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On-Farm Research Experience With Improved Cowpea Cultivars

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In Zambia, particularly in the Eastern Province, cowpea is cultivated under diverse soil and climatic conditions and is traditionally grown scattered in a main crop of maize or sorghum. The local cowpea is a vigorous, prostrate to semiclimbing plant that yields little grain.

The study was conducted to obtain farmers' assessment of leaf and grain qualities of 10 cowpea varieties and also to determine how tolerant the farmers' selected varieties were to disease and insect pressure. The varieties were planted in a randomized complete block design with sites as replicates. Number of varieties tested differed each season.

Results revealed that farmer participation played a very significant role in helping scientists to quickly understand what qualities the farmers required in a cowpea variety. However, it was not possible to find a single variety with all characteristics preferred by the farmers. ZVu 83, however, met most farmers' criteria.

Cowpea is one of the most commonly grown food legumes in Zambia particularly in the eastern Province. Although production figures are not available, it is estimated that all rural households grow a few plants mixed with local maize or sorghum each season.

In the Eastern Province, cowpea can be grown on the plateau and in the Luangwa valley (one-third of the Province) where other proteinaceous foods such as beans are environmentally out of place, groundnuts are difficult to grow, and cattle are absent.

Cowpea plays a major role in household diet. In the province, it is utilized at various stages of growth (Mitti 1983/84): fresh leaves are eaten as spinach (often prepared with pounded groundnuts) throughout the season; some leaves are par-boiled, sundried, and stored away for use in the dry season, green pods are also boiled and eaten as snack (along with pumpkin or green maize), starting around January/February when household food reserves are low or exhausted, and finally dry grain is a cherished relish (cooked like beans) in the dry season.

While food legumes, because of their high protein content in general, constitute the natural protein supplement to the predominantly maize staple diet, in the Eastern Province, cowpea represents the legume of choice for the majority of farm families. With 24 percent protein, 62 percent soluble carbohydrates, and a relatively high lysine content (Singh and Rachie 1985), cowpea can help reduce protein deficiency malnutrition. A good harvest would provide women a ready relish for their families, particularly in the dry season when relish material is scarce. However, local cowpea produces very little grain; the plants are susceptible to disease and insect pests, and often only a few survive to maturity.

In the 1987/1988 season, on-farm work was initiated to test some of the varieties being produced by the cowpea improvement program. The main objectives of the on-farm work was to obtain farmers' criteria for evaluating cowpea materials and to

enable scientists assess acceptable tolerance by the variety to disease and insect pest pressure.

Materials and methods

Ten improved cowea varieties including standard controls, ZVu83 and a local site variety which differed from site to site, were tested over four seasons: 1987/88, 1988/89, 1989/90, and 1990/1991. The number of varieties tested varied each season as those which exhibited severe susceptibility to diseases/insect pests were dropped and replaced by new varieties. The varieties tested during each of the four seasons are indicated in Table 1.

Farmer selection

Most of the farmers were volunteers among the numerous cowpea growers in the target area where the Adaptive Research Planning Team (ARPT) normally conducts its on-farm research Program. While many farmers were willing to test the new cowpea varieties in their own fields only five farmers could be accommodated each season. Thus, there were five test sites in each of the four seasons, whose location varied seasonally accordingly to the five farmers selected to participate in the trial for the particular season.

Table 1. Test materials and seasons

Cultivars	Crop season			
	1887/88	1988/89	1989/90	1990/91
ZVu 83	x	x	x	x
ZVu 237	x	x	x	x
Local		x	x	x
TVx 4654-44E	x	x	x	x
K80	x	x	x	-
IT82D-875	-	x	x	x
IT83S-872	-	x	-	-
Muliana	x	-	-	-
White wonder	-	-	-	x
TVx 3381-02F	-	-	-	x

x = Sown; - = Not sown

Trials design and records

The trial was superimposed on local maize planted with two seeds per station at 75 cm x 90 cm. Two seeds of each cowpea variety were sown 25 cm apart between the maize. Time of planting and other management aspects were controlled by the farmer. In some seasons, when an improved maize variety was used, some fertilizer was applied to the maize. The cowpea entries were planted in a completely randomized design with sites as replicates.

Trials were evaluated by the farmers' preference ranking of cowpea varieties, grain yield as a percentage of ZVu 83, and the number of plants surviving to fruition. Leaf harvest was also taken into account.

Similar management practices and evaluation procedures were followed at all sites. Grain yield data were subjected to analysis of variance.

Results

1987/88 season

A zero grain yield of the local variety was recorded during the 1987/88 season despite it recording the highest leaf yield, and near zero yields for Muliana (Table 2). The zero yield of the local variety could be because it was just starting to bloom at the time the season came to an end. Also, Muliana was rendered nearly fruitless by the cowpea aphid-borne mosaic virus.

Farmers preferred varieties K80 and ZVu 83 (control) for their high grain and leaf yield. However, some preferred ZVu 237 despite its low grain yield (24% of control).

Table 2. Leaf and grain yield (kg/ha), 1987/88 season

Variety	Leaf kg/ha	Grain kg/ha	% of control	Farmers' ranking
TVx 4654	772	586.4	67	2
ZVu 83	1543	875.0	100	1, 2
Local	1994	0.0	0	3
K80	1543	890.0	102	1, 2
ZUv 237	-	208.3	24	1
Muliana	-	7.7	1	-

1988/89 season

Despite similarities between the three sites, the local cowpea yielded at only one site (Table 3). The other test varieties however, competed stiffly yielding the same or even better grain than the control. Farmers preferred K80 most, followed closely by ZVu 237 and TVx 4654. In observation plots, however, IT 82D-875 and IT 835-872 gave very high grain yields and were consequently promoted to trial plots. There was no sensible leaf yield data this season due to frequent errors by farmers such as mixing-up of the varieties.

1989/90 season

Although the site local on average gave no grain yield, its leaf yield was far superior (over 10 times) to that of all other varieties put together (Table 4). However, the leaf yield data was not statistically analyzed.

ZVu 83 significantly outyielded other varieties by over 200 kg/ha (Table 4). Farmers ranked it most preferred followed closely by ZVu 237, TVx 4654-44, and K80 much like in the previous season. However, due to its susceptibility to CAMV, K80 was dropped and replaced by a less-prone but more leafy variety, TVx 3381-02F, the following season. White wonder was also included.

Table 3. Grain yield, 1988/89 season (over 3 sites)

Variety	Grain		Farmers' rankings
	kg/ha	% of control	
K801127	125	1, 2	
TVx 4654	1003	111	3
ZVu 83	900.2	100	1
ZVu 237	771.6	85.7	3
Others ¹			
Local	(241.8) ²	(27)	
IT 83S-872	(848.8) ³	(94)	
IT 82D-875	(1034.0)	(115)	

1. Excluded in ANOVA
2. All sites except one (725.3 kg/ha) gave zero yield
3. Two sites only
4. One site only

Table 4. Leaf and grain yield, 1989/90 season (over 5 sites)

Variety	Leaf kg/ha	Grain* kg/ha	% of control	Farmers' ranking
ZVu 83	111	719.6 a	100	1
ZVu 237	169	486.8 b	68	4, 2
IT 82D-875	129	455.0 b	63	(2)
TVx4654-44E	104	370.4 b	51	2, 4
K80	175	338.6 b	47	3
LSD (0.05)	232.5			
CV (%)	36.58			
Local**	1534	0.0 c	0	6

- * Mean with same letter not significantly different
 ** Local variety having given zero yield, not included in ANOVA
 () data from one site only

1990/91 season

Site locals were clearly superior in leaf yield, but still gave no grain yield (see Table 5). The introduced varieties yielded similarly (around 500 kg/ha) with no significant differences between them. Farmers again favored ZVu 237, followed by ZVu 83, and TVx3381-02F. The local variety was liked only for its leaf yield.

Table 5. Leaf and grain yield, 1990/91 (over 3 replicated sites)

Variety	Leaf kg/ha	Grain kg/ha	% of control	Farmers' rankings
ZVu 237	267	536.9	106	1
ZVu 83	492	506.0	100	2
TVx 3381-02F	192	459.8	90.9	3
LSD (0.05)		303.4		
CV (%)		42.8		
Observations*				
Local	17.44	0	0	6
IT82D-875	411	407.5	80.5	5
White wonder	169	367.0	72.5	4

* Not included in ANOVA

Overall performance

Leaf and grain weights were taken as straight averages for each variety over the seasons (i.e. no ANOVA was done). Farmers' comments for or against each variety were similarly averaged over the seasons.

Overall, farmers' ranked ZVu 83 highest, followed by ZVu 237 and IT82D-875 (Table 6). This ranking was expected as the same varieties more or less ranked highest at most sites every season.

Discussion

Cowpea varietal screening started with on-station tests many seasons back. Typical of on-station work, the materials were evaluated mainly on the basis of grain yield. As such, the initial set of varieties used for on-farm testing were selected because they were high-yielding (grainwise) and more tolerant to disease (on-station). But during the years of on-farm testing, when farmers themselves grew the varieties and evaluated them in their own way, a number of lessons were learnt about farmers' preferences:

- (a) farmers' choice was based on both grain yield and leaf yield;
- (b) farmers' preferred smooth (not hairy) and tender leaves;
- (c) preferred grain type was large, tasty/delicious, and quick to cook;
- (d) farmers preferred early-maturing varieties (though this quality sometimes leads to grain rot when harvesting is delayed).

Farmers were very concerned about varieties that:

- (a) lodge and climbed onto maize heavily;
- (b) were susceptible to storage pests;
- (c) had a dull color;
- (d) took long to cook (fuel or time shortage);
- (e) were small-seeded (though most are).

Table 6. Average yields and farmers' preference ranking

Variety	Leaf kg/ha	Grain kg/ha	% of control	Ranking	Reasons	Complaints
K80	859	784.7	106	4	More leaf, more pods, brown seed coat, big grain,tasty	Hard to cook
ZVu 83	715	742.4	100	1	Large seed, early maturity, leafy, delicious.	Hard to cook (small seed?)
TVx 4654	438	653.4	88	5	Delicious bigger seed.	Hard to cook, susceptible to storage pests, color not liked
IT82D-875	(270)	632.3	85	3	Lots of leaves tasty (good at the table)	Few leaves, lodges Small seed, poor seed colour, hard to cook, poor storage.
ZVu 237	*	517.9	70	2	More leafy more grain	Lodges, climbs maize, small seed, storability questionable.
White wonder	*	(546)	74	*	*	*
TVx3381-02F	*	(534)	72	5	*	*
IT83S-872	*	848.8	114	*	*	*
Local 1764	0	0	9		Leafy, long life	Late maturity, little/no seed
Muliana	*	7.7	1	*	Leafy	Seed spoiled by rain

() Data from one season or site

* Leaf harvest or farmer ranking/comments not recorded.

There were other lessons with implications on the methodologies used by scientists to evaluate the varieties:

(a) although statistical procedures were used to detect mean differences, farmers' choice was not necessarily based on yield level, but also on quality of the grain or leaf, a criterion which cannot be easily analyzed statistically,

(b) the leaf yield data provided by the farmers were highly subjective, as the amount picked by the farmers' depended on a number of factors including:

- size of the family to be fed
- availability of other preferred relish, e.g., meat
- leaf quality rather than harvestable quantity of the variety
- interest in preservation or capacity to do so for dry season use

Hence leaf harvest data does not lend itself to rigorous statistical judgement.

For these reasons farmers' choice was sometimes different from that of scientists, which made it rather difficult for scientists to decide which variety to release to the farmers. However, looking at the overall performance and ranking, ZVu 83 was most preferred by farmers and will be proposed for released. In the meantime, ZVu 83, K80, and others ranked highly by farmers will be tested further, along with new materials, until suitable varieties are found.

Farmers' participation will be increased and efforts will be made to come up with some standard evaluation criteria to use in grading the varieties. Farmers' practices such as planting dates, methods of planting, and time of harvests, will also be investigated.

Conclusion

Farmers' participation played a very significant role in helping scientists to quickly understand what qualities/characteristics the farmers wanted in a cowpea material. Most varieties were similar in grain and leaf yield as well as tolerance to some pests, hence, only the farmers' evaluation criteria that could separate them. Due to a shortage of improved or tested materials at this stage in the cowpea improvement program, it was not possible to find a variety that possessed all characteristics with farmers preferred. However, scientists are now in a better position to seek/develop suitable cowpea types. Meanwhile farmers will have to make do with ZVu 83 which some said took too long to cook.

References

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- Singh, S.R., and K.O. Rachie. 1985. Cowpea Research Production and Utilization. IITA/World Cowpea Research Conference.

Discussion

Q. Mligo: You ranked one of your test materials high partly because it had large seed size. However, you record small seed size as one of the complaints against it. Is the material small- or large-seeded?

A. Mulila-Mitti: I am sorry for the confusion. The material is large seeded.

Q. Doto: In any given year, testing was limited to about five participating farmers. Is it possible to enlarge the sample size by involving more people—possibly neighbors—in the evaluation process?

A. Mulila-Mitti: This is a good suggestion. In fact in future trials, we intend to involve more farmers so as to get a larger sample size. It's also a good idea to invite the neighboring farmers to participate in the assessment of improved cultivars.

Q. Matilo: Do the farmers consume the green pods? The lack of grain yield could have been due to pods having been eaten green.

A. Mulila-Mitti: Farmers do consume green pods, however, the lack of grain yield in the local variety is due to its late maturity. At the end of the season when the introduced varieties were being harvested, the local variety was only just starting to flower.

Q. Nleya: It seems as if the major complaint from the farmers was that the varieties are hard to cook, and all varieties seemed to get this complaint. Which variety were the farmers comparing these varieties to?

A. Mulila-Mitti: I am not quite sure. I suspect that the farmers compared the cooking time with that of their local varieties.

Q. Dashiell: Were any chemicals used for insect control?

A. Mulila-Mitti: No chemicals were used to control insect pests. Actually, no inputs were used in these trials.