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Performance of Improved Wheat and Triticale Varieties under Farmer Conditions in Rwanda

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PERFORMANCE OF IMPROVED WHEAT AND TRITICALE VARIETIES UNDER FARMER CONDITIONS IN RWANDA

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ABSTRACT

This work was conducted in Rwanda's Buberuka Highlands area with an average altitude of above 2000 m and a bimodal annual rainfall of about 1200 mm. Approximately one-half of Rwanda's total 4000 ha under wheat is located in this area where the average yield is only about 850 kg/ha. In contrast, at the ISAR (Institut des Sciences Agronomiques du Rwanda) station at Rwerere, located in the same work area, the average yield of wheat is over 3000 kg/ha.

We tested four of ISAR's improved wheat varieties and one triticale variety under the farmer's own production conditions. The purpose was to compare these varieties with the farmer's own variety and to learn farmer practices by closely working with them so that appropriate interventions could be proposed at a future date.

Preliminary results indicate that poor soil fertility and traditional cultural practices are the principal factors that limit wheat yield under the farmer's conditions. Other problems and possibilities in relation to wheat production by the area farmers are discussed.

INTRODUCTION

Rwanda is a small country of 26,300 km^2 located in Central Africa just south of the equator. With a population of more than 6 million, it is Africa's most densely populated country. About 95% of the population is engaged in subsistence farming in very hilly terrain.

Rwanda's National Agricultural Research Institute (ISAR) has a sub-station in Rwerere, located in the Buberuka Highlands region, one of Rwanda's 12 major agroclimatic zones. This station is specifically charged with research on wheat/triticale, beans, peas and, to a lesser extent, corn and sorghum in the high-altitude area around Rwerere. As members of a Farming Systems team attached to this station, our role is to determine farmer problems, search for and/or develop appropriate technology to address specific problems and test technology on farmers' fields in collaboration with farmers and extension workers. A successful technology to come out of this process must be biologically sound, economically feasible and socially acceptable (Shaner et al., 1981).

Work with wheat began at the station in February of 1987. Wheat is not a major crop in Rwanda and is not a staple in the Rwandan diet. Presently, only 4000 ha are planted annually in wheat, and one-half of that is located in the Buberuka Highlands area. Yield is only 850 kg/ha. To meet increasing demand for bread in the rapidly growing urban centers, the Government of Rwanda has decided that by the year 2000, wheat area in the country should be increased to 10,000 ha and yield to 1500 kg/ha. Again, under the Government's regionalization policy, wheat has been identified as a major crop for this zone.

In the project area, wheat is normally grown above 2,200 m above sea level. It is grown in both seasons, but season B (March-August) is more important for wheat production. Rainfall is bimodally distributed with a total annual rainfall of about 1200 mm. Temperature generally varies between 5 C and 25 C. Soil is lateritic, and the pH is typically between 4.5 and 5.5. Additional details on the project zone are provided in an annex at the end of this paper.

METHODOLOGY

We conducted a survey among wheat growers to learn the problems and the prospects of wheat production from their point of view (Paul et al., 1987). To learn their actual production practices, we selected 16 farmer-collaborators and worked with them during the entire season (1987 B).

We brought to them four of ISAR's wheat varieties and one triticale variety and planted these side by side with the farmer's own variety in 3 m x 5 m plots. To maintain some uniformity, we requested the farmers to prepare the land once and weed the wheat crop once.

The seeding was done by broadcasting at the rate of 120 kg/ha, which was the farmers' normal practice in the region. We visited each farm 4 to 5 times during the season accompanied by the farmer to gather data and to seek his/her opinion. Harvesting was done by clipping at maturity; the harvest from each plot was placed in separate bags and taken to the compound (rugo). Manually threshed grains were subsequently weighed.

We provided the farmers with seeds and helped a little during sowing and harvesting; all other operations were carried out by the farmers themselves. The harvest, of course, was for them to keep.

RESULTS AND DISCUSSION

The number of seeds sown for the five wheat and one triticale varieties and the number of seedlings emerged are presented in Table 1. The emergence of all the four improved wheat varieties was less than 50%, with Sesa being the lowest (30%); the percentage emergence for the local variety was much higher (63%), followed by the triticale variety used in this study. The seeds were sown traditionally on poorly prepared seed beds and were covered mostly with large clods of soil. Apparently, the local varieties are better adapted to this type of seeding practice. One would assume that the larger-seeded varieties (Musama, in this case) would be better able to emerge from a greater depth, but this was not so. Other determining factors, such as seedling vigor and coleoptile length and strength, might also be involved. In order to have a good stand, good seed bed preparation and shallow planting are more important for the improved varieties than for the local varieties.

Table 2 shows the characteristics of the test varieties. The number of tillers per plant varied between 1.5 and 2.5, and the number of grains per head ranged from 32 for the local to 41 for the triticale variety. Triticale produced the highest yield. The yields for varieties Musama and Rugezi were in the same range as the local, while the yields of Sesa and Mpinga were considerably lower. The grain sizes of Musama and Rugezi were much larger than the other varieties.

The yield data presented in Table 2 are the averages of 16 farms. Table 3 shows individual farm yields of three selected varieties. For the local variety, five out of 16 farms produced yields lower than 1000 kg. The corresponding numbers for Rugezi and the triticale variety were seven and one. In general, on most farms, the performance of triticale was superior to that of all the wheat varieties tested in the present study. This simply confirms the results of many others that triticale is better adapted than wheat under less than optimum production conditions.

An effort was made to determine why the yields on certain farms were much higher, and on other farms much lower than the median yields. As has been presented in Table 4, we selected four farms where the yields of the local wheat variety were 1600 kg/ha or more, and a second set of three farms where the yields were less than 800 kg/ha. Our objective was to find out what these two groups of farmers did differently. Aside from the soil fertility factor, some farmers are just better managers than others, and it would be worthwhile to tap into their expertise.

As we see them, three things were done differently:

previous crop and its management;

b) seed bed preparation; and

c) weed control.

All these have a major bearing on many other parameters.

Potatoes and beans are planted in fields not too far from the rugo. Land is well-prepared for these crops, and manure is applied to the bean crop if available. Both potato fields and bean fields are kept relatively weed-free. When the potatoes are harvested, the soil is left in a well-worked condition. One more hoeing of these fields is adequate for an acceptable seedbed preparation. Wheat sown on this soil on time should emerge well, and one more weeding should be enough to keep the crop relatively weed-free.

Most of our farmer-collaborators had sown wheat after beans or potatoes, but the difference was that some had properly managed the previous crop while others did not. This latter group had allowed the weeds to multiply and compete with both bean and wheat crops.

Peas are grown in Rwanda by broadcasting the seeds on land without cultivation, and then the seeds and the weeds are buried under by turning over clods of soil. The pea crop is not weeded. Therefore, after pea or fallow, the land is left in poor physical condition with a high weed population. If wheat is seeded in these fields after one hoeing and no subsequent weeding is done, the wheat crop will run into a multitude of problems, and, consequently, the yield will be reduced. The importance of weed control in wheat production has been adequately discussed by others (Kinfe, 1985 and Shaner et al., 1981).

There are, of course, certain factors over which the farmers have little control. In season B, normal planting time for wheat is early to mid-April in our area, and April is also the month of heaviest rainfall. Sometimes the farmers have to plant seed in the rain, thus causing soil compaction; heavy rainfall following seeding on steep slopes also washes away seeds. Both of these factors seriously affect the subsequent stand establishment.

FARMER OPINION

Almost all the collaborators thought that the varieties Musama and Rugezi were quite good. They yield well, have larger grain size and are easier to thresh.

The farmers, most of whom saw triticale for the first time, were impressed with its yield but did not like its smaller grain size and the "pate" made from the triticale flour. Although there is no market for triticale in Rwanda at the present time, all the farmer-collaborators will plant it again on their own. They are looking into other uses of triticale.

CONCLUSIONS

1. Even with the existing varieties, wheat yield could be substantially increased by making minor changes in the cultural practices. It would be advantageous to sow wheat after beans or potatoes rather than after peas or fallow. Good seedbed preparation, planting on time and good weed control would all add to increased yield. We should show the farmers how to do those things better over which they have control before giving them something new (such as fertilizer or pesticide).
2. Triticale appears to be a potential crop for our area.
3. All technologies generated on the research stations that are destined for the small farms should be tested for appropriateness under farmers' conditions before recommendations are made.

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Table 1. Emergence of wheat varieties under farmers' conditions (1987 B)[1].

Varieties	No. of seeds[2] sown/m^2	No. of seed-lings/m^2	Percentage emergence
Musama	186	72	38
Rugezi	210	102	48
Sesa	255	83	33
Mpinga	260	124	48
Local	280	175	63
Triticale (Delfina)	260	131	50

[1]Average of 16 farms.
[2]Based on a seed rate of 120 kg/ha.

Table 2. Yield characteristics of selected wheat varieties under farmers' conditions (1987 B)[1].

Varieties	No. of tillers per plant	No. of grains per head	Yield kg/ha	Wt (g) per 1000 grains
Musama	2.5	36	1314	65
Rugezi	1.5	37	1229	57
Sesa	2.5	34	831	47
Mpinga	1.5	38	972	46
Local	1.7	32	1223	43
Triticale (Delfina)	2.5	41	1738	46

[1]Average of 16 farms

Table 3. Yield distribution of selected wheat and triticale varieties in on-farm trials (1987 B).

Farm ranking[1]	Yield, kg/ha		
	Local	Rugezi	Triticale
1	2400	2200	2567
2	1833	2333	1800
3	1667	1267	1467
4	1600	1300	2100
5	1467	1267	2533
6	1450	1033	1117
7	1333	1733	2467
8	1333	1233	1733
9	1167	800	1400
10	1167	700	1333
11	1000	1000	3250
12	967	867	1433
13	933	767	1200
14	667	900	1600
15	500	600	1033
16	500	667	767
Average	1223	1229	1738

[1]Ranking of farms as per yield of the local variety

Table 4. Factors influencing the yields of local variety under farmers' conditions (1987 B).

	Factors	Farms with higher yields	Farms with lower yields
1.	Yield (kg/ha)	> 1600 (4 farms)	< 800 (3 farms)
2.	Previous crop & its management	Potato or bean; properly managed	Bean, pea or fallow; poorly managed
3.	Hoeing, once	Yes	Yes
4.	Seedbed prep	Adequate	Poor
5.	Time of planting	Early to mid April	Early to late April
6.	Stand establishment	Good	Poor
7.	Weeding, once	Yes	No
8.	Soil fertility & pH	To be determined	To be determined
9.	Manure / compost	Added to last crop	None
10.	Disease / insect	Mild	Mild
11.	Bird damage	Slight	Severe
12.	Soil erosion	Slight	Moderate

ANNEX

Overview of Farming Systems Research Project (FSRP) Zone

Rwanda is a landlocked country of about 26,300 km^2 located in Central Africa just south of the equator bordered, by Burundi, Zaire, Tanzania and Uganda. With a population of more than 6 million, it is one of Africa's most densely populated countries. About 95% of the population is engaged in subsistence farming on mountainous or hilly terrain. The capitcl city is Kigali.

Rwanda's National Agricultural Research Institute (ISAR), based in Rubona, has a number of research stations, one of which is located at Rwerere in the Buberuka Highland region, representing one of the 12 major agroclimatic zones. Elevation of most of the Highlands ranges above 2000 m, and rainfall is bimodal with an annual average of about 1200 mm. Longitude is East 29 53', and latitude is South 1 32'. This station is specifically charged with research on wheat/triticale, beans, peas and, to a lesser extent, corn and sorghum.

In 1985, the United States Agency for International Development initiated technical and material support to aid ISAR in developing the research capacities of the Rwerere high altitude station. The University of Arkansas (subcontractors: University of Minnesota and Lincoln University) was requested to provide the technical support to this program. The purpose of the Project is to assist the Government of Rwanda in developing a farming systems approach to research and extension (FSR/E), including a mechanism for effectively linking research and extension institutions and their activities (including training) to the solution of a range of problems faced by Rwanda's farmers.

Two major sub-zones were identified by the team in the Rwerere region of intervention: Buberuka and Central Plateau Zones.

Major Characteristics:	Buberuka	Central Plateau
Altitude (meters):	1900 - 2400	< 1500 - 1900
Rainfall (mm)	1100 - 1300	1300 - 1600
Common slope on farmland	60% - 70%	< 40% - 60%
Temperature (C):	13 - 17	17 - 22
Scil pH	4.6 - 6.7	4.3 - 5.2
Soil clay content (%):	33 - 66	31 - 37
Soil organic carbon (%):	1.27 - 3.8	0.99 - 1.51
Estimated surface area Km2 (excluding lakes)	492	372
Population (1984)	492,738	1,299,371
Average farm size (ha.)	1	1.1
Fallow land (%)	15.5	10.4
Use of manure and mulch (%)	4.6	5.4
Lack of manure/mulch (%)	70	57
Erosicn control, terracing (%)	40	43
No erosion controls (%)	55	55