, days to 1st flowering, days to 50% flowering, days to maturity, plant height, no. of tillers / plant, 1000 seed weight, earhead length, finger length, finger width, flag leaf blade length, flag leaf blade width, biological yield and seed yield per plant. The highest estimates of coefficients of variation were registered for flag leaf blade length followed by, plant height and flag leaf blade width. High heritability coupled with high genetic advance was observed for plant height only indicated the predominance of additive gene action in the expression of these traits. The analysis of variance indicated the existence of sufficient amount of variability among genotypes for all the characters and can be improved through individual plant selection.

Keywords: Finger millet, variability, heritability and genetic advance

Introduction

Finger millet/Ragi (*Eleusine coracana* L. Gaertn., 2n = 4x = 36) belong to the Gramineae family. Between the millets are the third most important after the sorghum and pearl millets. It also contains sufficient amount of iron and rich source of calcium. Small millets comprise of Finger millet, Little millet, Foxtail millet, Kodo millet, Barnyard millet and Proso millet is an important group of dry land field crops.

It is known in English as bridsfoot, coracana and African millet. It is widely grown in tropical and subtropical countries. Traditionally producing regions are Africa, India, China and Japan (Rachie and Peters, 1977) [18]. Finger millet are produced in Africa from the Eleuaine coracana subsp. Africana probably in the Ethiopian region. It was introduced in India probably more than 3000 years ago. Global climate change and the rapidly growing population are increasing the pressure on the agricultural sector to produce more food in a small land holding. The expected increase in temperature will have a significant impact on tropical areas, especially those with developing countries as they may have significant losses in food production (Cline, 2007) [4]. Even in warmer climates, several strategies need to be developed to adapt agricultural crops to changing climates such as temperature changes, constant rainfall, and the onset of severe floods and droughts (Meehl *et al*., 2007) [14]. Climate change is expected to have a negative impact on food production and food security in many drought-prone regions around the world (FAO, 2005) [7]. Crop improvement is highly dependent on the basic knowledge of genetic variability and population variability and the relationships between different factors. The presence of high variability contributes to its advancement (Poehlman, 1987) [17].

The development of varieties with an improved nutraceutical value and improved stress tolerance has therefore become one of the main areas of research these days. Modern methods of crop improvement include individual hybridization and selection of advantageous segregants. These segregants obtained from choosing of diverse parents with high magnitude of genetic variability for dissimilar traits.. The efficiency of selection in plant breeding programme largely depends on the extent of variability present in the population. So, basic information on the existence of genetic diversity, variability and the relationship between the various character is necessary to any prosperous crop breeding program. The assessment of genetic variability alone does not give a clear indication of feasible advancement that can be accomplished through selection and should be incorporated with heritability and gene interactions between genotypes and environment.

Current research was conducted to quantify the magnitude of yield differences in 15 native finger genotypes by studying genetic parameters such as phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance, may contribute to the expression of selection indices suitable for advancement in this crop plant.

Materials and Methods

The present investigation entitled "Study on genetic diversity in Finger millet (*Eleusine coracana* (L.))" was carried out at Instructional Farm of AKS University, Satna (during kharif, 2020). The experimental material comprised of fifteen diverse genotypes of ragi. This material was obtained from Agricultural Research Station, Vizianagaram, AP. The experiment was laid out in Randomized Block Design with three replication. Each genotype was sown in four rows of 2m length with a spacing of 20 cm and 10 cm between the rows and plants within the row respectively. All suggested agronomic and cultural practices accomplished to raise good crop. Data were recorded on five randomly selected plants per replication of each genotype for thirteen quantitative characters and the mean of these five plants was worked out for the statistical analysis and further used for the genetic diversity analysis. Genetic variability was studied based on the model proposed by Panse and Sukhatme (1961) [16] Estimates of GCV and PCV were estimated as per formula given by Burton and Devane (1953) [2]. Heritability in broad sense studied, the method suggested by Lush (1940) [13] and calculated as per the formula given by Allard (1960) [1]. Genetic advance was expressed by using the formula proposed by Johnson *et al*. (1955) [8].

Results and Discussion

The analysis of variance indicated the existence of sufficient amount of variability among genotypes for all the characters (Table 1). The mean performance of genotypes (Table 2) found to be significant. The genotypes showed a wide range of variation, which provides ample scope for selection for superior and desired genotypes by the plant breeders for further improvement in ragi.

The highest estimates of coefficients of variation were registered for flag leaf blade length (GCV = 30.58%; PCV = 31.45%), plant height (GVC = 22.44% ;PVC = 22.71%) and flag leaf blade width (GCV = 27.19%; PCV = 28.35%). (Table 3) These results are in accordance with the findings of Lad *et al* (2019) [12], Chuni Lal *et al*. (1996) [3], Dhamdhere *et al*. (2011) [5] and Dagnachew Lule *et al*. (2012) [6] for finger length; Kadam *et al*. (2010) [9] for earhead length. Higher estimates of genotypic and phenotypic coefficients of variation indicate the presence of ample variability among the genotypes for these traits. Therefore, simple selection could be effective for bringing further improvement. All traits exhibited relatively low magnitude of difference between PCV and GCV indicating less environmental influence on these characters.

The highest heritability (%) was observed for plant height (98.811%), followed by flag leaf blade length (97.233%), flag leaf blade width (95.908%), finger width (92.752%), ear head length (90.317%), and finger length (87.229%) (Table 3). These results are in correspondences with the findings of Dhamdhere *et al*. (2011) [5] for days to 50% flowering, days to maturity and seed yield / plant; Karad and Patil (2013) [10] for days to maturity, plant height, finger length and seed yield / plant; Dagnachew Lule *et al*. (2012) [6] plant height and finger length; Sharathbabu *et al*. (2008) [19] for plant height, days to 1st flowering, days to 50% flowering, earhead length, finger length and seed yield / plant. These observations are in accordance with the findings of Kebere Bezaweletaw *et al*. (2008) [11] for test weight and no. of tillers / plant; Dhamdhere *et al*. (2011) [5] for no. of tiller / plant. High heritability coupled with high genetic advance was observed for plant height (98.811 and 52.998 respectively) only. High heritability coupled with low genetic advance was observed for flag leaf blade width (95.908 and 0.879 respectively), followed by ear length (90.317 and 1.150 respectively) and finger length (87.229 and 1.533 respectively). High heritability coupled with moderate genetic advance was observed for flag leaf bade length (97.233 and 16.194 respectively) only (Table 3).

The highest genetic advance was recorded for plant height (52.99%). Moderate values of genetic advance were observed for flag leaf blade length (16.19%) only. The low genetic advance was recorded for days to maturity (-1.32) followed by biological yield (-0.349), days to 50% flowering (-0.339), no of tillers (-0.081), seed yield / plant (0.02%), test weight (0.06%), finger width (0.37%), days to 1st flowering (0.498), fingth length (1.53%), whereas the characters earhead length (1.15%), registered low estimates of genetic advance (Table 3). These are in consonance with the findings of Dagnachew Lule *et al*. (2012) [6] for plant height, no. of tillers / plant, test weight and grain yield / plant; Kebere Bezaweletaw *et al*. (2006) [11] for plant height, tillers, finger length, test weight and seed yield / plant.

Conclusions

Finally, data was subjected to statistical analysis by applying statistical procedure for study of genetic variability, genotypic and phenotypic coefficient of variance, heritability, genetic advance for all thirteen characters The results obtained on various analysis during the investigations are summarized as the analysis of variance indicated the existence of sufficient amount of variability among genotypes for all the characters. The phenotypic variance was in general higher than the genotypic variance for all the characters. Among different yield attributing characters studied, flag leaf blade length (cm) had the highest magnitude of PCV and GCV. The estimates of heritability revealed that characters namely, flag leaf blade length, Ear length, flag leaf blade width, plant height, finger length and finger width were recorded with high heritability. High heritability coupled with high genetic advance was recorded for the traits *viz*. Flag leaf blade width and plant height. Hence, these characters were predominantly governed by additive geneaction and can be improved through simple selection.

Table 1: Analysis of variance for thirteen quantitative characters in Finger millet

S. No.	Source	Replications	Treatments	Error
	Degree of freedom	2	14	28
	Mean Sum of Squares			
1	Days to 1st flowering	7.022222	51.031746	46.022222
2	Days to 50%flowering	6.688889	67.307937	71.450794
3	No. of tillers per plant	1.282667	0.056762	0.090286
4	Ear length	0.115049	1.232580	0.086325
5	Finger length	0.582000	2.414434	0.229457
6	Finger width	0.009129	0.123761	0.006357
7	Height at maturity	10.652390	2048.795814	16.061959
8	Days to maturity	8.422222	4.326984	9.779365
9	Flag leaf:Blade length	10.155550	199.847368	3.762223
10	Flag leaf:Blade width	0.032702	0.570180	0.005997
11	1000 seed weight	0.266667	0.628571	0.552381
12	Biological yield	21.225970	14.760802	16.803621
13	Grain yield per plant	0.000560	0.002225	0.004036

Table 2: Mean performance of different genotypes for 13 quantitative characters in Finger millet

Character	GPU-67	WN-585	WN-559	WN-591	VR-1116	VR-1110	VR-1101	VR-1175	BR 1427	RAUF-17	VL-376	PR-1639	PR-1511	PR-202	GPU-45
Days to 1st flowering	67.66	75.33	68.33	75.33	61.00	68.00	70.33	70.66	71.00	74.33	65.00	70.66	72.33	64.00	67.66
Days to 50%flowering	80..66	84.66	78.00	85.33	71.33	82.66	83.00	87.33	80.66	86.33	77.66	78.66	82.66	72.00	78.66
No. of tillers/plant	1.800	1.600	1.866	1.600	1.800	1.533	1.800	1.733	1.933	1.866	1.866	1.866	2.000	1.733	1.600
1000 seed weight	3.666	3.666	4.000	3.666	3.666	4.000	3.333	4.000	3.000	4.333	4.666	3.000	4.000	3.666	3.333
Biological yield	28.20	31.93	30.13	30.76	32.56	31.30	32.59	28.30	31.16	34.20	31.96	27.80	26.20	28.20	30.63
Flag leaf blade width	1.266	0.833	1.386	1.480	2.293	1.480	1.460	1.440	1.380	2.213	1.386	1.420	2.493	1.420	1.353
Flag leaf blade length	20.40	13.80	20.60	20.53	30.60	21.66	21.13	21.00	21.13	34.46	22.46	37.53	36.60	36.80	37.73
Plant height	91.74	52.76	91.06	133.8	131.3	134.4	137.8	97.44	97.08	138.1	95.72	133.8	136.1	135.1	133.1
Finger width	1.206	0.846	1.233	1.200	1.220	1.173	1.200	1.220	1.213	0.840	0.766	1.180	1.253	0.740	0.800
Finger length	5.680	5.600	4.473	5.346	5.806	5.860	5.726	5.686	3.606	5.293	5.740	5.780	3.553	3.520	5.766
Ear length	5.200	5.320	5.266	5.793	5.053	5.120	5.146	6.280	5.026	4.953	6.260	6.526	6.446	4.713	6.400
Days to maturity	120.0	119.3	122.3	122.0	121.3	123.0	121.0	123.3	123.0	122.3	122.0	121.3	120.0	122.0	122.6
Seed yield/plant	1.233	1.233	1.220	1.253	1.226	1.293	1.200	1.200	1.193	1.200	1.206	1.246	1.213	1.226	1.193

Table 3: Mean, range, genotypic and phenotypic coefficient of variation for 13 quantitative characters in Finger millet

S. No.	Characters	Grand mean	Range		Component of variability		Coefficient of variability		H^2	GAM
			Min	Max	Phenotypic	Genotypic	GVC	PCV		
1.	Days to 1st flowering	69.44	61.0	75.3	47.69	1.66	1.86	9.94	18.712	0.7173
2.	Days to 50% flowering	80.64	71.3	87.3	70.06	-1.38	1.45	10.37	13.982	-0.4214
3.	No. of tillers per plant	1.77	1.53	2.00	0.07	-0.01	5.96	15.86	37.578	-4.6152
4.	1000 seed weight	3.73	3.3	4.6	0.57	0.02	4.26	20.36	20.923	1.8436
5.	Biological yield	30.39	26.2	34.2	16.12	-0.68	2.71	13.20	20.530	-1.1493
6.	Flag leaf: Blade width	1.55	0.83	2.49	0.19	0.18	27.19	28.35	95.908	53.5993
7.	Flag leaf: Blade length	26.43	13.8	37.7	69.12	65.36	30.58	31.45	97.233	61.2719
8.	Plant height	115.96	52.76	138.04	693.63	677.57	22.44	22.71	98.811	45.7004
9.	Finger width	1.07	0.8	1.25	0.04	0.03	18.43	19.87	92.752	35.2294
10.	Finger length	5.16	3.52	5.86	0.95	0.72	16.53	18.95	87.229	29.6951
11.	Ear length	5.56	4.71	6.52	0.46	0.38	11.10	12.29	90.317	20.6578
12.	Days to maturity	121.71	119.3	123.3	7.96	-1.81	1.10	2.31	47.619	-1.0902
13.	Seed yield per plant	1.22	1.19	1.25	0.0034	-0.0006	2.00	4.79	41.753	-1.7364

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