



Genetic Diversity of Global Finger Millet Composite Collection Based on Qualitative Traits and Biological Races

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The global composite collection of finger millet (1000 accessions) was evaluated to study the variability for six qualitative traits under field condition in three environments. Wider variation for all the qualitative traits was observed and racial wise wild races *africana* and *spontanea* had more diversity for all qualitative traits. However the cultivated races showed difference in inflorescence shape. Most of the cultivated race accessions were predominated by the erect plant habit, green pigmented, top curved, low glume prominence and light brown seed colour. Genetic diversity in these traits can be used by broadening gene pool through national and international sources, wide hybridization, mutation or other genetic modification.

Key words: Genetic diversity, finger millet, composite collection, qualitative traits.

Finger millet is highly self-fertilized allotetraploid ($2n = 4x = 36$) derived from the wild tetraploid progenitor *Eleusine coracana* subsp. *africana*. At present 55 to 60 per cent of the finger millet crop is grown in southern and central Africa and remaining is produced in India (FAO, 2007). Traditionally, diversity studies and inter-relationship in finger millet have been undertaken using morphological and cytogenetical traits and methods of numerical taxonomy. Ayyangar (1931) described variability in inflorescence. Mehra (1963) studied rachis width, stem width, raceme width, spikelet length and glume length by metroglyph analysis and differentiated four taxa such as *E.indica*, *E.africana* (wild types), *E.coracana* (Afro-Asiatic type) and *E.coracana* (African highland type). Kempanna and Govindu (1969) reported the variation of plant habit, maturity, structure and composition of the ear and glume and grain colour in 78 African collections. Between 1970-2000, number of variability and diversity studies were reported in finger millet. Recently genetic diversity with larger number of finger millet germplasm (622) was reported (Upadhyaya *et al.*, 2006). The present study aims to assess diversity pattern of global composite collection (1000 accessions) based on qualitative traits.

Materials and Methods

The genetic material for the study was the global composite collection developed at ICRISAT consisting of 1000 diverse finger millet accessions. It included 622 accessions of core collection (Upadhyaya *et al.*, 2006), 222 accessions for various agronomic traits, and 50 accessions from Indian

national programme core collection, 85 accessions for various stress resistances, 12 accessions for grain nutrition traits, and 9 accessions possessing most genetic diversity in the ICRISAT collection. Race wise, the composite collection consisted of 579 accessions from race *vulgaris* [subraces *incurvata* (249 accessions), *digitata* (230), *stellata* (64) and *lilacae* (36)], 207 accessions from *plana* [subraces *confundere* (183), *seriata* (14) and *grandigluma* (10)], 132 accessions from *compacta*, 71 accessions from *elongata* [subraces *reclusa* (31), *sparsa* (20) and *laxa* (20)] and 7 from *spontanea* and 3 from *africana*.

The finger millet composite collection was evaluated during (2006) post rainy (E1) at Coimbatore, 2006 rainy (E2) and 2007 rainy (E3) seasons at ICRISAT Centre, Patancheru, thus constituting three environments (E1, E2 and E3 respectively). The experiments were conducted in alfisol fields in all three environments on ridges spaced 60 cm apart. Plant to plant spacing was 10 cm and the length of each row was 4 meters. An augmented design with four check cultivars (VR708, VL149, PR202 and RAU8) were used and repeated after every nine test accessions. Normal agronomic practices were followed to raise the crop. Observations on selected qualitative traits such as growth habit (decumbent, erect, prostrate), plant pigmentation (non pigmented, pigmented), inflorescence compactness and shape (long open, compact, fisty, top curved, pendulous, short open, Incurved, laxa), glume prominence (no prominence, low prominence, medium prominence, high prominence,), grain colour (brown, dark brown, light brown, reddish brown, white) and lodging (no

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lodging, slightly lodging, medium lodging, mostly lodging, completely lodging).

Results and Discussion

Qualitative Characters

A larger number of accessions were erect type (58.5%), followed by decumbent (41.2%). The prostrate type was very less (0.3%). Purple colour pigmentation was observed at internodes, leaf sheath and flag leaf of 287 accessions in the composite collection and classified as pigmented. Remaining 713 accessions had green colour and classified as non-pigmented. Composite collection was predominant with top curved (42.6%) followed

by incurved (32.2%), fisty (11.7%), short open (5.6%), long open (3.7%), pendulous (2.1%), compact (1.6%) and laxa (0.5%). Medium glume prominence was observed predominately in 38.2% of accessions, followed by low glume prominence (21.5 % of accessions), non prominence (20.7 %) and high prominence (19.6 %). More than half of the accessions (54.5 % of accessions) were light brown, followed by reddish brown (26.5 %), ragi brown (9.4 %), dark brown (6.6 %) and white (3.0 %). Accessions were grouped into no lodging (31.8% of accessions), slightly lodging (11.1 % of accessions), medium lodging (31.1 % of accessions), mostly lodging (8.9 % of accessions) and completely lodging (17.1 % of accessions) (Table 1 and Figure 1).

Table 1. Number of accessions grouped into different qualitative traits and biological races

Qualitative traits	No. of accessions	Subraces					
		<i>africana</i>	<i>compacta</i>	<i>elongata</i>	<i>plana</i>	<i>spontanea</i>	<i>Vulgaris</i>
1. Growth habit							
Decumbent	412	3	49	45	81	5	229
Erect	585	-	83	27	126	1	348
Prostrate	3	-	-	-	-	1	2
2. Plant pigmentation							
Green	713	3	97	60	150	6	397
Purple pigmented	287	-	35	12	57	1	182
3. Inflorescence shape							
Long open	37	3	-	32	-	2	-
Compact	16	-	16	-	-	-	-
Fisty	117	-	115	-	-	-	1
Top curved	426	-	1	-	201	-	224
Pendulous	21	-	-	21	-	-	-
Short open	56	-	-	19	4	-	33
Incurved	322	-	-	-	1	-	321
Laxa	5	-	-	-	-	5	-
4. Glume prominence							
No prominence	207	-	48	2	60	-	97
Low prominence	215	-	23	7	47	-	138
Medium prominence	382	-	49	22	76	-	235
High prominence	196	3	12	41	24	7	109
5. Seed colour							
Ragi brown	94	3	2	16	15	5	53
Dark brown	66	-	3	9	9	2	43
Light brown	545	-	96	28	129	-	292
Reddish brown	265	-	23	19	54	-	169
White	30	-	8	-	-	-	22
6. Lodging*							
No lodging	318	3	53	21	57	1	183
Slightly lodging	111	-	22	3	33	-	53
Medium lodging	311	-	44	16	77	1	173
Mostly lodging	89	-	7	8	11	2	61
Completely lodging	171	-	6	24	29	3	109

Racial diversity for qualitative traits

All the prostrate types were *spontanea* accessions (IE2921, IE4476 and IE 4442). This was because of spreading morphological nature of plants. The large numbers of accessions from race *vulgaris* were erect (348 accessions) and decumbent (226 accessions) out of 576 accessions, followed by race *plana* (126 accessions of erect

and 81 accessions of decumbent) out of 208 accessions. The frequency of purple pigmentation was predominant in accessions of race *vulgaris* (18.2%). Most of the accessions belonging to race *compacta* have fisty inflorescence (115 accessions), whereas *vulgaris* accessions were both incurved (321 accessions) and top curved (224 accessions), and *plana* accessions were top curved (201

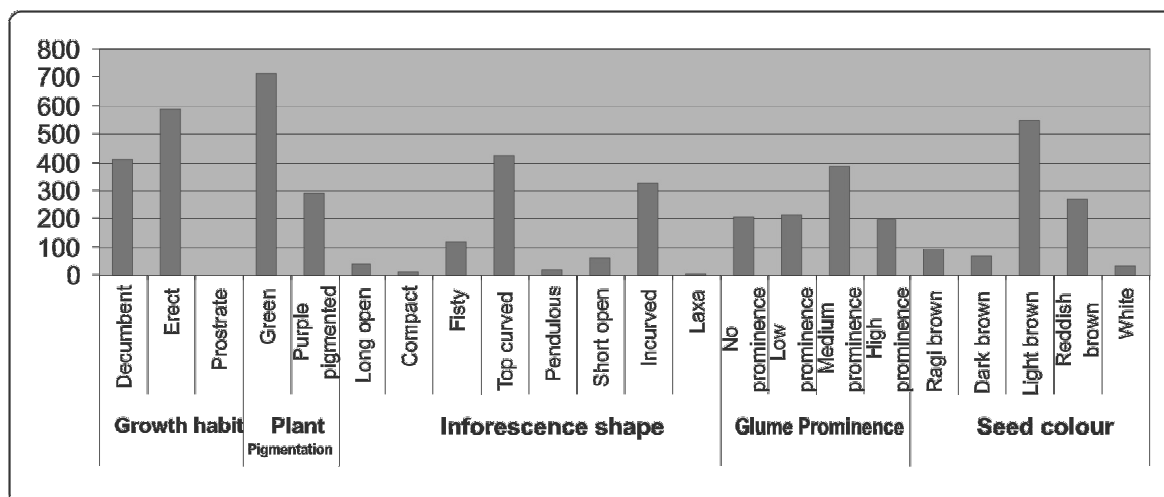


Figure 1. Frequency distribution of qualitative traits of global finger millet composite Collection

accessions). All accessions of wild races, *africana* (3 accessions) and *spontanea* (7 accessions) had high glume prominence, whereas the accessions of cultivated race accessions had all four types of glume prominence. A wide range of grain colour was observed. Thirty white colored accessions were from races *vulgaris* (22 accessions) and *compacta* (8 accessions).

The phenotypic characterization is the first step towards the classification of crop germplasm and economically more important for crop improvement. Out of the six qualitative characters studied, distinction could be seen in accessions for inflorescence shape between races such as *compacta* (fist), *vulgaris* (incurved and top curved) and *plana* (top curved). This is not surprising as the classification of finger millet races itself is based on inflorescence shape (Prasada Rao *et al.*, 1997). Most of the cultivated race accessions were predominated by the erect plant habit, green pigmented, top curved, low glume prominence and light brown seed colour.

The wide variability for these six qualitative traits were reported earlier in finger millet with 185 ICRISAT accessions (Geetharani, 2005), 622 accessions of core collection (Upadhyaya *et al.*, 2006; Upadhyaya *et al.*, 2007). More lodging was observed in *vulgaris* race and south Asian accessions as they are tall. Genetic diversity in these traits can be improved by broadening gene pool through national and

international sources, wide hybridization, mutation or other genetic modification. It is concluded that sufficient genetic diversity is available at phenotypic level which provide an opportunity for selecting desired traits.

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