stover, farmers preferred the new varieties for this purpose because they had improved stay-green characteristics. Except for Population-22, the new varieties were not shade-tolerant.

Postharvest traits. Assessment of postharvest traits revealed that the local varieties were better with respect to grain color and type, taste, grit-to-flour ratio, stored-grain pest infestations, and cooking quality. The farmers who were able to comment on taste reported that Manakamana-1 was good but still inferior to the local varieties. The taste of Population-22 was inferior to local varieties and to Manakamana-1. However, these varieties all fetch good market prices compared with yellow types (figure 1b).

The overall ranking of the tested varieties from different sites with different groups of farmers revealed that despite its lateness, farmers liked Population-22 in field conditions (table 2). The traits farmers liked were higher yielding potential, taller plants with multiple ears, stay-green characteristics, freedom from foliar diseases, and tolerance to lodging. Because of the taller plant height, there was less shading of millet when the lower leaves are stripped by farmers to harvest fodder and reduce competition with the millet. However, at the Murtidhunga and Parewadin sites, farmers said it affects millet because of its larger leaves and late maturity.

Table 2. Overall Rank of Varieties from Different Sites with Different Groups of Farmers (1999)

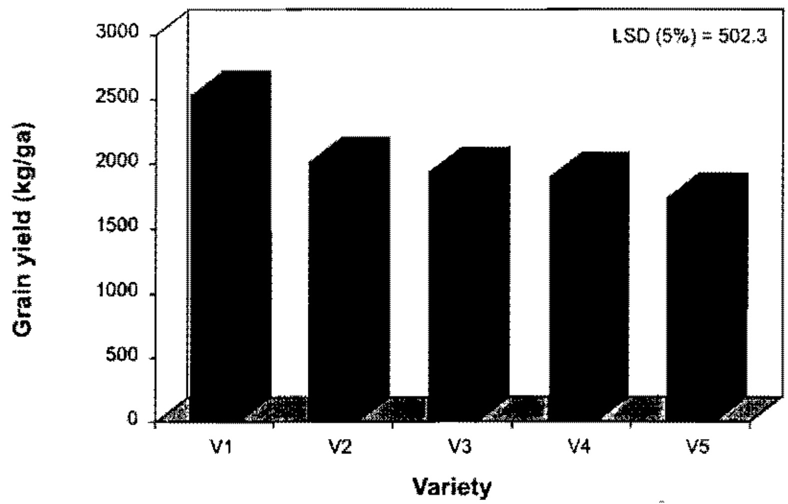
	Marga		Patle		Fakchamara		M/Dhumga	Tankhuwa
CVs\sites	Male	Female	Male	Female	Mixed	Mixed	Mixed	Mixed
Mana-1	2	5	3	2	5	4	3	3
Pop-22	1	1	1	1	1	1	1	1
BA-93	4	3	5	5	4	3	5	2
Arun-1	2	2	2	4	2	2	4	4
Locals	3	4	4	3	3	5	2	5

There was little distinction between the preferences of male and female farmers. It was rather surprising that the late variety Population-22 scored the highest (40), followed by Arun-1 (26). The score of Mana-1, local varieties, and BA-93 was similar (21). This was supported by the observed grain yield from FAMPAR trials, where Population-22 was found to be significantly superior (p<.05) to local varieties (figure 2). Other entries were on par with local varieties for grain yield.

As in the FAMPAR trials, Population-22 was found to be the highest yielder in the multilocational varietal display trials, although this result was not statistically significant (p=.38). The mean grain yield, irrespective of site, ranged from 2294 kg ha^{-1} to 2949 kg ha^{-1}. Arun-1 was the lowest yielder. Most of the farmers who grew Arun-1 commented that because of its early maturity, birds and rodents were attracted to it. A further problem was the theft of ears. Thus, there was no seed to keep for the following year or to assess for postharvest traits. However, because of its earliness and other desirable traits, farmers were willing to continue to use it. Some farmers also expressed the opinion that it provided early food and that demand for it would increase in the future when green ears were marketed locally for roasting.

Impact of FAMPAR varieties

The impact of any variety is assessed by looking at the area covered by that variety in a particular location and how confidently farmers have taken to that variety. Although it is too early to assess



Note: V1=Population-22; V2= Manakamana-1; V3=BA-93; V4=local varieties; V5=Arun-1.

Figure 2. Summary results of grain yield of FAMPAR varieties

impact, most of the participating farmers stated that they had saved seeds from some of the FAMPAR varieties that they grew last year, thus confirming the potential of PVS to increase biodiversity. The amount of seed saved for this year's sowing was 31 kg of Population-22, 29 kg of Manakamana-1, 24.5 kg of BA-93, and 13.5 kg of Arun-1 across all sites. Most farmers stated that one or two years' experimentation was not sufficient to fully understand the performance of a variety, so a few more years would be needed to have a more complete picture. According to the farmers, the seed demand from other farmers for FAMPAR varieties was limited except in a few cases (there was some demand for Population-22, Manakamana-1, and Arun-1) because of less exposure. A participatory seed-multiplication program for Manakamana-1 and Population-22 has been launched. Farmers were briefed about the selection of maize seeds in the field and the relative advantages of the field selection techniques.[2]

Conclusions

The basis for farmers' decisions to either accept or reject a variety is complex.

- Farmers' interest in growing new maize varieties without replacing existing local varieties confirmed that participatory crop improvement is a means of increasing genetic diversity.
- No ideal variety that satisfies all the criteria set by farmers has been developed so far by research. Varieties generated by following the top-down approach provide only a few traits that farmers required, but the participatory approach is more satisfactory because it offers more choices and gives the new varieties more exposure.

2. This refers to detasseling of 50% of phenotypically desirable maize plants from the terraces, which mostly lie in the central part of the field. Tassels from detasselled plants can be used as fodder. This operation is also expected to reduce the shading effect on the maize crop, reduce the degree of lodging, and stabilize yield through regeneration of heterosis. This operation also creates interest among farmers for testing the variety in the next season. This is a very simple and easy technique; however, care should be taken not to damage the flag leaf, which is important for photosynthesis.

- Farmers' interest in taking an active part in the selection process indicated that the success of this approach could be sustainable in the future.
- Farmers who had only one year's experience with a variety felt that this was not sufficient for precise feedback on a variety. This could have resulted in inconsistent opinions during the assessment of pre- and postharvest traits.
- Women farmers need to be encouraged to participate in the program because most of the field work in maize is carried out by women. It was noted that feedback received from women farmers was of better quality.
- The participatory approach provides a reciprocal educational experience between farmers and researchers because each recognizes the other's opinions and taken them into account.
- Despite its lateness, farmers liked Population-22 in field conditions (table 2). The traits farmers liked were higher yielding potential, taller plants with multiple ears, stay-green characteristics, freedom from foliar diseases, and tolerance to lodging.

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Participatory Varietal Selection in Finger Millet

B.H. Halaswamy, B.T.S. Gowda, A. Seetharam,
D.S. Virk, and J.R. Witcombe

Abstract

Finger millet (*Eleusine coracana* [L.] Gaertn.) is an important small millet for rainfed areas in India. A dozen varieties have been released for cultivation but there is little adoption by farmers, particularly in the Chitradurga and Bellary districts of Karnataka state where the present study was conducted. Participatory rural appraisal (PRA) showed that all farmers wanted higher grain and fodder yields, while only 8% mentioned resistance to diseases. Varieties of 105 to 110 days duration with moderate to high tillering and compact-top, in-curved ears were more acceptable. The PRA also showed that there was a varietal monoculture of PR 202 from Andhra Pradesh state.

Six varieties were selected for testing with farmers. They were chosen from those released for Karnataka but not adopted, and from those that were promising in all India co-ordinated trials. Most of them performed well in two-year trials. Participatory varietal selection (PVS) trials were conducted with 150 farmers in seven villages. Pre- and postharvest focus-group discussions (FGDs) revealed that the two recently released varieties, GPU 26 and GPU 28, met several of the farmers' selection criteria. GPU 26 was found to be suitable for late sowing up to the middle of August if the onset of rain was delayed, but GPU 28 could be grown in the second week of July. Among the nonreleased varieties, the short-duration variety (85 days), VL 305, was identified to be suitable as a second crop for sowing in September after sesame or cowpea—an option not available to farmers with the released varieties or nonreleased cultivars.

Introduction

In India, finger millet occupies an area of around 2 million ha, and annual production is about 2.6 million tonnes. It is grown as a rainfed crop on marginal sloping lands, where moisture and plant nutrients are limited. The crop withstands a variety of biotic and abiotic stresses, and traditionally, it has been an indispensable component of the dryland farming system. It is a staple food in southern Karnataka and in Tamil Nadu, Andhra Pradesh, South Bihar, Maharastra, Orissa, and Uttar Pradesh.

In Karnataka, a dozen high-yielding varieties were bred and released for cultivation during the 1970s, '80s, and '90s. These varieties were developed through hybridization between exotic (African) and native Indian germplasm. Farmers, particularly in areas where rainfall is more evenly distributed, have accepted some of these varieties, but their adoption is uneven in the major finger-millet-growing belts of Karnataka. Adoption is higher in districts and areas where annual rainfall is more evenly distributed than where rainfall is scanty and erratic. For example, in Chitradurga and Bellary, farmers still grow old varieties because of their specific adaptation to the local environments. The reasons for nonacceptance of new varieties in these districts could be a lack of traits farmers consider important in the new varieties, or a lack of location-specific adaptation, or both.

This paper reports results on farmer participatory varietal selection in finger millet in Karnataka. The major objectives of the study were to find out what traits farmers prefer to have in a new

B.H. Halaswamy, B.T.S. Gowda, and A. Seetharam are with the Project Co-ordination Cell, AICRP on Small Millets, GKVK, Bangalore, India. D.S.Virk and J.R. Witcombe are with the Centre for Arid Zone Studies, University of Wales, Bangor, UK.
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variety, to provide a basket of choices of recommended and nonrecommended varieties (the nonrecommended selected from those in advanced stages of formal varietal testing) to farmers for testing and selection, and to identify farmer-preferred varieties for dissemination.

The study was carried out in three major finger-millet-growing subdistricts (*taluks*): Chitradurga, Holalkere, and Hosadurga of Chitradurga district, Karnataka, India. The mean annual rainfall in Holalkere is 602 mm, in Chitradurga 590 mm, and in Hosadurga 463 mm.

Participatory rural survey

A household baseline survey for varietal preferences was conducted, involving 150 finger-millet-growing farmers categorized into upper, medium, and lower socioeconomic classes. The survey was made in 1999 in seven villages: Katihalli, Jalikatte, and Erajjanahatti of Chitradurga *taluk*, surveyed in May; Maddheru and Kumminagatta of Holalkere *taluk*, surveyed in June; and S. Roppa and Bansihalli of Hosadurga *taluk*, surveyed in July.

What characteristics do farmers want in a new variety?

Disregarding those farmers who did not respond, all farmers preferred a variety with higher grain and fodder yields. Among other traits, 67% farmers preferred varieties with compact ears, 65% wanted plants of medium height of around 100 cm, and 38% considered early maturity an important trait. Farmers did not express a specific preference for characteristics such as ear size, number of tillers per plant, or quality of fodder or grain (table 1).

Table 1. Frequency of Farmers' Preferred Characteristics in Finger Millet

Trait	Preference (percent, based on 150 farmers)	
Higher yield	100	(11 not responding)
Higher fodder yield	100	(11 not responding)
Ear compactness	67 compact, 8 semi-compact, and 25 loose	
Ear size	69 medium, 31 large	
Plant height	65 semi-dwarf, 15 medium, and 19 tall	
Duration	38 early	(62 not responding)
Tillers per plant	16 high	(84 not responding)
Fodder quality	11 good	(89 not responded)
Grain color	11 red	(89 not responded)
Grain quality	1 good	(99 not responded)
Disease resistance	8 resistant	(92 not responded)

The farmers' ideal variety would be high-yielding, maturing in about 105 days, with a plant height of 100 cm, medium-sized compact ears, and moderate tillering ability (table 1). Farmers also required a suitable variety for late sowing (in the middle of August) as a second crop following sesame or cowpea in the rainy (*kharif*) season.

The baseline survey also showed that there was a varietal monoculture of PR 202, a selection from local cultivars from Andhra Pradesh. PR 202 is an old variety that was released for Andhra Pradesh in 1976 as a pure-line selection from a Mettachodi landrace of the Vishakapatnam area. Its plants

are medium tall (110 to 120 cm) and ears are in-curved with six to eight fingers per ear. PR 202 has a good threshing ratio, and its orange-brown grains are medium bold (1000 grains weigh 2.8 g). However, PR 202 is highly susceptible to blast—a major disease of finger millet, and farmers wanted an alternative to this variety.

Selection of cultivars for farmer-managed participatory-research trials

Following the baseline survey, a search was undertaken to find varieties that would best match the farmers' selection criteria. Six varieties were chosen for testing by farmers in a participatory varietal selection program. Three of the selected varieties were released varieties, or identified for future release, i.e., GPU 28 and GPU 26 (released for Karnataka in 1998 and 1999, respectively), and VL 149 (nationally released in 1994). The other three varieties, VL 305, GPU 46, and 9002, were promising entries in advanced All-India co-ordinated finger-millet trials.

Conduct of the farmer-managed participatory-research trials

All the 150 farmers sampled in the baseline survey were involved in the conduct of farmer-managed participatory-research (FAMPAR) trials during the rainy season of 1999. There were two types of trials.

Single-variety trials

The 150 farmers were divided into six groups of 25 each across the seven selected villages; the number of participating farmers varied across villages. Each group was given one cultivar to grow side by side with their local variety in the same field under farmer-managed conditions, so there were 25 replicate-farmers for each variety. Each participating farmer was supplied with 1 kg of seed of the new variety (table 2).

Table 2. Details of the FAMPAR Trials Conducted in the Study Villages and Their Clusters, Chitradurga District, Karnataka, India

Taluk	Cluster	Village	No. of trials	Mean distance from district headquarters	No. of trials	No. of successful trials
Chitradurga		Katihally	30			
	1	Erajjanahatti	12	10	30	29
	2	Jalikatte	18	7	30	30
Holalkere		Maddheru				
	3		30	32	30	29
		Kumminagatta				
	4		30	38	30	29
Hosadurga		Bansihalli	18			
	5			50	30	29
		S.Roppa	12			

Single-replicate all-variety trials

Two farmers in each village were given seed of all six varieties for growing together with the local variety in the same field in a single-replicate trial. These trials served two purposes: to compare the performance of all varieties and to serve as foci for demonstration and focus-group discussions. A

two-way analysis of variance with varieties as one factor and locations (villages) as the other provided significance of differences among location, varieties, and interaction of varieties with locations.

Farmers took a great interest in experimentation since only four FAMPAR trials out of 150 were unsuccessful. The variety GPU 28 yielded more than all other varieties in all clusters (table 3). Only variety GPU 46, in clusters 1 and 5, and variety GPU 26, in clusters 2 and 5, yielded on a par with GPU 28. All other varieties yielded less than GPU 28 in all five clusters.

Table 3. Mean Performance of Six FAMPAR Varieties over Five Village Clusters (Table 1), Rainy Season, 1999

	Grain yield (t ha^{-1})						Increase over local
Variety	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Mean	(%)
GPU 28	5.52 a	5.21 a	5.85 a	5.46 a	4.91 a	5.39	51
GPU 26	4.82 bc	4.76 ab	4.10 cd	4.82 b	4.66 abc	4.63	29
GPU 46	5.34 ab	4.34 bc	4.80 b	4.58 bcd	4.75 ab	4.76	33
VL 149	4.15 d	3.94 cde	3.87 cde	4.21 de	3.74 de	3.98	11
VL 305	4.29 cd	3.88 cde	3.41 e	4.25 cde	3.70 de	3.91	9
9002	4.72 cd	4.12 cd	4.12 c	4.68 bd	4.11 d	4.35	22
Local	3.44	3.41 e	3.41 e	3.57	4.05 de	3.58	—
LSD (t ha^{-1})	0.61	0.55	0.55	0.44	0.53	—	—

Note: Values followed by the same letter do not differ significantly from each other.

On average, GPU 28 yielded 5.39 t ha^{-1}—51% more than the local cultivar. All of the varieties showed some yield superiority to the local cultivar. GPU 46, the entry ranked second for grain yield, produced 33% more grain than the local variety, and GPU 26, the entry ranked third, yielded 29% more grain. Moreover, GPU 26 was significantly earlier to mature than either GPU 46 or the local variety, an important advantage as it allows the escape of terminal drought caused either by late sowing or early cessation of the rains.

Farmers' perceptions were recorded in pre- and postharvest focus-group discussions (FGDs). Nine traits were scored in the FGDs: grain yield, stover yield, grain size, grain density, grain color, ear type, cooking quality, days to flowering, and disease resistance. The cultivar GPU 28 closely matched farmers' criteria for a variety to grow under normal sowing in the second week of July. Early-maturing GPU 26 was the most preferred variety for late sowing. A nonrecommended variety, VL 305, was preferred by farmers for its 9% higher yield than the control and its extra-early maturity in 85 days, which allows it to fit in a double-cropping sequence. It can be sown in September after a crop of sesame or cowpea.

In the present study, farmers of Chitradurga district did not prefer the nationally recommended variety, VL 149. On the other hand, varieties GPU 26 and GPU 28, released by Karnataka state were accepted by farmers, although they still lacked the ear characteristics preferred by farmers. An important result of farmer-participatory varietal selection was the identification of variety VL 305 for growing in very specific niches as a second crop after sesame or cowpea. Farmers preferred this

variety because of its earliness even though this results in lower productivity compared to later-maturing varieties.

Participatory varietal selection in finger millet has been successful in identifying varieties for specific agroecosystems, which are difficult to reproduce on research stations. Our results confirm those of various workers in other crops and agroecological systems: farmers prefer to adopt varieties from a basket of choices irrespective of their recommendation domains (Sthapit, Joshi, and Witcombe 1996; Joshi and Witcombe 1996, 1998; Virk, Bhasker Raj, and Witcombe 1996; Thiele et al. 1997). The participatory approach is more effective than conventional on-farm adaptive research (Gowda et al. 2000) because it provides farmers multiple choices from among varieties that are selected for farmer-preferred traits.

Conclusions

The PVS approach in finger millet was a useful tool for the following reasons:

- understanding farmers' criteria for selecting a variety
- analyzing reasons for nonadoption of a released variety
- identifying varieties for different sowing times and cropping systems from a basket of choices
- decreasing the gap between recommendation and adoption

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