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FARMERS PRIORITIES FOR NEW SORGHUM AND MILLET VARIETIES BASED ON ON-FARM TRIALS IN SEMI-ARID TANZANIA

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Summary

In the 1993/94 cropping season the Mvumi Rural Training Centre conducted on-farm trials with new sorghum and millet varieties in cooperation with the SADC/ICRISAT Sorghum and Millet Improvement Program of the Ilonga research station. Post harvest aspects were tested on station. Taste preferences and farmers priorities for further breeding were identified via discussions in the villages.

All new sorghum varieties have poor post-harvest qualities. Based on field observations farmers liked the SDS 2293-6 most. SV-1 was found to be too similar to Tegemeo to be of interest. The millet variety TSPM 91018 was successful: it out yielded the others with more than one third and has good post-harvest characteristics. TSPM 91001 is too similar to the local variety to be of interest.

In general improved millet varieties need the highest priority as it is the most important food crop and it has no post harvest- or marketing problems. New millet varieties can be an incentive for farmers to further improve the management of their crops. The pure seeds needed could be produced by the MRTC in cooperation with the SMIP.

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1. INTRODUCTION

The MRTC is a church based NGO, but it's extension work is done by the VEW's from the ministries of agriculture and livestock and of natural resources. As a result of this cooperation the MRTC was asked by the Regional Extension Officer of Dodoma to conduct on-farm trials in cooperation with the Tanzanian SMIP program in Ilonga. As one of the aims of the MRTC is to develop new technologies in a participatory way, it agreed to do so.

2. BACKGROUND INFORMATION

The Mvumi division is part of Ugogo, the dry heart of semi-arid Tanzania. Its problems are characteristic for semi-arid Africa: low (550 mm) and unreliable rainfall, poor (sandy loam) soils, overpopulation (75 inh/km²), out-migration of men (38%) and overgrazing.

The accelerated soil erosion resulting from the over-exploitation of the natural resources could only be stopped by an enforced destocking in 1986 by the Dodoma soil conservation project (HADO). Since 1991 the MRTC is successfully introducing zero-grazing in the area: it is economically viable and ecologically sound (Holtland, 1994a).

The cropping system is based on hoe-cultivation. Fallow periods are reduced to nearly nil and crop residues are burnt. Two major types of fields can be distinguished:

1. 'migunda' (84% of the area): dry planted cereals, intercropped with minor crops like Cucurbitaceae, lab-lab, cowpea and pigeon pea. Bulrush millet occupies roughly 75% of the area while maize and sorghum occupy each half of the remaining 25%. Dry planting is essential as the rains can start or stop any time;
2. ' vigundu' (12%): groundnuts and Bambara nuts in pure stands, sown after a proper land preparation after the onset of the rains.

Over the years many improved cropping practices are tried. All failed, including oxenisation and the use of chemical fertilizer. Despite this and despite the reduced fallow the average yield is still the same as fifty years ago (± 500 kg/ha) due to an improved management of the crops (via an increased labor input per ha). Seeing the deteriorating exchange rate between external inputs and local products (due to the liberalisation policy of the Tanzanian Government) for the near future only innovations which build on this slow process of intensification can be successful. So new varieties which respond better to improved management must be an important component of any extension message, together with planting on lines and higher plant densities (Holtland, 1994b).

3. METHODOLOGY

The trials involved sorghum and (bulrush) millet. Of both four varieties were used: a local variety, the locally used improved variety and two not yet released varieties from TZ-SMIP.

To make the trials realistic of each variety a quarter of an acre was grown. As the amount of seeds was only small this limited the number of farmers to 12 per crop. These 12 were divided over two villages selected by the MRTC.

The selection of farmers was done by the VEW in cooperation with the MRTC-committee of the village. The VEW and the MRTC assisted the farmers in selecting the fields for the trial. As the seeds were obtained rather late most farmers had already planted most of their (best) fields. So many fields were not uniform.

The seeds were given to the farmers with only one pre-condition: they should plant on lines: 75 x 30 cm. The farmers decided on the management (weeding and thinning) themselves so no organic or inorganic fertilizer was used. On a next occasion also the spacing might be left to the farmers to decide as different varieties have a different optimum plant density.

In order to asses the harvest sub-samples were taken from all plots. Due to the high variability of the fields and the low number of farmers, complete random sampling was not done as it most likely would not result in any statistically significant result. So obvious deviating areas were left out from the sampling; mostly after lengthy discussions with the farmer on the history of the field and other causes of the observed variation (old kraals, old river beds etc.). As most of the deviating areas in the plots were bad, the measured yields are higher than the real yields. It is more the potential yield under good farmers management which is measured than the actual yield under average farmers conditions. This is in line with the need to get new varieties which respond better to improved management.

The yield of the sub samples were taken to the MRTC where the threshing, dehulling and milling was done (and the time needed recorded). The flour was taken back to the villages and a blind taste test was done. At the same occasion the farmers were asked to evaluate the varieties and to give their priorities for new varieties. This was done in three steps: first the farmers were asked to mention the differences between pairs of varieties. The most important differences were then taken as criteria to evaluate all varieties systematically. The last step was to ask for the most important characteristics of possible new varieties. After mentioning these, the farmers were forced to prioritise them via allocating more or less of the 20 available points (visualised by maize cobs) to the different characteristics. In this last case men and women were separated.

The rainy season of 1993/94 was not bad. It started very late (5 January) but continued without dry spells until half March. So drought escaping crops did relatively well compared to drought resistent crops.

4. RESULTS

4.1 Sorghum

Introduction

Locally many varieties of sorghum are grown. All are long straw, open headed, white seeded, long term varieties. Most are grouped under the name of 'Lugugu', a Guinea type of sorghum (Rao et al, 1989). Earlier adapted varieties from outside the area are 'Sandala' and 'Bangala' which are less tall and earlier ripening. The local variety chosen for this trial is 'Mhoputa' which matures slightly earlier than the others of the 'Lugugu' group.

Until now the only successfully introduced variety is Tegemeo: a short straw, short term variety, released in 1983. It is appreciated for its earliness and high yields but has a number of setbacks: problems with pests (in the field and during storage), dehulling is difficult (and gives high losses) and a poor taste. So locally it is difficult to sell. As also the expected industrial market did not materialise marketing is very problematic. The price is 20% lower than for other sorghums. This is one of the major reasons (next to loan repayment problems) for the failure of the Global 2000 program to transform the farming system in Dodoma. This failure also made farmers shy away from capital intensive, market-oriented messages from the extension service.

Next to Mhoputa and Tegemeo two new varieties were selected by the Tanzanian SMIP program to be included: SV-1 and SDS 2293-6.

The seeds were dry-planted by 11 of the 12 farmers. After the onset of the rains the improved seeds germinated very poorly. In the farmers fields only 5-20% emerged while in an on-station germination test only 51-62% of the improved seeds proved viable. The cause of the problem was poor storage of the seeds in Ilonga. The local variety had no germination problems. After re-allocating the seeds to the best fields and after soaking them before planting, in the second round a few farmers managed to get enough plants to asses the basic characteristics of the varieties.

Grain yields

Only 2 fields had a fair stand of all varieties and they were used to asses the yield. Table 1 gives the results. It shows that all new varieties outyielded the local variety. The two new varieties produced about one third more while Tegemeo produced over 50% more. As the LSD (5%) is 1,040 kg/ha only in the case of Tegemeo the difference is statistically significant.

Table 1. Average grain yield (kg/ha) of 4 sorghum varieties, Mvumi 1993/94

Variety	Mean
Mhoputa	1,929
Tegemeo	3,026
SV-1	2,648
SDS 2293-6	2,607
SE ±	327
CV (%)	13

Post harvest aspects

The next table gives an overview of the post harvest characteristics of the four varieties.

Table 2. Some post harvest characteristics of the four sorghum varieties

	g/100 seeds	threshing rate (%)	minutes to dehull 4 kg (1 mortar)	flour/grain ratio (%)	flour yield (kg/ha)
Mhoputa	1.8	68	15	75	1,447
Tegemeo	2.3	78	20	60	1,816
SV-1	2.1	74	20	63	1,668
SDS 2293-6	2.6	78	21	61	1,590

The new varieties have bigger seeds and higher threshing rates but lower flour/grain ratios. The losses during dehulling depend on how clean the end-product should be. Some people want the flour to be as white as possible (f.e. leading to losses of 45% for SDS 2293-6) while others do not dehull at all. Poor people, using milling stones, have to do a proper dehulling otherwise milling is impossible. Bigger losses during the dehulling are accompanied by longer dehulling times. The extra time needed is about one third. In the overall process from grains to flour (so including winnowing, second pounding, second winnowing and soaking) the extra time needed is about 20% for Tegemeo and SV-1 and 25% for SDS 2293-6.

Compared to Mhoputa the yield in terms of kg flour/ha is only 10-15% higher for SV-1 and SDS 2293-6 and 25% for Tegemeo.

The three taste tests (including 39 respondents) did not give clear results. Too many factors contribute to the final taste, among them the cleanliness of the flour (depending on the extend to which the dehulling was 'completed'), the process of cooking (f.e. water content and whether it was well cooked) and customs (some people are not used to dehulled sorghum, other not to fermented flour). In general the local variety scored best. If well prepared (meaning big losses during dehulling) SDS 2293-6 also has a good taste. Tegemeo and SV-1 have a similar taste which is not considered good but it is acceptable.

Farmers evaluation

Due to the germination problems only few farmers have an impression of the new varieties. In general they are very impressed by SDS 2293-6 as it is vigorous, has big semi-compacted heads with big white seeds, ripens early and is not too tall. It's vigor is associated with high yields and drought resistance. Many farmers who have seen the fields are keen to get the seeds of SDS 2293-6. As nobody has yet started to thresh the new varieties the farmers have no opinion about post harvest aspects.

Farmers priorities for new varieties

Table 3 gives the criteria farmers would like to be used for selecting new varieties.

Table 3. Farmers priorities for new varieties (each group could allocate 20 points)

	Male farmers		Female farmers		
	Mvumi makulu	Idifu	Mvumi makulu	Idifu	Total
Yield	5	4	5	4	18
Drought resistance	6	4	3	4	17
Earliness	4	3	2	3	12
Taste *	2	3	3	2	10
Storage	1	2	1	2	6
Easy pounding **			3	2	5
Plant length ***	1	2		2	5
Beer quality		1	2	1	4
Covered kernel smut	1	1	1		3

* good taste is associated with white seeds;
** easy pounding is associated with small dehulling losses;
*** not too long plants makes bird scaring easier and gives less lodging.

Most priorities are in line with those of the Tanzanian sorghum breeding program as given by Rao et al. (1989), except for the taste. Surprisingly farmers give taste a lower priority than researchers. Farmers aim at an improved household food security and are prepared to eat everything which is available. That a bad taste makes marketing difficult seems to be less important.

The priority for high yields is clear to all but the importance of losses during dehulling is not explicitly mentioned by Rao et al. (1989). Saadan and Mndolwa (1993) on the other hand suggest that this has been an important criterion in selecting new varieties. It seems that the result is not yet good enough so women want more attention for it.

On the side of diseases, covered kernel smut is the biggest problem. For farmers in Mvumi it needs a higher priority than it has in the present breeding policy (Rao et al. (1989)).

Conclusions

Farmers are most impressed by the vigor of SDS 2293-6 but Tegemeo had the highest yield. SV-1 does not differ much from Tegemeo, so it should be replaced by a variety which is selected for its drought resistance and easy dehulling.

As industrial marketing has failed, more attention is needed for post harvesting handling of sorghum in rural households.

4.2 Bulrush millet

Introduction

Due to its cross pollination only one (very heterogeneous) millet variety is available in Mvumi: Uwele. After the second world war 'Buluma' was introduced from Birma. People liked its earliness and big heads. Due to the cross pollination the variety got lost. In the 1970's Serere was introduced: a composite variety which ripens very early. It has a short straw and small heads, but the seeds are big. It is not well adopted in Mvumi as it is often eaten by birds or stolen and farmers do not like the small heads.

Next to Uwele and Serere two not yet released varieties from the SMIP program were used: TSPM 91001 and TSPM 91018.

Nine of the 12 fields were dry planted. Only 7 fields were finally included in the analysis: one farmer planted too late, one failed to plant on lines properly, 2 failed to do the weeding of the different varieties within a reasonable time span and one field showed a clear gradient in soil fertility.

Grain yields

Table 4 shows the yields of the four millet varieties. The yields are less than those of sorghum but still considerably more than the average of normal farmers fields. Only the TSPM 91018 produces (38%) more than the local variety. As the LSD (5%) is 382 kg/ha the difference is statistically significant.

Table 4. Average grain yield (kg/ha) of 4 millet varieties, Mvumi 1993/94

Variety	Mean
Uwele	1,239
Serere	1,076
TSPM 91001	1,217
TSPM 91018	1,696
SE ±	182
CV (%)	14

Post harvest aspects

Table 5 shows the most important post harvest characteristics of the four millet varieties.

Table 5. Some post harvest characteristics of the four millet varieties

	g/100 seeds	threshing rate (%)	minutes to dehull 5 kg (1 mortar)	flour/grain ratio (%)	flour yield (kg/ha)
Uwele	0.7	68	16	75	922
Serere	1.0	65	17	74	796
TSPM 91001	0.7	60	14	70	852
TSPM 91018	1.0	71	16	74	1,255

Serere and TSPM 91018 have bigger seeds and a higher threshing rate (specially TSPM 91018) than the local variety. The time for dehulling and the flour/grain ratio do not differ much.

The two taste tests gave consistent results. First of all many people could not identify the local variety. Secondly TSPM 91001 and TSPM 91018 scored better than the others in both cases.

Farmers evaluation

The farmers appreciate the TSPM 91018 very much. They like its time of ripening (early, but not so early that it is eaten by birds), its long heads and big seeds (both associated with high yields), its appropriate length and its high yield. They have doubts about its drought resistance: although no long dry spells occurred some claim it was the worst variety in this respect.

Serere is considered useful as a hunger relief crop but its earliness attracts too many birds and thieves. Several solutions are advocated for this: planting around the house or hidden between longer varieties, breaking of the first heads (and harvest the regrowth) and late planting. Only in the first case the advantage of an early harvest is realised. Its abundant tillering was appreciated but it was not considered very drought resistent.

TSPM 91001 was considered to be the same as the local variety in nearly all aspects.

Farmers priorities for new varieties

Table 6 shows the priorities of farmers for new millet varieties.

Table 6. Farmers priorities for new millet varieties (each group allocated 20 points)

	Male farmers		Female farmers		
	Chanhumba	Ilolo	Chanhumba	Ilolo	Total
Yield *	6	5	5	8	24
Drought resistance	10	5	5	4	24
Earliness **	4	5	5	3	17
Field diseases		2	2	1	5
Tillering		2	1		3
Easy dehulling ***			2		2
Taste		1		1	2
Beer quality				1	1
Plant length				1	1
Storage				1	1

* associated with long heads;
** associated with short straw;
*** associated with easy milling.

Even more than in the case of sorghum the only interest seems to be food security. Only the prevention of diseases in the field and tillering get some priority.

The priorities of the farmers are very similar to the priorities for the Tanzanian millet breeding program as mentioned by Saadan and Mndolwa (1993).

Conclusion

The TSPM 91018 performed very well, both in the field and during the post harvest handling. Farmers like it very much. TSPM 91001 is too similar to the local variety to be of interest.

The Tanzanian breeding program for bulrush millet seems to be on the right track from the point of view of farmers in Mvumi.

5. Discussion

The on-farm trials and on-station tests with sorghum and millet yielded a lot of interesting data and insights. An interesting question is whether all the work to collect the data on yields and post harvest aspects was worth the effort. In other words: do the data provide insight which could not be gained by discussions with the farmers. In general the answer should be negative. The data on the yields and the post harvest aspects only 'prove' the ideas of farmers and hardly add to it. However more can be said. The major gain of the data collection is that when doing so, the researcher has to acquaint himself thoroughly with the farming system and it is there where the learning process starts which enables him to start a real dialogue with the farming community. In other words the data collection finally improves the quality of the dialogue with the farmers.

The ultimate dialogue with farmers is of course not on data nor on statistical significance. It is about seeds. Specially for the cross pollinating millet a permanent source of pure seeds (grown in isolation) is needed. In the respect the new seed policy of the of the Tanzanian government is a major step forwards (Lujuo, 1994). Under this new legislation the MRTC could produce the seeds needed in Mvumi in cooperation with the SMIP program.

6. Conclusions and recommendations

For sorghum it seems difficult to come with new varieties as long as the post harvest aspects are problematic, specially the dehulling and the marketing. Farmers will only consider market oriented production again if they see a well established market.

Seeing the severe shortage of food in the overpopulated Mvumi division and the high percentage of the area occupied by millet, developing better millet varieties for home consumption should get the highest priority. New varieties responding well to improved management can improve the productivity of the cropping system. TSPM 91018 performed very well in the 1993/94 season. If it also proves to be drought resistent it should be released as a variety. In that case SMIP should supply the MRTC and other rural projects in Dodoma with foundation seed so that they can produce the amount of pure seeds needed.

Acknowledgement

This paper is the result of a lot of work by many people. First of all of the farmers in the villages and their village extension workers: Mzee Galahenga, J. Sijila, E. Dunstan and A. Muhembano. At the MRTC the assistance of Mr. R. Makali was very supportive. Outside the MRTC thanks goes to Mr. Mussa, the REO of Dodoma for linking the MRTC with the SMIP program. Lastly Dr. H.M. Saadan, the national sorghum and millet coordinator in Tanzania is greatly acknowledged for his cooperation which was very pleasant and open minded.

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