Phaseolus beans, a staple food in Burundi

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Résumé

Cet article met en lumière l'importance du haricot (Phaseolus vulgaris L.) *au Burundi. Les principales régions productrices sont indiquées. Des données agroclimatologiques sont fournies, ainsi que des estimations de la production annuelle et de l'aire de culture au niveau national, les méthodes de culture, l'utilisation et la diversité variétale. Les principaux ravageurs et maladies sont passées en revue. Une stratégie pour la recherche sur le haricot au Burundi a été établie en tenant compte des considérations précédentes. Ainsi l'accent a été mis sur la sélection variétale par l'établissement d'essais multilocaux à différentes altitudes et cela pendant plusieurs saisons. Sur base de la première série d'essais multilocaux, deux variétés de haricots nains ont été diffusées:* Karama var 1/2 *pour la zone d'altitude entre 800 et 1 200 m, et* Diacol Calima *pour les altitudes de 1 200 à 1 900 m.*

Summary

This paper reviews the cultivation of beans (Phaseolus vulgaris L.), *the most important food crop in Burundi. The principal areas of cultivation are indicated. Data are included on climate, annual production and cultivation area, cultural practices, utilization and varietal diversity. A review of the main pests and diseases is added. Taking into account all these considerations a strategy for bean research was established, giving the main emphasis on varietal selection, by establishing multilocation trials at different altitudes over several seasons. On the base of the results from the first series of multilocation trials, two dwarf bean varieties were released:* Kamara var. 1/2 *for the 800-1 200 m altitude range, and* Diacol Calima *for altitudes between 1 200 and 1 900 m.*

Introduction

Burundi belongs to the group of least developped countries, is situated in Central Africa and has a total surface of 27 830 km^2. It is a poor country with one of the world's highest population densities, dependent almost solely on coffee as an export crop. Of its four million inhabitants 83.9% belong to farming communities (5). The country itself is mountainous, with altitudes ranging from 785 to 2 665 metres, yet about 40% of all available land is covered with annual crops.

Beans *(Phaseolus vulgaris L.)* occupy the first place, not only among the grain legumes, but also among all other food crops. As the importance of beans in the country fully justifies an intensive research program, it has been necessary to define first the conditions in which beans are grown, as well as the farmers' varietal preferences.

Climate and soils

Although beans are grown at all altitudes in Burundi they are best adapted to the 100-1 800 m altitude zone. It covers firstly the regions on both sides of the crest between the Nile and Zaire watersheds, having poor, acid soils (ferrasols and ferrisols, according to Van Wambeke, 1963) and very heavily populated (rural population density over 250 persones/km^2).

On the other hand this altitude zone contains the Eastern plateaux close to Tanzania with better soils (xeroferralsols) and less population pressure.

In the low-attitude Ruzizi plain (800-900 m), beans are replacing the better adapted cowpea *(Vigna unguicultata*(L.) Walp.) because of the latter's sensitivity to insects. On altitudes above 2 000 metres, night temperatures limit bean development and field peas *(Pisum sativum L.)* become the main legume crop.

Burundi has a continental climate (Table 1) with large differences between day and night temperature. Table 1 also features absolute ground temperature minima during bean growth periods and mean annual rain fall.

It is clear that low temperatures, such as those observed in Kisozi, seriously inhibit crop growth and yield. The length of the vegetative period is linked with altitude and ranges from 75 days at SEMS-Imbo to 140 at Kisozi.

Rainfall during the growth period is usually sufficient except at the Imbo where water shortages occur frequently. The length of the dry season varies between 3 months at high altitude and 5 months at lower elevations. The two main growing seasons are not clearly separated by a dry period, so that the first season crop is usually harvested in humid conditions. Maturity of the second season crop occurs at the beginning of the dry season.

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TABLE 1

Climate of Burundi: temperatures and rain fall for 4 ISABU research stations

Name (and observation period)	Altitude (m)	TM (°C)	Tm (°C)	Tag (°C)	P (mm)
SEMS-Imbo (1977)	830	29.2	19.1	13.8	783.2
Mosso (1955-1970)	1 250	27.0	15.5	10.0	1 206.0
Murongwe (1963-1970)	1 500	26.5	13.5	6.0	1 340.9
Murongwe (dry season)	1 500	28.5	12.0	3.0	1 340.9
Kisozi (1931-1970)	2 150	21.5	11.5	2.8	1 491.6

TM: mean maximum temperature during growth period;
Tm: mean minimum temperature during growth period;
Tag: absolute minimum ground temperature during growth period;
P: annu 1 precipitation;
Source: Bureau Climatologique de l'ISABU (1978).

Bean production, cultural practices and utilization.

Statistical data on bean yield and total cultivated area vary from one source to another (Table 2). All agree, however, that bean production is superior to those of all other food crops, including both maize and sorghum, the two most important cereals of Burundi.

TABLE 2

Estimates of cultivated area, yield and annual production of field bean in Burundi

Source	Year	Surface cultivated (ha)	Yield (kg/ha)	Annual Production (tons)
FAO (1971)	1964-66	—	—	137 000
FAO (1979)	1969-71	215 000	616	132 000
	1978	259 000	627	162 000
Agronomie (1978)	1977-78	461 188	1 109	511 452

National bean production can be considered to fluctuate annually between 150,000 and 200,000 tons. Mean yields differ according to regions and soil quality, but a national mean of 600 kg/ha for monocropped beans can be considered realistic.

The surface cultivated reflects the sum of the areas under bean culture during the three growing seasons. The first season starts with the rains in September to November and ends in December to January, the second season begins in March and ends in June-August, the third bean crop is cultivated during the dry season from August to November.

The dry season crop in the hydromorphic valley bottoms is a typical feature in Rwanda and Burundi. Land pressure in these countries has caused the progressive clearing and cultivation of about half the 130,000 ha of hydromorphic valleys of marshes ("marais") in Burundi (7) in the densely populated areas between 1 300 and 1 800 metres. The marshes are cut by a network of small, twisting drainage channels into irregular islets of 50-100 m^2. Water flow in these canals is slow, and the groundwater table does not go below 50 cm, so the crops planted in the marshes, mainly beans and maize, benefit from a continuous moisture supply. Moreover the marshes are fertile, as periodic inundations during the rainy season enrich the soil with alluvic material. The marshes are planted after about two months of dry season, firstly to allow excess water to drain away and secondly to avoid the very low temperatures that are especially frequent at the beginning of the dry season. Yields in the marshes are above average because of good nutrient and moisture supply.

Data on the area under bean cultivation during the three growing seasons are supplied by the Agronomy Department of the Burundi Ministry of Agriculture (Table 3).

Monocropped as well as intercropped beans are included in these figures.

TABLE 3

Area covered by bean cultivation during the three growing seasons in 1977-78

	Hectares	%
First season	169 955	37
Second season	236 071	51
Marshes	5 516	12
Total	461 182	100

Source: Agronomie (1978).

Although these data may be somewhat exaggerated they indicate the importance of the second season and the relatively large area planted as a dry season crop. The total area cultivated annually with beans can be estimated as 300,000 to 400,000 hectares.

Beans are sown in an irregular pattern at densities between 15 and 30 plants/m^2, depending on soil fertility and cropping system. Weeding is done by hand once or twice until canopy closure. Fertilizers and pesticides are seldom available, but farm manure is currently used at higher altitudes to improve soil fertility. Bean staking is common only on the hills surrounding Bujumbura, but in other areas maize plants are used as live stakes whenever possible.

Bean plants are harvested whole at full maturity and carried to the homestead for drying and threshing. However if ripening occurs during a rainy period, plants are harvested earlier, when many pods are still green.

Dry beans are the main product, although unripe beans and young shoots are eaten occasionally, especially in the December-January period at higher altitudes, when very little other food is available.

In areas where firewood is scarce, sufficient beans for two days are cooked together, so that a simple warming up of the remainder is enough for the next day. Addition of fine ashes to the cooking water is considered to diminish cooking time, but the practice is not appreciated as it modifies bean taste.

Dry beans are stored in baskets inside the houses and sometimes mixed with fine ashes; farmers think the ashes act as a desiccant and inhibit bruchid development.

The excess harvest is sold on the markets to local buyers or to traders who transport the beans and resell them in the urban centers (e.g. Bujumbura) or in the densely populated high-altitude regions where bean production is marginal. Traders do not keep bean stock for fear of bruchids. Prices fluctuate between 20 and 60 Fbu per kilo (100 Fbu = U.S.$ 1.00), depending on place and time of the year

In Burundi nearly all arable land is actually cultivated and possibilities for its increase are limited. Already some slopes over 100% are cultivated with annual crops.

The most important crop associations with beans found in Burundi change from season to season:

1st season: maize — beans;

2nd season: pure stand beans, young cassava — beans at lower altitudes — beans — peas at higher altitudes;

marshes: pure beans, maize — beans, beans — peas.

Maize is not sown in the second season, and beans tend to be planted in pure stand, or with other crops.

Varieties

A great varietal diversity can be found in Burundi. Bean mixtures are normally used for planting: it is not unusual to find at least twenty different varieties in a handful of beans. Although the exact reason for using bean mixtures is not yet defined, it is clear that their use reduces the risk of crop failure due to disease epidemics or an unfavorable climatic period, because of a different reaction of each of the varieties included in the mixture. Besides mixtures a small proportion of pure varieties is planted locally. They always have attractive colours (white, yellow, gold or red) and are probably separated because of their flavour.

Most local bean varieties have an indeterminate growth habit, with vegetative terminals on the main stem and are erect or prostrate (Types II, III or IV of CIAT, 1980) Very few varieties with determinate growth habit (reproductive terminals on the main stem) are found on local farms.

Seed coat colours can be homogenous, striped or spotted with all colour gradations from white, yellow and red to brown and black. Dark colours, such as black or bluish grey, are not appreciated and are tolerated only in small proportions in mixtures.

The 1 000-seed-weight for local bean seed varies between 200 and 500 grams. Small seed size is little appreciated. Burundi farmers consider that small-seeded beans take longer to cook than large seeded ones.

Principal pests and diseases

Bean yield losses due to diseases and pests have never been evaluated in Burundi. This chapter will be limited to a review of the most important of them.

The most common diseases not linked with altitude are angular leaf spot *(Isariopsis griseola)* and floury leaf spot *(Ramularia phaseoli).* Less frequent are the mosaic diseases (Bean common mosaic virus (BCMV), bean yellow mosaic virus (BYMV), bean rugose mosaic virus (BRMV) and others), bean rust *(Uromyces appendiculatus).* Common and fuscous blight is frequently observed at lower altitudes (800-1 200 m). Web blight *(Rhizoctonia microsclerotia),* also observed at lower altitudes, is of less importance. Anthracnose *(Colletotrichum lindemuthianum)* and Ascochyta leaf spot *(Ascochyta phaseolorum)* are important at higher altitudes. Halo blight and some minor fungal pathogens have not yet been detected in Burundi.

The most important pests of beans in Burundi are bean fly *(Melanagromyza phaseoli),* black aphids *(Aphis fabae)* during the dry season crop, and bruchids *(Acanthoscelides obtectus* and *Zabrotes subfasciatus)* during storage. Of less importance are *Maruca testulalis,* leafhoppers *(Empoasca kraemeri),* mites and nematodes.

Chemical plant protection of farmers' fields is not feasible due to the high cost of pesticides and the low income of the farmer. Selection or breeding of resistant or tolerant varieties would be the most economical solution to the disease problem.

Strategy for bean research in Burundi

Bean research in Burundi started in 1933 with the introduction of about ten varieties from Guatemala. However bean research was not important in the program of ISABU (Institute for Agricultural Sciences of Burundi), which mainly concentrated on industrial crops, and was limited to the keeping of a bean collection at Kisozi, and from 1976 at Mosso. Introductions were only made sporadically. Proposed varieties were *0688 Colorado* (line selected at Kisozi in 1942) and *SG 44* (black seeded line from hybridization at the INEAC Station of Mulungu, Zaire).

In 1979, on arrival of the coordinator for bean research, a global research programme, was established. Taking into account all previous considerations the following conclusions were reached:

1) To be assured of a maximal impact in the shortest possible time, large changes in habits or preferences should not be imposed on local farmers. Taking the example of varietal selection, only varieties with acceptable size, colour and taste will be retained

for further testing. For the same reason, density trials on beans will be postponed.

2) Pesticide and fertilizer trials are only of academic importance as these products are at present hardly available for food crops. One exception could be research on bean storage, where cheap and available products can limit post-harvest losses.
3) Bean research in Burundi can achieve the highest impact on rural yields by selecting adapted and disease-resistant varieties. Priority is given to non-climbing beans, while selection of bean varieties with good yields in association with maize will be considered next. The latter will not necessarily be climbing beans, as they will have to yield as well without staking during the second season.

In varietal research the main selection criteria will firstly be high production in different growth conditions over a large altitude range, and secondly resistance to the most important diseases of that zone. Selected varieties must give reasonable yields, even in bad conditions. A high adaptibility of varieties to altitude is needed as differences in altitude of 500 metres can sometimes be found over a distance of 3 kilometres.

Local and imported varieties are compared simultaneously in preliminary trials at different altitudes. The selected varieties are then tested in replicated trials at different altitudes over two seasons. Finally the few retained varieties are to be tested in farm trials at about 10 different locations for another two seasons.

Actual status of bean research in Burundi

For implementing the proposed program, ISABU has several Research Stations and Multiplication Centers over the country: SEMS-Imbo (830 m.), Mosso (1 250 m), Buhoro (1 300 m), Murongwe (1 450 m), Luvyronza (1 850 m), Kisozi (2 100 m), Munanira (2 140 m.) and Nyakararo (2 200 m) (6). Moreover, other sites are available from other agricultural projects for trials in regions not covered by ISABU Stations.

In 1979-80 a first series of 13 trials, with six replications, compared 6 non-climbing bean varieties selected for their yields in an evaluation of the collection.

Although these trials showed many imperfections they have allowed the selection of two dwarf bean varieties: *Kamara var. 1/2* was chosen for the lower altitude regions where it produced twice the yield of the check *0688 Colorado*, and *Diacol Calima*, originally from Colombia, was selected for altitudes between 1 200 and 1 900 m., where it produced 60% more than 0688 Colorado. These two varieties are being multiplied by the "Service des Semences Sélectionnées" (Pure Seed Multiplication Service) which released over 200 tons of elite seed in 1980-81, of which 54 tons were beans (8).

A second series of experiments has been initiated in 8 locations during 2 seasons with 10 varieties, 5 of which were imported from CIAT (Centro Internacional de Agricultura Tropical, Cali, Colombia) and 5 are of local origin. Each trial contains 4 replications without fertilizer and 4 with a light fertilizer dose. ISABU pathologists are evaluating varietal disease reactions at each stage.

Recent introductions from CIAT show a high level of resistance to angular leaf spot, anthracnose and bean common mosaic, but most varieties are clearly not adapted. Local bean varieties appear more resistant to Asxoxhyta leaf spot and bacterial blight and more tolerant to poor soils with low pH. A breeding program is envisaged to incorporate disease resistance into locally adapted bean varieties.

Conclusion

Beans *(phaseolus vulgaris l.)* constitute the most important food crop of Burundi. Taking into account the high population increase and the lack of production aids for rural farmers, selection of high-yielding varieties readily acceptable to the local population appears to be the best means of avoiding imminent food shortages.

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