

On-Farm Evaluation of Improved Pearl Millet Varieties in Namibia

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Abstract

Pearl millet varieties for on-farm testing in Namibia were selected from on-station testing during the 1990/91 and 1991/92 seasons. The on-farm trials were conducted at up to 14 locations in Owambolands and Kavango during the 1992/93 and 1993/94 seasons. During both seasons research-managed farmer-implemented (RMFI) trials were conducted. Farmer-managed farmer-implemented (FMFI) trials were also conducted at five locations during the 1993/94 season. Under RMFI trials, Okashana 1 gave significantly higher grain yields over the farmers' local landrace variety (LLV) in Owambolands. In Kavango the performance of Okashana 1 and the farmers' LLV control was the same over the last 2 years of testing.

Under farmer management all the varieties produced similar yields to the farmers' LLV. However, in the RMFI trial, varieties responded to fertilizer, and Okashana 1 was significantly superior to the farmers' LLV in respect of grain yield. Without any improvement in crop management practices, there seemed to be a little yield gain from cultivar change. None of the improved varieties under test produced higher grain yield than Okashana 1. The development of pearl millet cultivars needs to be targeted to zones currently broadly defined as Owambo and Kavango.

Introduction

Pearl millet is the most important crop in northern Namibia where 60% of the nation's population lives. Low rainfall (300 mm y⁻¹ in the west increasing to 700 mm y⁻¹ in the east), and the predominantly sandy soils in the area limit the farmers' crop choices in the west to pearl millet only. During the pre-independence era no research on pearl millet was conducted. The introduction of a pearl millet nursery by

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SADC/ICRISAT SMIP in 1987 through the Rossing Foundation led to the subsequent release of Okashana 1 following the farmers' identification of the variety as a preferred type. The post-independence government, however, is very supportive of pearl millet research. The NARS' collaboration with both SADC/ICRISAT SMIP and other regional NARS has provided a ready source of pearl millet cultivars for testing.

Following on-station testing during the 1990/91 and 1991/92 seasons, varieties for on-farm testing were identified. The on-farm trials were conducted in the Owambolands and Kavango regions during 1992/93 (11 locations) and 1993/94 (14 locations) seasons with two objectives: (a) to study the yield potential of improved varieties in farmers' fields with and without the use of improved cultivation practices, and (b) to study the traits preferred and not-preferred by farmers in new varieties. In this paper, the grain yield potential of new varieties is discussed.

Materials and Methods

During the 1992/93 season, eight varieties of pearl millet were evaluated in farmers' fields at 11 locations. The varieties included in the trial were ICMV-F 86415, ICMV 82132, Kaufela (a Zambian released variety), SDMV 89004, Okashana 1 (the improved control), Kantana 1, Kantana 2, and the host farmers' own local landrace variety (LLV). Kantana 1 and Kantana 2 are local landraces that were identified during the 1990/91 season. These RMFI trials were given a randomized complete block design (RCBD), with two replications per site. Plot size was 10 rows, 5 m long, and 0.75 m apart. Hill-to-hill spacing was 0.50 m. Eight central rows were harvested. The crop was thinned to three plants per hill 3-4 weeks after sowing. All plots were fertilized at the rate of 40 kg P ha⁻¹ and 60 kg N ha⁻¹. The N was applied in two split applications: one-third at sowing and two-thirds just before the boot stage.

In the 1993/94 season, the RMFI trial was conducted in a RCBD with two factors—eight varieties, and two levels of fertilizers (with and without)—and replicated twice per location. Included in the trial were three new varieties (SDMV 90016, SDMV 91018, and SDMV 90004), three selected varieties from the 1992/93 on-farm trial (ICMV-F 86415, SDMV 89004, and Okashana 1), and two controls (Kantana and the host farmer's LLV). The fertilizer applied was 15 kg P ha⁻¹ and 40 kg N ha⁻¹, based on the results of the 1992/93 fertilizer response in on-farm trials. The N was also applied in two split applications as for the previous experiment. The crop was sown and managed in the same manner as the 1992/93 RMFI trials crop. Plot size was reduced to five rows with a net plot size of three rows. Fourteen locations (eight in Kavango and six in Owambolands) were included in this study. RMFI trials were managed by extension with the assistance of researchers.

Five entries, namely SDMV 89004, ICMV-F 86415, Okashana 1, Kantana, and the host farmer's LLV were also evaluated during the 1993/94 season under the farmer's management. Each farmer provided a replicate, and the trial was sown at five locations with four farmers (replicates) at each location. The plot size was 5 x 5 m, with a net plot size of 3 x 3 m. The farmers sowed and managed the crop in the same

manner as they usually do for their pearl millet crop fields. No extension/research influence was imposed on managing these trials.

The analysis of variance was carried out using ANOVA (SAS Institute, 1985). Pooled analysis was done by zone (region). The zones were based on agroecological potential as dictated by rainfall, and to a lesser extent by soils. Two major zones identified were as follows:

- a) Owambo, which has an annual rainfall of 300-400 mm. This can be further divided into Owambo West (poor drainage due to terrain and soil chemical composition), and Owambo East (no drainage problems).
- b) Kavango, which receives between 400 and 600 mm of rainfall per year. This can be further divided into Kavango West and Kavango East which receive 400-500 mm and 500-600 mm annual rainfall respectively.

Results and Discussion

The grain yield data for 1992/93 season in four zones are presented in Table 1. Four varieties in Owambo West and three in Owambo East were significantly superior to the farmers' LLV control in respect of grain yield production. However, none of the improved varieties was superior to the farmers' LLV in the Kavango East and Kavango West zones, although they performed equally well as the farmers' LLV. Two varieties—Okashana 1 and SDMV 89004 (released in Zimbabwe as PMV 2)—produced significantly higher grain yields in comparison with the farmers' LLV in both Owambo West and Owambo East zones. These results suggest to some extent that the improved varieties are more adapted to the zones of Owambo than to the zones of Kavango.

Table 1. Mean grain yield (t ha⁻¹) trial data of on-farm pearl millet varieties averaged over one to four locations in different regions of Namibia, 1992/93 season.

Variety	Owambo West	Owambo East	Kavango West	Kavango East
Okashana 1	1.71**	1.83*	1.93	1.25
ICMV-F 86415	1.48**	1.42	2.14	1.34
SDMV 89004	1.39*	2.19**	2.03	1.17
ICMV 82132	1.44**	1.44	1.78	1.03
Kaufela	1.11	1.75*	2.13	1.18
Kantana 1	1.01	0.97	1.57	1.13
Kantana 2	1.02	1.22	2.07	1.20
Farmers' LLV control	1.05	1.33	2.00	1.33
SE	±0.096	±0.118	±0.142	±0.066
Mean	1.27	1.52	1.95	1.20
CV (%)		11.0	-	-
Number of locations	3	1	3	4

*, ** Significantly different from farmers' control variety at 5% and 1% levels of probability respectively.

Table 2. Mean squares (M.S.) for grain yield ($t\ ha^{-1}$) trial data of on-farm pearl millet research-managed farmer-implemented varieties in two regions of Namibia: Kavango and Owambolands, and across two regions, 1993/94 season.

Sources	Owambolands		Kavango		Namibia	
	d.f.	M.S	d.f.	M.S	d.f.	M.S
Varieties (V)	7	0.336**	7	0.128	7	0.261
Fertilizers (F)	1	2.265**	1	3.679**	1	5.941**
Locations (L)	5	14.708**	7	32.048**	13	22.941**
V * F	7	0.052	7	0.125	7	0.106
L * V	35	0.271**	49	0.089	91	0.168
L * F	5	0.313**	7	0.296	13	0.280*
L * V * F	35	0.148*	49	0.148	91	0.142
Pooled error	90	0.088	120	0.171	210	0.136

*, **, Significant at 5% and 1% levels of probability respectively.

During the 1993/94 season, RMFI trials were conducted with and without fertilizer at 14 sites. Combined data analysis suggests that the differences among varieties were significant only in Owambolands and not in Kavango (Table 2). These results are in agreement with the findings of the 1992/93 season.

The mean squares due to fertilizers and locations were significant in Owambolands and Kavango as well as on a combined-location basis (Table 2). With the application of fertilizers, on an overall basis, grain yields increased significantly from 0.73 to 0.95 $t\ ha^{-1}$ in Owambolands, and from 0.67 to 0.91 $t\ ha^{-1}$ in Kavango. It is interesting to note that there were no interactions between varieties and fertilizers (Table 2), and therefore the variety means over fertilizer levels are discussed.

Table 3. Mean grain yield ($t\ ha^{-1}$) trial data of on-farm pearl millet research-managed farmer-implemented varieties averaged over two fertility levels and eight locations in Kavango, six locations in Owambolands, and across 14 locations, Namibia, 1993/94 season.

Variety	Owambolands	Kavango	Namibia
Okashana 1	1.00**	0.73	0.85
SDMV 90016	0.93*	0.74	0.82
SDMV 91018	0.92	0.92	0.92
SDMV 90004	0.90	0.81	0.85
SDMV 89004	0.87	0.80	0.83
ICMV-F 86415	0.79	0.82	0.81
Farmers' LLV	0.76	0.80	0.78
Kantana	0.63	0.72	0.68
SE	±0.061	±0.073	±0.049
Mean	0.85	0.79	0.82

* ** Significantly different from farmers' control variety at 5% and 1% levels of probability respectively.

Table 4. Mean grain yield (t ha⁻¹) trial data of on-farm pearl millet farmer-managed farmer-implemented varieties averaged over three locations in Kavango, two locations in Owambolands, and across five locations, Namibia, 1993/1994 season.

Variety	Owambolands	Kavango	Namibia
Okashana 1	0.72	0.32	0.49
SDMV 89004	0.76	0.35	0.51
ICMV-F 86415	0.77	0.32	0.50
Farmers' LLV	0.67	0.36	0.49
Kantana	0.44	0.31	0.36
SE	±0.087	±0.035	±0.040
Mean	0.68	0.33	0.47

Two varieties in the RMFI trial—Okashana 1 and SDMV 90016—produced significantly higher grain yields as compared with the farmers' LLV in Owambolands (Table 3). The results for two seasons suggest that Okashana 1 has yielded significantly higher than the farmers' LLV in Owambolands.

The evaluation of the improved varieties under farmers' own management during the 1993/94 season showed that none of the improved varieties had grain yield superiority to the farmers' LLV in both Kavango and Owambo regions (Table 4).

The results of 2 years of testing indicate the following findings:

1. Under research management, Okashana 1 gave significantly higher grain yield over the farmers' LLV in Owambolands. In Kavango the performance of Okashana 1 and the farmers' LLV was the same over the last 2 years of testing.
2. Under farmer management, all the varieties produced similar yields to the farmers' LLV. However, in the RMFI trial, varieties responded to fertilizer, and Okashana 1 was significantly superior to the farmers' LLV in respect of grain yield. Without any improvement in crop management practices, there seemed to be a little yield gain from cultivar change.
3. None of the improved varieties under test produced higher grain yield than Okashana 1.
4. The development of pearl millet cultivars needs to be targeted to zones currently broadly defined as Owambo and Kavango.