On-Farm Evaluation of Pearl Millet Varieties in Malawi for Farmer Preferences, Grain Yield, and Food Quality Traits

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Abstract

During the 1993/94 season two types of on-farm trials (research-managed and farmer-managed), were conducted in 66 farmers' fields in the Shire Valley to verify crop performance and to expose new varieties to the farming community. Both trials were implemented by farmers. Three new pearl millet varieties (SDMV 89004, SDMV 89005, and ICMV 88908) and two controls (Nigerian Composite-tall [NC-tall], and farmers' local landrace varieties [LLV]) were evaluated for plant and grain traits preferred by farmers, yield potential, and for their acceptability as food.

Variety SDMV 89004 had the highest grain yields: 1.95 t ha^{-1} when research-managed and 1.47 t ha^{-1} when farmer-managed. Under research-management the three test varieties and NC-tall performed similarly and were superior to the LLV used, whereas, under farmer-managed trials, the three test varieties produced similar yields that were superior to both NC-tall and the LLV.

Of the 164 farmers who evaluated the pearl millet on-farm trials for plant and grain traits, the majority preferred ICMV 88908 as their favorite, followed by SDMV 89004, and SDMV 89005 based on field observations. All the varieties were ranked better than the LLV for grain traits (grain size, dehulling, grinding ease). However, for food taste NC-tall was the most preferred, followed by SDMV 89005, SDMV 89004, and ICMV 88908.

These results, and those from previous years, indicate that farmers prefer the new varieties because of their high grain yield, good grain traits, and acceptability as food (taste). These varieties will therefore be recommended soon for release in Malawi.

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Introduction

Pearl millet is the second most important cereal crop (after sorghum), both in respect of area and production, in the Shire Valley in Malawi. It is grown together with either maize or sorghum, but it is harvested earlier than sorghum and maize and provides food early in the season.

In the Shire Valley where there is the possibility of drought in 1 out of every 5 years (Kumwenda 1993), sorghum and pearl millet are the only crops that can produce grain. Munyenyembe (1993) reported that pearl millet production in the Shire Valley was 58% of the national production during the 1992/93 season. Pearl millet grain yield on the farm has been low, with 600 kg ha^{-1} compared with 2000 kg ha^{-1} at the research station (Chintu 1993). This yield gap has largely been attributed to continued use of local varieties, poor agronomic practices by farmers, and poor and erratic distribution of rainfall. Munyenyembe (1993) also attributed the failure of farmers to take up new technologies, due to social and economic constraints.

Since 1980, researchers in Malawi have evaluated new pearl millet varieties in the Shire Valley at Ngabu and Kasinthula research stations. Through this effort Nigerian Composite-tall (NC-tall) was released in 1983.

Recently the research department has identified three improved varieties for on-farm evaluation. These varieties have been evaluated on the farm with the following objectives: (a) to evaluate the performance of the new varieties under farmers' and improved managements, and (b) to assess farmers' acceptance of the varieties and determine the reasons for acceptance or nonacceptance. This exercise was geared towards involving farmers themselves in selecting varieties according to their preferences.

Materials and Methods

Agronomy

Five varieties—SDMV 89004, SDMV 89005, ICMV 88908, NC-tall, and LLV (farmer's local landrace variety)—were evaluated in research-managed farmer-implemented (RMFI), and farmer-managed farmer-implemented (FMFI) trials. Recommended cultivation practices were followed in RMFI trials, whereas the farmers' local practices were followed in FMFI trials.

In the case of RMFI trials, the gross plot size was 10 rows of 10 m long, 0.75 m apart. The central 8 rows, each 8 m long were harvested. The plot size in FMFI trials was obtained by marking the area which each variety had occupied at the time of sowing and at harvest. Five seeds were sown 40 cm apart and thinned to 2 plants per stand at the 15-cm seedling stage in RMFI trials. In these trials fertilizers were applied per plot at the rate of 810 g at sowing and 540 g urea at the thinning stage. No recommendation was followed for FMFI trials. These trials were sown in 11 extension planning areas (EPA). In each EPA, 3 unreplicated sites (farmers) were selected, for

each of the RMFI and FMFI trials. Farmers were treated as replicates (randomized) in each EPA.

The data were analyzed from 22 RMFI sites over 10 EPAs and from 18 FMFI sites over 8 EPAs, following multilocational analysis using the SAS program.

During the season, research and extension staff jointly visited the trials to observe and record the performance of the varieties with the farmer participation. The following data were collected from RMFI and FMFI net plots:

- maturity of the varieties as early (E) medium (M) and late (L);
- plant height at harvest from plant base to tip of panicle;
- plant count: the number of plants per net plot at harvest;
- head count: the number of heads per net plot at harvest;
- grain yield: obtained by multiplying the threshing percentage with plot head weight 1 kg head weight per plot was threshed to determine threshing percentage;
- a sample of 500 g grain was collected from each plot to determine the 1000-grain mass and moisture content. The moisture content was used to adjust the grain yield to 12% moisture. The maturity data were recorded by farmers themselves, and the other traits were recorded jointly with researchers and extension officers.

Before harvest, 31 farmers at Livunzu, 25 farmers at Mitole, 36 farmers at Dolo, 23 farmers at Mpasa, 18 farmers at Dzunde and 31 farmers at Nyachilenda were gathered at the site to evaluate the varieties in the field according to plant and grain traits. For evaluation purposes each individual farmer was asked to indicate whether the new varieties were better, the same or worse than his or her own local landrace variety. They were also asked to rank the varieties according to their preference.

After the trial plants were harvested, the farmer was advised to thresh and store the grain of each variety separately. A 10-kg grain sample of each variety was obtained for evaluation of grain traits and palatability tests. This evaluation was conducted in the six EPAs (Livunzu, Dolo, Mitolo, Mpasa, Dzunde and Nyachilenda) for grain traits and in the three EPAs (Mitole, Mpasa, and Nyachilenda) for palatability tests.

Palatability tests

The 1-kg grain sample was used to prepare flour and food (thick porridge) from each variety. At each site women farmers or farmers' wives dehulled and ground the grain into flour, using pestles and mortars. At Mpasa and Nyachilenda, due to shortage of time, flour was prepared by hammer mill.

Seven women farmers at Mitole, six women farmers at Mpasa, and five women farmers at Nyachilenda were gathered to dehull and prepare flour and food (thick porridge). These farmers were individually asked to indicate whether each of the four varieties was better, the same, or worse than her own LLV. Their responses were recorded. Finally a total of 20 men and women farmers at Mitole, 19 men and women farmers at Mpasa, and 34 men and women farmers at Nyachilenda were grouped at each site to taste the prepared food, with or without beef relish. These farmers were

individually asked during tasting to indicate whether each of the four varieties was better, the same, or worse than their LLV. Again, responses were recorded.

Results and Discussion

There were significant differences among varieties in respect of grain yield, 1000-grain mass, plant height, plant count, and head count across 10 EPAs (22 sites) in the RMFI trial (Table 1) and across 8 EPAs (18 sites) in the FMFI trial (Table 2). All the three new varieties produced significantly higher grain yield than the LLV and NC-tall in the RMFI trial (Table 1) and than the LLV in the FMFI trial (Table 2). However, the differences in grain yield among three new varieties were not significant in both the trials.

SDMV 89004 produced the highest grain yield averaged over sites under research-managed (1.95 t ha^{-1}; Table 1) and farmer-managed (1.47 t ha^{-1}; Table 2) trials. These results of on-farm trials from the 1993/94 season are in agreement with the 1992/93 season. SDMV 89004 produced the highest grain yield (1.91 t ha^{-1}) based on the mean data of 22 locations during the 1992/93 season (ICRISAT/SEA Regional Program, 1994). During the 1993/94 season, in both the RMFI and FMFI trials, i.e., under improved as well as farmers' management, the LLV gave the lowest yield.

ICMV 88908 had the largest grain mass, whereas the LLV had the smallest grain under both management systems (Tables 1 and 2). SDMV 89004 ranked 2nd and SDMV 89005 3rd for grain mass.

On farmers' preference, the varieties were ranked in six EPAs by farmers. Seventy-three farmers evaluated RMFI trials whereas 66 farmers evaluated FMFI trials. In both trials, farmers ranked ICMV 88908 as their first choice, followed by SDMV 89004 and SDMV 89005, while NC-tall ranked fourth and and the LLC fifth.

Table 1. Performance of pearl millet on-farm trial varieties averaged over 19–22 farmers under a research-managed system, Malawi, 1993/94 season.

Variety	Grain yield (t ha^{-1})	1000-grain mass (g)	Plant height (cm)	Plant count (ha^{-1})	Head count (ha^{-1})
SDMV 89004	1.95	10.04	215	36510	90602
ICMV 88908	1.87	12.00	191	39683	89452
SDMV 89005	1.84	9.82	214	38700	89287
NC-tall	1.82	9.13	265	35476	78509
LLV	1.26	8.34	294	41771	94178
SE	±0.105	±0.362	±4.7	±990.5	±4256.7
Mean	1.75	9.88	235	38414	88319
CV (%)	28.0	17.2	9.3	11.8	21.0

Table 2. Performance of pearl millet on-farm trial varieties averaged over 16–18 farmers under a farmer-managed system, Malawi, 1993/94 season.

Variety	Grain yield (t ha^{-1})	1000-grain mass (g)	Plant height (cm)	Plant count (ha^{-1})	Head count (ha^{-1})
SDMV 89004	1.47	9.80	212	35139	81417
SDMV 89005	1.44	9.04	217	34583	88069
ICMV 88908	1.38	11.58	184	33750	76819
NC-tall	1.00	8.34	259	30236	65069
LLV	0.93	7.60	280	35114	87064
SE	±0.122	±0.323	±5.6	±1671.4	±6424.5
Mean	1.26	9.35	228	33688	79272
CV (%)	41.0	14.66	10	20	32

There was no EPA by variety interaction for grain yield and grain mass under both managements. The implication of this is that each variety can perform equally well in all the EPAs where varieties were tested.

Responses on grain traits were obtained from farmers at six EPAs (Table 3). At all EPAs, the majority of farmers felt that SDMV 89004, ICMV 88908, SDMV 89005, and NC-tall were better than their LLV in respect of grain size. Similar responses were obtained in respect of grain color at five EPAs (except at Dolo for ICMV). At Dolo, 83% of farmers reported ICMV 88908 worse as compared with the LLV.

Results obtained from three EPAs for food taste are presented in Table 3. All the new varieties and NC-tall were preferred over the LLV by a majority of farmers in all the three EPAs in respect of food taste with relish as well as without relish. By comparing the preference of different varieties over the LLV, NC-tall was preferred most by farmers, followed by SDMV 89004, SDMV 89005, and ICMV 89008.

At Mitole 80% of the farmers felt that NC-tall tasted better than the LLV without relish, while 70% of them felt SDMV 89005 had better taste, followed by SDMV 89004 with 55%. For with relish, 70% of the farmers thought that both NC-tall and SDMV 89004 tasted better than the LLV.

At Mpasa a majority of the farmers felt that all the four varieties were better than the LLV without relish (74–84% preference) and with relish (53–74% preference).

At Nyachilenda, about half of the farmers indicated that ICMV 88904 was worse than the LLV. Fifty-six percent of the farmers thought that SDMV 89004 tasted better, while 53% of them mentioned SDMV 89005.

The differences among varieties were similar with and without relish.

Table 3. Preference rating of on-farm pearl millet varieties over farmers' control (LLV, in %) for gain traits by 164 farmers across six sites, and for food taste by 73 farmers across three sites in Malawi, 1993/94 season.

	No. of responses	SDMV 89004			SDMV 89005			ICMV 88908			NC-tall		
		Better	Same	Worse	Better	Same	Worse	Better	Same	Worse	Better	Same	Worse
Livunzu													
Grain size	31	100	0	0	97	3	0	100	0	0	71	26	3
Grain color	31	77	-	-	71	-	-	68	-	-	48	23	10
Mitole													
Grain size	25	100	0	0	100	0	0	100	0	0	84	16	0
Grain color	25	56	44	0	76	24	0	72	28	0	84	16	0
Dehulling	7	43	57	0	14	86	0	100	0	0	29	71	0
Food preparation	7	14	86	0	29	71	0	0	14	86	14	86	0
Taste, no relish	20	55	15	30	70	20	5	50	20	30	80	20	0
Taste + relish	20	70	25	5	70	15	15	45	5	50	70	20	10
Dolo													
Grain size	36	78	22	0	81	19	0	81	19	0	-	-	-
Grain color	36	92	8	0	64	36	0	0	17	83	42	58	0
Mpasa													
Grain size	23	100	0	0	96	4	0	100	0	0	91	4	5
Grain color	23	100	0	0	100	0	0	96	4	0	87	4	9
Dehulling	6	67	33	0	67	33	0	100	0	0	33	67	0
Food preparation	6	33	67	0	50	50	0	0	50	50	17	83	0
Taste, no relish	19	79	16	5	74	16	5	74	21	5	84	5	11
Taste + relish	19	68	21	11	74	26	0	53	21	26	74	21	5
Dzunde													
Grain size	18	100	0	0	100	0	0	100	0	0	100	0	0
Grain color	18	100	0	0	83	-	-	83	-	-	72	11	-
Nyachilenda													
Grain size	31	87	-	-	74	-	13	84	3	-	81	3	3
Grain color	31	65	13	6	55	16	13	52	10	26	68	10	10
Dehulling	5	100	0	0	100	0	0	100	0	0	100	0	0
Food preparation	5	20	80	0	0	100	0	0	0	100	0	100	0
Taste, no relish	34	56	21	23	53	35	12	44	12	44	50	38	12
Taste + relish	34	[illegible]	24	26	53	35	12	29	18	53	59	41	0

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