research article | International Journal of Plant Sciences, (January to June, 2010) Vol. 5 Issue 1 : 24-29

Genetic variability, association and path coefficient studies in two interspecific crosses of finger millet [*Eleusine coracana* (L.) Gaertn]

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Accepted : August, 2009

SUMMARY

The interspecific hybrids between cultivated species *Eleusine coracana* involving three different popular varieties *viz.*,HR 911 and PR 202 with *E. africana* for assessing genetic variability, path and correlations among yield and yield components in segregation population. Results indicated that the hybrid showed intermediate for productive tillers, finger length, finger number and days to 50 % flowering and exhibited reduced pollen fertility. The F_2 populations of two crosses registered high PCV and GCV values were observed for grain yield per plant and finger width and low for plant height and days to 50 % flowering whereas low moderate for all other characters. Plant height, finger length, test weight and grain yield per plant reported high broad sense heritability accompanied with high genetic advance. The correlation studies of these crosses showed grain yield per plant exhibited highly significant positive association with finger width and test weight. The path analysis in F_2 populations indicates that productive tillers per plant had the highest positive direct effect followed by finger width and test weight on grain yield in these two crosses while finger number exerted low positive direct effect on grain yield.

Key words : Interspecific hybrids, Finger millet, Genetic variability, Correlation coeficient, Path analysis

Finger millet (*Eleusine coracana* L. Gaertn.) commonly called as ragi in India, ranks fourth place after pearl millet (*Pannicum glaucum*), foxtail millet (*Setaria italica*) and Proso millet (*Panicum miliaceum*) with an approximate 8 per cent of the area and 11 per cent of the production in the world. About 4.5 million tonnes of grains are produced annually on 5 million hectares of land throughout the world (Rao , 1989). India alone produces 40-45% of the total world production with 2.70 million tonnes grains on two million hectares of land with a productivity of 1225 kg per hectare and rest of finger millet is produced in East and Central Africa. In India, the south eastern area of Karnataka and adjoining regions of Andhra Pradesh and Tamil Nadu states produce the bulk of the total crop. Karnataka alone contributes 55 per cent of total India's area and production of finger millet with a productivity of 1335 kg per hectare (Anonymous, 2004).

As a rainfed crop, finger millet is routinely subjected to moisture stress whose intensity varies across the seasons / regions. In addition to drought stress, various diseases especially blast and leaf blight causes considerable yield loss. Crop improvement work in finger millet during the last three decades has been directed to improve yield and agronomic attributes and considerable progress has been made by way of releasing superior varieties suitable to various regions. The variability available in cultivated species is limited in respect of certain important characters like finger length, straw quality, tillering ability, drought tolerance and resistance to several kinds of biotic stresses. In order to overcome above limitations, introgression of desirable genes from wild relatives into cultivated varieties which is required for sustainable agriculture.

In general, variability is the basic material for any crop improvement programme. So quantification of the extent of variability created in grain yield and its contributing traits by segregation after hybridization and the knowledge of heritability, genetic advance for the yield components and their correlations with yield in the segregating populations are the prerequisites for selection of desirable segregants in any crop breeding programme. The path analysis is an effective measure to find out direct and indirect effects of component characters contributing to yield. *Eleusine africana* is close relative of cultivated

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species of *E. coracana*. It has more tillering ability (15-20) and high drought tolerance capacity. It matures early (95-100 days) with more fingers per ear. Hence, in the present investigation *E. africana* is used as donor species for finger millet improvement. An attempt was, therefore, made in the present investigation to assess the variability released in F_2 generation of three crosses and to understand the degree and direction of association and furnish additional information of path analysis to determine the components of yield in interspecific hybrids of finger millet.

MATERIALS AND METHODS

The material for present study comprised of three crosses between wild species (*Eleusine africana*) with three cultivated popular varieties *viz*., HR-911and PR 202. The crossed seeds were obtained from the Project Coordination Cell, All India Coordinated Small Millets Improvement Project, Indian Council of Agricultural Research, Gandhi Krishi Vignana Kendra, Bangalore. The crossed seeds were sown during *Kharif* 2005 along with parents. The F_1 plants were identified based on morphological characters of donor parent during *Kharif* 2005. The F_2 population of two crosses of finger millet *viz.,* HR 911 x *E. africana* (cross I) and PR 202 x *E. africana* (cross II) were grown during summer 2006 along with parents. A total of 255 and 295 F_2 plants were selected from I and II crosses, respectively for recording observation on 10 quantitative traits including grain yield per plant. The phenotypic and genotypic coefficients of variability were computed as per the methods of Burton and De Vane (1953). The method of (Johnson *et al.*, 1955) was followed for estimation of broad sense heritability and genetic advance for all the traits recorded. The phenotypic correlation coefficients were computed as per the formula suggested by (Al-Jibouri *et al*., 1958). Path coefficient analysis was carried out following the method of Dewey and Lu (1959).

RESULTS AND DISCUSSION

Comparisons of morphological characters of different interspecific hybrids with their parents were presented in Table 1. It indicated that most of the characters were intermediate in interspecific hybrids. There was considerable difference in respects of productive tillers per plant between the two species. The cultivated species *E. coracana* var HR911 and PR 202 showed less productive tillers (2 to 4) while *E. africana* had as many as 17 tillers. The F_1s was intermediate with 8-10 tillers per plant.

With regard to finger number, the interspecific hybrid was intermediate between parents in all the three crosses. Finger length in interspecific hybrid was more towards *E. africana* (13 cm) than cultivated species. It indicated significant contribution of male parent (*E. africana*) to the F_1s in respect of this trait. On the other hand, the mean pollen fertility was 82.00 %, 84.17 % and 80 % in *E. coracana var* HR911 and PR 202, respectively and 88.85 per cent in *E. africana* (Table 1). The reduced fertility in the hybrid may be due to cryptic structural differences in the chromosome

There was considerable difference for days to 50 per cent flowering between the two species. The varieties *viz.*, HR911, PR202 were took 83, 85 days for flowering, respectively. Whereas *E. africana* flowered early in 50 days. The F_1 were intermediate between parents with 68, 67 days in cross I and cross II, respectively. Chennaveeraiah and Hiremath (1974) observed interspecific hybrids were intermediate between the parent species for most of the characters.

Table 1:Comparative morphological features of three interspecific hybrids *E. coracana* × *E. africana* and their parents

Sr. No.	Characters	Parents			F_1	
		P_1	P_2	P_3	$P_1 \times P_3$	$P_2 \times P_3$
1.	Pollen fertility (%)	84.17	80.00	88.85	47.28	42.25
2.	Plant height (cm)	109.00	92.00	150.00	144.00	145.00
3.	Productive tillers / plant	3.00	4.00	17.00	8.00	10.00
4.	Finger number / ear	7.50	6.00	11.00	9.00	8.00
5.	Finger length (cm)	7.00	5.10	13.00	11.50	10.00
6.	Finger width (cm)	1.10	1.20	0.40	0.60	0.70
7.	Days to 50% flowering	83.00	85.00	50.00	68.00	67.00
8.	Days to maturity	120.00	117.00	95.00	115.00	112.00
9.	Test weight (g)	3.33	3.20	1.03	1.97	1.43
10.	Grain yield per plant (g)	25.40	26.00	4.70	7.50	8.75

where,

P_1- HR 911 P_2- PR 202 P_3 – *Eleusine africana* (wild species)

Table 2 : Mean and range values for 10 metric traits in the F_2 generation of three crosses

Sr. No.	Characters	Range				Mean(±SE)	
		Lowest		Highest		Cross I	Cross II
		Cross II	Cross II	Cross I	Cross II		
1.	Plant height (cm)	99.00	94.00	157.00	158.00	125.85(±1.26)	127.58(±1.46)
2.	Productive tillers / plant	2.00	2.00	15.00	17.00	6.81(±0.27)	6.98(±0.30)
3.	Finger number / ear	5.00	5.00	15.00	13.00	8.84(±0.16)	7.97(±0.19)
4.	Finger length (cm)	6.00	4.00	17.00	14.50	9.23(±0.21)	8.31(±0.21)
5.	Finger width (cm)	0.30	0.40	0.90	1.10	0.62(±0.01)	0.63(±0.01)
6.	Days to 50% flowering	73.00	76.00	90.00	87.00	81.41(±0.49)	81.48(±0.26)
7.	Test weight (g)	1.32	1.32	2.90	2.87	2.09(±0.04)	2.10(±0.01)
8.	Grain yield / plant (g)	1.58	1.21	22.00	14.86	5.79(±0.41)	4.36(±0.31)

Cross I – HR 911 × *E. africana* and cross II - PR 202 ×*E. africana.* SE– Standard error

The F_2 population derived from interspecific crosses exhibited lot of diversity for different quantitative traits (Table 2). The F_2 population of two interspecific crosses exhibited considerable variability in respect of all characters studied. More variability was observed for plant height, productive tillers, finger number per ear and finger length in all the crosses which confirm the earlier reports of Appadurai *et al.* (1977). It indicates much scope for improvement of these characters through direct and indirect selection

The results of phenotypic coefficient of variability (PCV), Genotypic Coefficient of variability (GCV), heritability and genetic advance are presented in Table 3. For all the characters PCV were generally higher than GCV which indicated that substantial influence of environment in the expression of these characters. The highest PCV and GCV observed for grain yield per plant, productive tillers per plant and finger length exhibited high PCV and moderate GCV in all the crosses. These results are in confirmation with the earlier findings of Desalegn (1998). Plant height and days to 50 per cent flowering showed low PCV and GCV in F_2 population of all the three crosses and agrees with the observation of earlier workers (Kempanna *et al*., 1971 ; Mishra *et al*., 1980). Finger width reported high PCV in cross I and moderate in cross II but their GCV were moderate for cross II and low for cross I indicating high magnitude of environmental effect on the expression of this trait between the crosses. All other characters showed moderate PCV and GCV in all the crosses.

Finger length, test weight and grain yield per plant reported high broad sense heritability accompanied with high predicted genetic advance as per cent of mean in all the crosses indicated the broad sense of additive gene effects in its inheritance, and such characters could be improved by direct selection (Panes, 1957). Plant height and days to 50 per cent flowering revealed high broad sense heritability but they exhibited less genetic advance as per cent of mean, suggesting preponderance of non-additive gene action in the inheritance of these trait in all the crosses. Similar results were reported by Mohan Prem Anand (2005). Finger width in cross II had high broad sense heritability accompanied with high predicted genetic advance as per cent of mean indicated good scope for

Table 3 : Estimates of genetic parameters for 10 metric traits in the F_2 generation of two crosses

Sr. No.	Characters	PCV (%)		GCV (%)		Heritability in broad sense (%)		GA as % mean	
		Cross I	Cross II	Cross I	Cross II	Cross I	Cross II	Cross I	Cross II
1.	Plant height (cm)	10.23	10.51	9.51	9.81	86.42	87.26	18.21	18.89
2.	Productive tillers / plant	39.95	39.87	11.43	13.12	8.91	10.82	7.34	8.88
3.	Finger number / ear	18.10	22.12	8.46	11.27	21.87	25.94	8.14	11.31
4.	Finger length (cm)	23.32	23.51	20.36	19.58	76.26	69.37	36.60	33.57
5.	Finger width (cm)	22.56	17.90	7.25	14.61	10.52	65.38	1.61	23.80
6.	Days to 50% flowering	6.12	2.97	4.70	2.50	59.04	64.17	7.44	4.58
7.	Test weight (g)	18.41	15.45	16.77	13.82	83.10	80.00	31.10	25.23
8.	Grain yield / plant (g)	72.33	65.90	63.91	48.10	78.05	53.26	76.35	72.01

PCV– Phenotypic coefficient of variation, GCV– Genotypic coefficient of variation, GA – Genetic advance
Cross I – HR 911 × *E. africana* and cross II - PR 202 ×*E. africana*