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The University of Arkansas, Fayetteville
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Rwandan Institute for Agricultural Sciences (ISAR)

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FSRP Bean Varietal Research
I. Selecting High-Yielding Cultivars
II. Farmer's Evaluation of Climbing Bean Varieties

K. B. Paul

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HIGH-YIELDING BEAN VARIETIES FOR THE NORTHERN HIGHLANDS OF RWANDA

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INTRODUCTION

Beans (Phaseolus vulgaris) are the major component in the Rwandan diet, providing 25% of the total caloric intake and up to 45% of the protein intake. In Rwanda, beans occupy about 25% of the harvested hectarage. In 1980, there were about 238,000 ha planted to beans, and the projections are that by the year 2000, about 300,000 ha will be planted to this crop. However, the yield of beans has decreased over the years because of declining soil fertility and expansion to more marginal land (ISNAR, 1982). The present estimated yield is about 800 kg/ha. The total dry bean production in the country is about 200,000 tons, of which 75% is produced in season A (Resultats de l'Enquete Nationale Agricole, 1985).

This work was conducted in the four eastern communes of Ruhengeri prefecture: Cyeru, Butaro, Nyamugali and Nyarutovu. Approximately three-fourths of the work area lies in the Buberuka Highlands and the remaining one-fourth in the Central Plateau region, which are two of Rwanda's 12 major agro-climatic zones (Delepierre, 1975). In this area all three types of beans, e.g. climbing, semi-climbing and dwarf, are grown. Climbing types are generally planted pure and as monoculture, except when planted in banana groves; when planted as a mixture, the number of varieties rarely exceeds five or six. The dwarf and semi-climbing types are grown together in a mixture, and a typical mixture contains around 10 to 14 different varieties. About 50% of the dwarf beans in the project area are planted in monoculture while the rest are planted in association with maize or sweet potatoes. Although the climbing types yield much more under favorable conditions, the choice between the two depends on many factors such as climate, soil fertility, availability of stakes, farmer preference, etc.

During our diagnostic survey (Franzel et al., 1985; Bizimana et al., 1986), we noted the following constraints that limit bean production in the project area:

a) low soil fertility,
b) lack of improved varieties,
c) diseases,
d) difficulties in finding stakes for the climbing beans and
e) traditional cultural practices.

Consequently, we designed our initial on-farm trials to address some of these problems.

For our initial trials, which we began in 1986 B, it was considered appropriate to test some high-yielding bean varieties under farmers' conditions for their adaptability and grower acceptability. Our aim was to identify some "improved" varieties that are resistant/tolerant to certain stress conditions such as soil acidity, certain diseases, drought, etc. By reducing losses caused by various stresses, moderate increase in output is possible. For this approach, no costly input is necessary.

There were, of course, other considerations:

a) on-farm variety testing is relatively less risky;
b) if a good, acceptable variety is found, the farmer will adopt it right away as this will not involve any changes in his traditional production practices;
c) The International Center for Tropical Agriculture (CIAT) and the Agronomic Institute of Rwanda (ISAR) had some promising bean varieties available for testing on the farmer's fields;
d) this would provide us an opportunity to learn more about farmer practices and the existing farming systems so that appropriate interventions could be suggested at a later date.

Objectives of the study were as follows:

1. To test several ISAR/CIAT improved bean varieties under farmers' conditions for their adaptability, yield, resistance to diseases and farmer acceptability.
2. To test some promising local varieties collected by us from certain locations in the project area to test in other localities within our zone of action.
3. To test two FSIP bean mixtures, one dwarf and one climbing, under farmer conditions. These mixtures were created by combining a few improved and some promising local varieties and upon consultation with the farmers.

MATERIALS AND METHODS

The initial selection of the farmer-collaborators was done with help from the local political appointees and the agricultural extension workers. As we began our work in the community, we received requests from other farmers to accept them as our collaborators. We worked with about 60 farm families in these bean trials in the 1987 A and B seasons.

Before installing any trial on the farmers' fields, we clearly explained to the farmer-cooperator the objectives of the study, stressing that the study was research and not demonstration and that we would work together as researchers and do the evaluations together. Furthermore, we arrived at a clear understanding that the farmer-collaborator would provide land and labor free of charge, that we would furnish all the necessary inputs free of charge and that the harvest was for him/her to keep.

Varieties Tested, 1987 A

Table 1 is a list of varieties tested in season 1987 A. The ISAR/CIAT varieties that were given to us for on-farm testing had been tested on the research station and on multilocational sites and appeared quite promising.

We were aware of the fact that one should not take too many varieties for on-farm testing; at the same time, we wanted to narrow down our choices of varieties without losing much time. Therefore, we took all the varieties to a farmer and requested him/her to choose anywhere between four and ten varieties to be compared with his own variety or varieties, depending on the availability of land. This method also gave us the opportunity to determine the initial farmer preference of varieties based on size and color of seeds. On most farms we planted about five climbing bean and/or four dwarf bean varieties. We installed these trials on a total of 41 farms, allowing us enough combinations that, except for C 10 and Mwirasi, all other varieties were planted on a minimum of eight farms.

Varieties Tested, 1987 B

Based on the results of 1987 A, we narrowed down our choices of varieties for this season (Table 2). This did not mean that we rejected all the other varieties; we may further test a few of these at a later date.

This season the trials were planted on a total of 33 farms; some farmers planted only the climbing types, some only the dwarf types, while other decided to plant both types. Altogether, we had 22 sites for the climbing beans and 19 sites for the dwarf beans.

Trial Installations and Monitoring

The farmers prepared the land twice, and we helped them to lay out the plots. We supplied pre-packaged seeds of 350 of each variety, which the farmers planted in their own traditional way in 2m x 5m plots, in our presence. They managed the plots (e.g. weeding, staking, etc.), but we helped them with the harvesting. We visited each farm four to five times to gather data on plant density, disease evaluation, number of plants per plot at harvest, number of pods per plant, yield and farmer opinion on the varieties tested. At weighing time, we requested the farmers to invite some of their neighbors to help with the evaluation.

RESULTS AND DISCUSSION

Climbing beans

The yields of climbing beans for seasons 1987 A and 1987 B are presented in Table 3.

In season 1987 A, four of ISAR/CIAT's varieties and one local variety produced yields over 2100 kg/ha, as compared to 1620 kg/ha for the local varieties of mixtures. In season 1987 B, a more or less similar trend was observed. Among the ISAR/CIAT varieties, the farmers preferred G858, G2333 and Puebla Criollo over the other varieties, primarily because of their high yield potentials. Their maturity period was about the same as that of the farmer's own traditional varieties. The seeds of G811 given to us in 1987 A were a mixture of four varieties of different maturity periods; hence two pickings were necessary. Later we realized that G811 is a pure variety and that it was mixed with others accidentally. In 1987 B, it was planted pure, and in most farms it grew like a semi-climbing variety. The farmers were not pleased with its overall performance.

Some of the collaborating farmers who never grew climbing beans before are now planting them as they have seen for themselves their yield advantages over the dwarf types (under normal conditions the climbing beans produce about 50% more than the dwarf beans). The local variety Mwirasi appeared to be an excellent performer; in our agro-climatic conditions it matures in about 135 days. The plants are relatively light weight, and Pennisetum stakes can easily support them. The seeds of Mwirasi are of good size and have brilliant violet color, and best of all, it is an excellent producer.

Dwarf beans

The yield data for the dwarf beans in seasons 1987 A and B are presented in Table 4.

The data show that the varieties Kirundo and Ikinimba had a small but consistent yield advantage over the local mixtures in both seasons. However, Kirundo is susceptible to halo blight and Ikinimba to rusts. Moreover, some farmers did not like the black seed color of Ikinimba. In season 1987 A, G11060 gave slightly higher yield than the local variety, but the farmers did not like this variety because of its long growing period and small seed size. Presently, ISAR/CIAT has no other dwarf bean varieties to offer for our high-altitude region. We have collected a few promising dwarf bean varieties from the farmers' fields and have given these to ISAR researchers for on-station evaluation.

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Table 1. Varieties tested in season 1987A.

Climbing types	Code	Dwarf types	Code
Urunyumba 3	VV 1 *	Kirundo	VN 1 *
Rwamirego	VV 2	Ikinimba	VN 2 *
Kilyugaramwe	VV 3	Kilyumukwe	VN 3 *
Mwirasi	VV 4	Urubonobono	VN 4 *
Local Mixtures	VV 5	Local Mixtures	VN 5
FSRP Mixture	VV 6	FSRP Mixture	VN 6
G858	VV 7 *	G11060	VN 7 *
G811	VV 8 *		
G2333	VV 9 *		
Puebla Criollo	VV10 *		
C 10	VV11 *		

Composition of FSRP Mixture (1987 A) :

Climbing Type	%	Dwarf Type	%
Rwamirego	20	Mbagara	25
Mwirasi	30	Bataaf	25
Urunyumba 3	20	Kilyumukwe	20
Nyiramushali	15	Nyiramuhondo	20
Kilyugaramwe	15	Rubona 5	10

* ISAR/CIAT varieties

Table 2. Varieties tested in season 1987 B.

Climbing Types	Code	Dwarf Types	Code
Local Mixtures	VV 5	Kirundo	VN 1
FSRP Mixture	VV 6	Ikinimba	VN 2
G858	VV 7	Local Mixture	VN 5
G811	VV 8	FSRP Mixture	VN 6
G2333	VV 9	Mbagara	VN 8
Puebla Criollo	VV 10		

Composition of the FSRP Mixture (1987 B) :

Climbing Types	%	Dwarf Types	%
Urunyumba 3	20	Mbagara	30
Puebla Criollo	20	Bataaf	15
G2333	20	Kirundo	15
Rugandura	20	Nyamukecuru	15
Mwirasi	20	Gacwekano	15
		Ikinimba	10

Table 3. Yields of climbing beans, 1987 A and B.

Varieties	Yields (kg/ha)	
	Season 87 A	Season 87 B
Urunyumba 3	1566 (21)[1]	-
Rwamirego	1541 (8)	-
Kilyugaramwe	1662 (16)	-
Mwirase	2326 (4)	-
Local Mixtures	1620 (26)	1897 (22)
FSRP Mixture	1702 (27)	2126 (22)
G858	2285 (11)	2214 (19)
G811	2520 (8)	1927 (22)
G2333	2130 (9)	2445 (22)
Puebla Criollo	2161 (13)	2205 (22)
C 10	1420 (3)	-

[1]Figures in parentheses refer to the number of on-farm trials (or replications).

Table 4. Yields of dwarf beans, 1987 A and B.

Varieties	Yields (kg/ha)	
	Season 87 A	Season 87 B
Kirundo	945 (16)[1]	1560 (9)
Ikinimba	832 (12)	1410 (19)
Kilyumukwe	713 (16)	-
Urubonobono	645 (14)	-
Local Mixtures	758 (21)	1274 (24)
FSRP Mixture	865 (22)	1223 (19)
G11060	847 (6)	-
Mbagara	-	1132 (19)

[1]Figures in parentheses refer to the number of on-farm trials (or replications).

FARMERS' EVALUATION OF CLIMBING BEAN VARIETIES

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In order to obtain a systematic evaluation of bean test varieties, we used a questionnaire designed by Dr. Joachim Voss, CIAT's sociologist based in Rubona, Rwanda. We interviewed 19 farm families who have been collaborating with us for the past three growing seasons in our bean variety trials.

The questionnaire was designed in a way that permitted us to determine 1) the criteria that the farmers use to evaluate bean varieties and 2) their opinion of our three best test varieties chosen primarily for their yield performance from the CIAT/ISAR introductions.

The following is a list of criteria, in order of importance, that the farmers of our area use to evaluate bean varieties:

1. Grain yield,
2. Grain color,
3. Grain size,
4. Resistance to disease (high humidity),
5. Maturity period,
6. Taste of dry beans.

The farmers use more or less the same criteria to evaluate all three types of beans, i.e. dwarf, semi-climbing and climbing. Yield is by far the most important criterion, while the ranking of other characteristics could change from one farmer to the next. Whenever we asked farmers to evaluate a standing crop of beans, they invariably responded by saying, "let's wait until harvest time." Besides the six criteria listed above, the farmers also mentioned the following:

* Growth habits (erect or procumbent for dwarf; light or heavy for climbing),
* Drought tolerance,
* Performance on poor soil,
* Edible/inedible leaves,
* Quality of green pods.

The farmers evaluated our three test varieties as better performers than their own variety (or mixture of varieties). All three varieties got high marks for their yields and grain color (Table 1). They admired the large grain sizes of Puebla and G858. They took note of the fact that G2333 is an early-maturing variety and G858 is a late variety. They thought G858 was more susceptible to high rainfall (diseases) than the other two varieties. The farmers rated Puebla as the best, while G858 and G2333 received about the same scoring. These three varieties and our local selection, Mwirasi, are all immensely liked by the area farmers. Farmer demand for these varieties is increasing three to four fold from one season to the next. We are responding to their requests through the introduction of a farmer-based seed-multiplication system, designed specifically to multiply the seeds of these four sought-after bean varieties.

One final note: In 1988 B, I asked several farmers to rank our four recommended varieties, i.e. Puebla 444, G858, G2333 and Mwirasi. Puebla is their number one choice, followed by Mwirasi, G2333 and G858.

1988 B was an unusually dry season; I do not recall receiving any rain during the months of June and July. Because of drought, disease was not much of a problem, but we noticed heavy aphid infestations, especially in variety Puebla.

The maturity periods for our varieties were as follows: G2333 = 110 days; Mwirasi = 115 days; Puebla = 128 days; and G858 = 135 days.

Table 1. Farmer evaluation of test varieties (listed in order as mentioned by the farmers).

PUEBLA	G2333	G858
	POSITIVE ASPECTS	
1. Good grain yield	1. Good grain yield	1. Good grain yield
2. Good grain color	2. Disease resistance	2. Good grain color
3. Disease resistance	3. Good grain color	3. Large grains
4. Large grains	4. Early maturing	
5. Pods are tasty	5. lots of pods	
6. Leaves edible	6. Resist drought	
7. Resists drought		
	NEGATIVE ASPECTS	
	1. Small grain size	1. Late maturing
		2. Lacks disease tolerance