Selection of trait specific fingermillet genotypes involving farmers' participation

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Abstract

The success of development of a new crop variety depends on the rate and extent of adoption by the target farmers. Fingermillet (*Eleusine coracana* L. Gaertn.) is a stable food crop with inherent hardy nature and quality nutritional grain in majority of drought prone areas in several East African and South Asian countries in the world. Based on this premise, an investigation was carried out in the Department of Millets, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore during 2012-2013 to develop high yielding and nutritionally rich genotypes adapted to local conditions and accepted by farmers and consumers at large using farmers' knowledge and breeders' scientific approach. Participatory Varietal Selection (PVS) approach was applied to select high yielding elite finger millet genotypes along with certain quality parameters like grain size, grain color, ear head shape, maturity duration and drought, insect pests and disease resistance using farmers' indigenous knowledge and breeders' scientific approaches. Most of the farmers preferred a genotype having high yield potential along with quality parameters like compact ear head, copper red coloured grains and resistant to lodging, drought, insect pests and diseases. A total of 40 Small Millets growing farmers participated in the evaluation programme. The farmers critically observed the entries in Small Millets trials and scored the varieties based on their preferences. They have showed their interest towards compact ear head, bold seeds, pest and disease free genotypes and non-lodging characteristics. The results of the present study showed that farmers' characterization of several accessions combined with statistical, nutritional, and genetic analyses performed by the breeders had allowed selection of fingermillet genotypes that fullfiled the concer of both the scientists and farmers.

(**Key words:** Fingermillet, participatory selection, locally variety and characterization).

Introduction

Finger millet is a predominant stable food crop of Tamil Nadu and has been produced by many small and marginal farmers. Tamil Nadu is a repository of vast collection of finger millet germplasm including land races and cultivated varieties. Plant breeding strategies that make use of and maintenance of this crop diversity have been formulated in recent years. There is diversity in agronomic and socio economic requirements of small holders, farmers and consumers. Close cooperation between scientists and farmers in evaluating plant material and establishing plant breeding goal is also a key feature of these strategies, known as of participatory research method. Farmer's participation in the breeding of crop varieties for low resource farmers is regarded by some as necessary help to ensure local adaptation and preference (Gyawali *et al*., 2007; Mekbib, 2006). Even its importance as a stable food of Tamil Nadu, Karnataka, Andhra Pradesh, Maharastra and Uttar Pradesh, still there is a gap between production and need. Despite yield, the other quality parameters like area of adaptation, grain size, ear head shape, grain colour, flouring capacity and cooking quality play an important role in choice of genotype selection. Participatory Varietal Selection involves a range of different approaches, from farmer – led initiatives (Sperling *et al*., 1993; Almekinders *et al*., 2006; Mc Guire *et al*., 2003; Witcombe *et al*., 2006). This paper focusses on the development of PVS in a farmer - led environment, where in farmers decide on their breeding objectives.

The availability of genetic materials, including products of locally adapted land races and breeding lines, is extremely important for the success of PVS. This implies that the approach entitles well founded partnership alliances between the farmer community and plant breeding institution, including assurance concerning the results of PVS (Samolders and Camballeda, 2006). Involving farmers in the breeding process in Participatory Varietal Selection (PVS) takes longer time as several years elapse before varieties can be obtained from the variable breeding materials that are created based on farmers' requirements first identified. This can be done by using several methods, either separately or in combinations. The method includes the examination of farmer's crop around harvest time and pre – selection, by farmers, of varieties from trials of many entries, grown on either research station or on farm. The extent of diversity can be evaluated in the trial and the best entries among the pre – release cultures are determined by using the criteria of farmers' preference (Witcombe *et al*., 2005). The specific objective of the

present study was to select the diverse and productive finger millet cultures adapted to local conditions and accepted by farmers' indigenous knowledge and breeders' scientific approach.

Materials and Methods

Participatory variety selection

Participatory varietal selection (PVS) was applied in the present study to select diversified finger millet lines that possess farmers' preferred plant and grain traits. Forty farmers comprising 19 men and 21 women's were invited to a `field exposure visit to Department of Millets, Tamil Nadu Agricultural University, Coimbatore on 05. 10. 2010. The participant farmers were selected based on their indigenous knowledge. A purposive sampling was undertaken to target specific people in the villages (both men and women) who were believed to possess more indigenous knowledge about finger millet and also ensured women participation in decision making in selection of genotypes adapted to their local conditions and fulfill their needs. These criteria were met with the help of field extension workers and the village chiefs who were familiar with the farmers' in the study. The experimental material comprised of sixteen entries including local and national checks. They were raised during *kharif*, 2010. The experiment was designed in randomized complete block design with three replications. Each entry was planted on 2.25 x 3 m plot with a spacing of 22.5x 10 cm. The crop was managed with proper agronomic practices to have a good crop stand. The best entries were selected based on farmers' criteria at maturity stage. The selection was based on maturity duration, ear head shape, grain colour, grain size, flouring capacity, pest and disease resistance, drought resistance and lodging resistance. Based on the preferential evaluation made by the farmers on the quality parameters, scores of 1 to 5 (1 being the lowest and 5 the highest score) were given to each quality characters except yield. Yield was measured by separate weighing of grain produced from the entire trial plot. The best performing entries were selected based on index value of each character.

Results and discussion

In the present study, sixteen finger millet genotypes were evaluated to select elite genotypes through PVS with the indigenous knowledge of farmers and the scientific approach of the breeders. The performance of the genotypes in Participatory Varietal Trial were adjudged visually as well as qualitatively by a group of 40 farmers specially formed for this purpose, so that the final judgment and ranking of varieties were solely made by the farmers. The group

visited all the trial plots. The evaluation based on preference of farmers on eight quality traits, attributed to the adaptation to the local environment of the farmers where they were located. Study included both men and women analyse the gender preferences. Most of the agronomic traits like maturity duration and resistance to drought, lodging, pests and diseases were preferred by men. These traits favoured ease in cultivation and reduced the cost of cultivation and led to increased production with low cost. Likewise, overall appearance and the cooking quality parameters like ear head shape, grain size and grain colour, flouring capacity were the most preferred by women. Some of the characters were highly preferred by both the genders like bold grains. While analysing the percentage of preference by the farmers for each character revealed that early maturity was preferred by most of the farmers (21 %) followed ear head type (16 %), flouring capacity (15 %) and grain color (12 %) were preferred by most of the farmers. The farmers in general, mostly preferred the traits that contributed to the yield, adaptability to local environment and ease in cultivation. Studies on gender preferences on various quality character, most of the men farmers had given highest preference to certain quality characters like maturity duration (13 %), followed by ear head type (13 %), grain size (13 %), resistance to drought (13 %) and resistance to lodging (12 %) which helped in easy cultivation. On the other hand, women had given the highest preference to the characters like flouring capacity(15 %), grain size (15 %), grain colour (15 %) and grain and fodder yield which contributed to their cooking quality. Certain farmers preferred crop with long duration and moderately susceptible to pest and diseases because of their adaptability to crop rotation and high yield. High yielding varieties shown high rate of susceptible to pest and diseases, drought and lodging. Varieties resistant to pest and diseases, drought and lodging had low yield potential. Because of these reasons farmers prefer to choose a moderately resistant varieties with good yield potential.

Farmers evaluated all the 16 genotypes and the score index for various quality traits of finger millet are summarized in table 1. Most of the farmers preferred genotypes with a set of traits such as, early duration, compact ear type and bold grains with copper red color. Certain farmers preferred long duration genotypes because, its maturity coincided with paddy harvest that resulted in reduced bird damage. Genotypes like PRM 6107, DHRS 1-1, VR 708, OEB 532, TNAU 1066, VL 347, and CO 14 mature at 95 – 100 days and they were preferred by most of the farmers. The genotypes were ranked based on the cumulative points calculate using the scores given by the farmers (Table 1). Similarly the sixteen genotypes were also ranked based on

the actual yield performance in terms of grain and dry fodder (Table 3). Variety OEB 532 recorded the highest grain and fodder yield (3955 & 7100 kg /ha respectively) followed by VL 347 (3876 & 6600 kg / ha). Whereas, VR 708, DHRS 1-1, DM 7 recorded 3810 & 6400, 3439 & 6100 and 3267 & 5400 kg / ha, respectively. When compared to the commercial check variety (Co(Ra)14) the best performing variety OEB 532 showed 42.73 per cent increase over local which was followed by VL 347 (39.88 %), VR 708 (34.50) and DHRS 1-1(24.11 %) as described in Table, 3. According to farmers preference TNAU 1066 ranked first, followed by DHRS 1-1, VR 708 and OEB 532. Certain genotypes are less preferred (VL 347) by farmers even though they had higher yield potential, because of their poor performance in quality traits like grain size, color of grain, ear head compactness and flouring capacity. Based on farmers knowledge, the top ranking genotypes are TNAU 1066, DHRS 1-1, VR 708 and OEB 532. Breeder after recording the yield and yield components chose the genotypes OEB 532, VL 347, DHRS 1-1 and TNAU 1066 as top rankers. When the views of both were given consideration, the genotypes OEB 532, TNAU 1066 and DHRS 1-1 might be recommended for cultivation as regional specific varieties. It is clearly understood that the PVS apart from giving new high yielding variety to the participating farmers, gives an opportunity to the farmers to uplift their family income by cultivation of these cultivars like TNAU 1066, DHRS 1-1, VL 347and OEB 532. They would be suitable for cultivation with inter crops such as pulses red gram or lab – lab and oil seeds (mustard and niger) which pave the way for increasing the production and income.All categories of target farmers benefited from this exercise. They included male and female farmers from all social groups representing resource rich, medium and poor farmers. The 40 farmers who took part in PVS benefited directly but hundreds of their relatives and neighbours would also be benefited indirectly by this PVS through them. Since women took part in evaluation of varieties they also benefited from selection of varieties that had traits of their liking. Cultivation of superior cultivars will empower women in decision making because of their increased role in storage, marketing and processing by selecting a genotype of their choice which would adapt in their environment and exhibit its highest yield potential.

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Table 1. Scoring of quality traits by the farmers in finger millet

S.NO	Quality traits	Scale (1 to 5)	Points	Number of farmers preferred		
				Men	Women	Total
1.	**Maturity duration**					
	a. Short duration	1	5	17	9	26
	b. Medium duration	2	3	0	0	0
	c. Long duration	3	1	2	6	8
2.	**Ear head type**					
	a. Compact	1	5	15	5	20
	b. Semi compact	2	3	4	2	6
	c. Open	3	1	0	0	0
3.	Grain size					
	a. Bold	1	5	8	18	26
	b. Moderately bold	2	4	8	2	10
	c. Small	3	3	0	1	1
	d. Moderately small	4	2	0	0	0
	e. Very small	5	1	0	0	0
4.	**Grain color**					
	a. Copper red	1	5	8	15	23
	b. Brown	2	3	3	3	6
	c. Dark	3	1	3	3	6
5.	**Flouring capacity**					
	a. High	1	5	8	21	29
	b. Medium	3	3	2	0	2
	c. Low	5	1	0	0	0
6.	**pest and disease resistant**					
	a. Moderately resistance	1	4	17	12	29
	b. Moderately susceptible	2	3	2	2	4
	c. Susceptible	3	2	0	0	0
	d. Highly susceptible	4	1	0	0	0
7.	**Drought resistance**					
	a. Moderately resistance	1	4	19	3	22
	b. Moderately susceptible	2	3	0	10	10
	c. Susceptible	3	2	0	0	0
	d. Highly susceptible	4	1	0	0	0
8.	**Lodging resistance**					
	a. Moderately resistance	1	4	18	10	28
	b. Moderately susceptible	2	3	0	3	3
	c. Susceptible	3	2	0	0	0
	d. Highly susceptible	4	1	0	0	0

* Points: 5 for most and 1 for least preferred scores.

Table 2. Ranking of finger millet genotypes based on cumulative points.

*checks

Genotypes	Maturity duration	Ear head type	Grain size	Grain color	Flouring capacity	Drought resistance	Pest and disease resistance	Resistance to lodging	Overall appearance	Cumulative points	Rank
TNAU 1066	130	100	130	115	145	30	12	72	64	798	1
DHRS 1-1	130	100	130	6	145	30	12	72	64	689	2
VR 708	130	100	130	6	145	30	0	12	100	653	3
OEB 532	130	100	130	18	145	0	12	0	100	635	4
RAU 8*	24	100	130	115	145	0	12	0	64	590	5
OEB 526	24	100	130	6	145	88	12	0	64	569	6
VL 149*	24	100	130	115	145	0	0	0	9	523	7
CO(Ra) 14*	130	18	0	115	0	88	12	72	0	435	8
VL 347	130	18	0	18	0	88	0	72	100	426	9
PRM 6107	130	18	3	6	0	88	0	72	0	317	10
DM 1	130	18	0	18	0	0	0	0	64	230	11
HR 374*	24	18	40	115	8	0	12	0	9	226	12
VL 351	24	18	0	6	0	30	0	12	64	154	13
DM 7	24	18	3	18	0	0	12	0	64	139	14
GPU 45*	24	18	3	18	0	30	12	12	0	117	15
PPR 2885	24	18	0	18	0	0	12	0	9	81	16

***** The cumulative points were calculated by multiplying the scale and points with number of preferred farmers for each character.

For example, the cumulative points for maturity duration is arrived as follows No. of farmers preferred

a. Short duration (scale 1, points 5 x number of farmers preferred 26 = 130) scale 1 x score points 5 x 26 = 130
b. Medium duration (scale 3, score points 3 x number of farmers preferred 0 = 0) scale 3 x score points 3 x 0 = 0
c. Long duration (score 3, score points 1 x number of farmers preferred 8 = 8) scale 3 x score points 1 x 8 = 8

Cumulative points for maturity duration = 138

Table 3. Ranking of finger millet genotypes based on yield.

Genotypes	Yield kg / ha	Fodder yield Yield kg / ha	Increase over commercial variety (%)	Rank
OEB 532	3955	7100	42.73	1
VL 347	3876	6600	39.88	2
DHRS 1-1	3810	6400	34.50	3
TNAU 1066	3439	6100	24.11	4
DM 7	3267	5400	17.9	5
VL 351	3036	4800	9.56	6
OEB 526	3022	4900	9.06	7
RAU 8	2995	3700	8.08	8
DM 1	2963	4500	6.92	9
VR 108	2831	4300	2.17	10
HR 374	2599	2900	-6.207	11
VL 149	2216	3400	-20.03	12
GPU 45	2103	3200	-24.11	13
PPR 2885	2037	2800	-26.48	14
PRM 6107	1720	3000	-37.92	15
CO (Ra) 14(check)	2771	3400	--------	16