Potential for Field Beans (*Phaseolus vulgaris* L.) in West Asia and North Africa

Proceedings of a
Regional Workshop in
Aleppo, Syria
21-23 May 1983

ISBN 84-89206-45-7
April 1985

Potential for Field Beans (*Phaseolus vulgaris* L.) in West Asia and North Africa

Proceedings of a
Regional Workshop in
Aleppo, Syria
21-23 May 1983

The workshop was sponsored by:

The Ford Foundation
Centro Internacional de Agricultura Tropical (CIAT)
International Center for Agricultural Research
in Dry Areas (ICARDA)

Centro Internacional de Agricultura Tropical (CIAT)
Apartado 6713
Cali, Colombia

ISBN 84-89206-45-7
April 1985
Print order: 600 copies

*Centro Internacional de Agricultura Tropical. 1985. Potential for Field Beans (***Phaseolus vulgaris** *L.) in West Asia and North Africa. Proceedings of a regional workshop in Aleppo, Syria, 21-23 May, 1983. Centro Internacional de Agricultura Tropical, Cali, Colombia. 144 p.*

Beans — Near East. 2. Beans — Africa, North. 3. Beans — Production — Near East. 4. Beans — Production — Africa, North. I. Centro Internacional de Agricultura Tropical. II. International Center for Agricultural Research in Dry Areas. III. Ford Foundation.

Contents

Background and Objectives

Field beans or dry beans (*Phaseolus vulgaris* L.) are a widely-grown food legume in many countries of the West Asian and North African region. Increased production and yields could contribute significantly to protein nutrition and provide an important complementary legume crop in the yearly crop rotation, particularly in irrigated areas. Dry bean production is lagging behind the population growth in most countries, and research to improve the crop is needed.

The Consultative Group on International Agricultural Research (CGIAR) has asked CIAT (Centro Internacional de Agricultura Tropical) to assume world responsibility for the collection, preservation, and improvement of bean germplasm at the international level. The Bean Program of CIAT develops appropriate technology to overcome the production problems encountered in small-scale farming, where most bean cultivation is centered. This research includes breeding for disease and pest resistance, improvement of plant architecture, water stress tolerance, and less reliance on chemical fertilizers. Breeding for climbing bean varieties adapted to associated cropping with maize is also an important component of program activities.

Up to now, over 32,000 accessions of *Phaseolus* have been collected, and over half of these have been evaluated for agronomic characteristics.

Initially, the CIAT program, based in Cali, Colombia, directed its efforts mainly toward Latin America. Now that improved technology has been developed to increase bean production and yields in Latin America, and a research network is operational, intensification of program activities outside this region is contemplated.

This workshop, planned and organized jointly with ICARDA (International Center for Agricultural Research in Dry Areas), studied the feasibility of a collaborative regional bean research effort for West Asia and North Africa. The workshop sought to obtain the views of national research scientists from the region in order that any future program of research meets regional requirements. Analysis of the constraints limiting field bean production in these areas was undertaken, and actions necessary at the national, regional, and international levels to increase bean production through research were discussed.

Delegates from the following countries presented reports on the bean production problems, potential, and research in their respective countries:

Egypt	Pakistan
Ethiopia	Spain
Iran	Sudan
Jordan	Syria
Lebanon	Tunisia
Morocco	Turkey
	Yemen Arab Republic

The country reports were followed by round-table work sessions on overall needs in research, training, and seed production of beans.

The conference was attended by additional delegates and observers from national and international research centers and donor agencies.

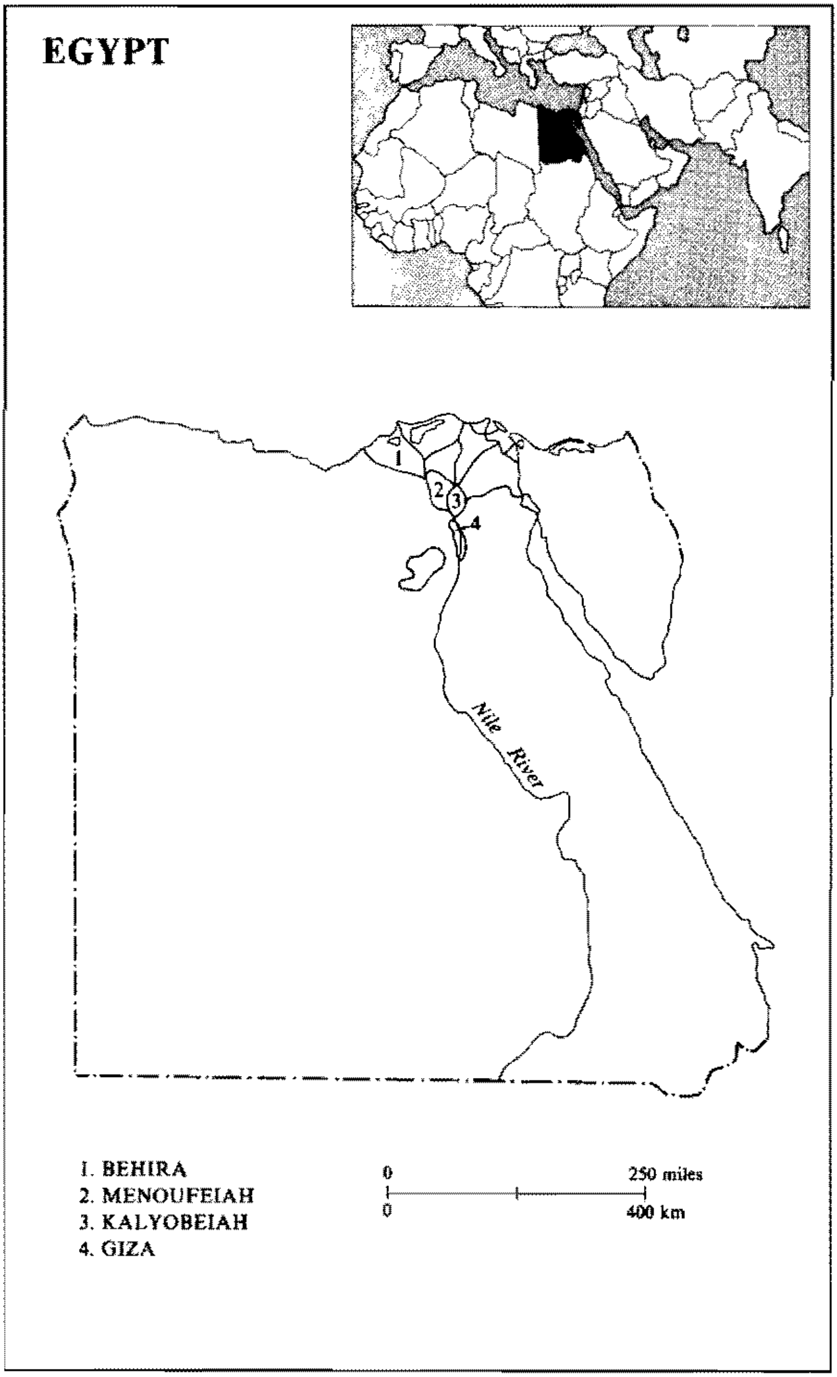


Figure 1. *Bean producing areas.*

Bean Production in Egypt

Salah A. Baha Eldin

Importance

Field beans (*Phaseolus vulgaris* L.) are considered one of the important food legume crops in the Arab Republic of Egypt (A.R.E). They are commonly consumed both as green pods and dry seeds by a relatively high proportion of the Egyptian population. They could be considered a supplementary legume crop to other high protein legumes such as broad beans and lentils. Increased productivity and production of field beans are required to meet the increasing local demand resulting from the high rate of population growth. (See regional map, Figure 1.)

Field beans are the second legume crop after broad beans in the A.R.E. Total area exceeded 16,848 ha in 1982. It is anticipated that the position of field beans, whether as a monoculture or intercropped, in the Egyptian cropping system will be strengthened in the near future. The government goal is to increase the area under field beans to about 75,600 ha in 1990. Therefore, research to improve the technology of production and productivity in the country is needed.

Area, Production, and Yield

Table 1 presents data on the total area, production, and yield of beans over the last 3 years (1980, 1981, 1982). Although there was a slight reduction in area and production in the year 1981 (as compared to 1980), an apparent increase in both was noticed in 1982. This trend was especially visible for dry bean production, with an increase of about 23% as compared to 9% for fresh bean production. However, current consumption patterns of the Egyptian market highly favor fresh bean production as shown by the almost 3:1 ratio for area in fresh bean versus dry bean. The levels of productivity for both have been relatively stable over the last 3 years.

Table 1. **Area, yield, and production of dry and green beans (1980, 1981, and 1982).**

Year	Crop	Season	Area (ha)	Yield (t/ha)	Production (t)
	Green	Summer	4630	9.42	43611
1980		Fall	7925	8.19	64899
		Total	12,556		108,510
	Dry	Summer	2215	2.04	4558
		Fall	2666	2.00	5347
		Total	4882		9905
	Green	Summer	5219	9.90	51708
1981		Fall	6857	8.00	54808
		Total	12,076		106,516
	Dry	Summer	2048	2.11	4354
		Fall	2164	1.97	4272
		Total	4212		8626
	Green	Summer	5303	9.45	50100
1982		Fall	8201	8.23	67711
		Total	13,504		117,811
	Dry	Summer	3632	2.04	7475
		Fall	2539	1.85	4707
		Total	6171		12,182

SOURCE: Agricultural Economy Dept., Ministry of Agriculture, Dokki, Cairo.

Cropping Systems

Field beans are grown in Egypt entirely as a monoculture crop in both the summer and fall seasons. Planting dates for the summer crop are from February 1st to March 1st, whereas fall planting takes place between September 1st to October 1st. A third planting in November-December is possible in limited areas in upper Egypt.

Beans are usually produced in limited areas in a few Egyptian provinces in rotation with vegetable crops such as tomato, spinach, and cucumber. Common agronomic practices such as surface irrigation, fertilization, weeding, and pest control are used. Field bean production in Egypt is labor-intensive, usually employing hand labor from planting to harvesting.

Production Constraints

Biological

Insect pests such as beanflies, whiteflies, leafhoppers, leaf feeding caterpillars, aphids, and mites can inflict heavy losses to dry beans. Viral diseases (bean common mosaic virus and bean yellow mosaic virus) and fungal diseases (mostly rust and *Macrophomina*) can severely limit bean production. Bacterial blight and root rot may also be important diseases.

Environmental

Both high temperatures during summer and low temperatures during winter in Egypt limit bean production. Varieties tolerant to heat or cold stress are needed. Other environmental factors of importance in limiting bean production are water stress during the summer and salinity-alkalinity stress. There is a need to develop new varieties with increased resistance to diseases and insects attacking field beans during growth and storage. Tolerance to moderately saline soils is a varietal requirement.

Socioeconomic

Due to the limited area of cultivated land available in Egypt, there is severe competition between field beans and alternative crops, which may limit the prospects of expanding bean acreage. However, the introduction of high-yielding varieties in combination with proper production technology such as intercropping systems can mitigate area limitations by making beans more profitable. Compared to other dry legume crops, field beans still hold a comparative advantage as far as the net farm return is concerned. This could be an additional incentive to the farmers to increase bean production. It is estimated that a net income of US $1000-1250 per hectare per season (4 months) could be expected from fresh bean production. Net return from dry bean production is less than that from fresh beans (US $600-750 per ha).

Institutional

Marketing, processing, and storage facilities should be considered as limiting factors for bean production. Since beans are small-farmer, free-market crops, there is no governmental policy concerning their production, marketing, or credit facilities. However, in a few cases, beans are grown on a relatively large scale on big farms. Other than the Union of Growers of Horticultural Crops which deals with export activities, there is no official or private organization controlling bean production in Egypt.

Research Activities

The objectives of the research program are to:

- Introduce, evaluate, and select new varieties adapted to the local production conditions

- Increase the yielding ability of the local varieties
- Select for resistance to common diseases of field beans

This modest research program needs to be strengthened and broadened to include more and better germplasm so that both yield and quality can be further improved. The international bean germplasm bank and the newly acquired CIAT technology in bean production should provide valuable resources for the national research program.

Varietal introduction

The Vegetable Research Department selected and released four bush bean varieties which proved to be more productive than the previously used varieties.

Variety Giza 3. This is a selection from a cross between the Contender and Swiss Blanc varieties. Giza 3 is suited for both fresh bean and dry bean production. This variety requires about 60-70 days from sowing to flowering. Its green pods are tender and fiberless with an average length and diameter of 10-11 cm and 7-8 mm, respectively. The seed is white-colored and medium-sized.

Variety Giza 4. This variety resulted from a selection of a cross between Giza 3 and Van de Villeneuve. Like Giza 3, it is a dual-purpose variety, with similar plant, pod, and seed characteristics. The pod diameter of Giza 4 is slightly less than that of Giza 3 (6 mm as compared to 7-8 mm). The green pods of Giza 4 are highly acceptable in the European market and therefore the variety is produced mainly for export.

Variety Giza 5. This is a selection from an artificially-induced mutation in the Van de Villeneuve variety. It is a single-purpose fresh bean variety with very tender and fiberless pods.

Variety Giza 6. Giza 6 is a selection from a backcross between varieties Giza 3 and Swiss Blanc. It is a single-purpose variety for dry bean production. The seed is white, large, and kidney-shaped. The dry seed yield of Giza 6 is higher than that of either Giza 3 or Giza 4.

These varieties, which currently may occupy 90% of the bean production area, represent a successful output of the national research program over the last years.

Conclusions

From the data presented in this report, it is apparent that field beans play an important role as a food legume in Egypt. In light of the increasing local demand due to a high rate of population growth (2.3%), it is appropriate to conclude that a great need for increasing bean production, whether fresh or dry, exists in Egypt. Therefore, the current national research program should be strengthened with more and effective cooperation with regional or international programs.

Publications

Abdel-Lateef, M., Ziedan, M., El-Sawah, M.Y., and About-Neama, M. 1979. Green-house and field evaluations of some systemic and non-systemic fungicides on *Fusarium oxysporum* sp. *Phaseoli.* Microbiol. Annu. Proc. Soc. Appl. Microbiol. Annu. Meet., Cairo, 81-94.

Ali, A.M.M., Abdel-Aziz, M., and Desouki, I.A.M. 1979. DNA relatedness in five species belonging to four different genera in the tribe Phaseoleae. Res. Bull. No. 1058, Fac. Agric., Ain-Shams Univ.

Allam, E.K., Eid, S.A., and El-Kady, M.A.S. 1979. Bean yellow mosaic virus isolates naturally occurring in bean fields in Egypt. 3rd. Egypt. Phytopath. Cong., Cairo: 62-74.

Allam, E.K.,El-Afifi, S.I., andEid, S.A. 1979. Some factors affecting the presence of some viruses in bean seeds. Ibid. pp. 49-61.

Allam, E.K., El-Afifi, S.I., and Eid, S.A. 1979. Chemical and serological diagnosis of bean common mosaic virus in bean seeds. Proc. 4th. Intern. Cong. for Statistics, Computer Sci. and Soc. Res. Cairo:177-184.

Allam, E.K., Soher, L., El-Afifi, S.I., Eid S.A., and Kishtach A.A. 1979. Comparative study between the effect of bean common mosaic and bean yellow mosaic virus on some chemical compounds of levels and immature seeds of bean plants. 3rd. Egypt. Phytopath. Cong., Cairo: 35-48.

Atwa, A.A., Ali El-Shiekh, T.M., and Dessouky, S.M. 1980. Effect of some chemicals and different packing methods on green beans: (A) Storage under cold storage condition. Agric. Res. Rev., Cairo. 58(3):10.

Baha El-Din, S., Mohamadein, S.A., Abd-El-Wahab, M., and Mohamed, M.A. 1971. Effect of environmental factors on cracking and yielding ability of dry seeds in some bean varieties. 3rd Convention Veg. Res., Alex. Univ., 23-25. (In Arabic.)

Eid, S.A., Allam, E.K., and El-Afifi, S.I. 1978. Inhibitory effect of bean flower and seed extracts on infectivity of bean yellow mosaic virus. 3rd Intern. Pl. Path., Munich, W. Germany (Abs.) p. 47.

El-Kady, M.A.S., Eid, S.A., and Kishtah, A.A. 1979. Isolation, purification and electron microscopy of cucumber mosaic virus from beans (*Phaseolus vulgaris* L.). Proc. 3rd. Egyp. Phytopath. Cong., Cairo:92-101.

El-Shami, M.R., Nassar, S.H., andAttia, M.S. 1972. Amal (Giza 3): a new variety of snap white seed bean resistant to common mosaic virus. Agric. Res. Rev., Cairo, 50: 93-108.

Fadl, F.A.M. 1983. Induced mutations in beans and peas for resistance to rust. Reprint from induced mutations for disease resistance in crop plants. 2. International Atomic Energy Agency, Vienna.

Gamal-Eldin, A.S. and Tolba, M.A. 1979. Preparation of bean yellow mosaic virus antiserum. 3rd. Egypt. Phytopath. Cong., Cairo: 22-34.

Hafez, H., Mazyad, H.M., Faris, F., El-Kady, M.A., and Nakhla, M.K. 1983. Effect of foliar fertilization on bean plants infected with bean yellow mosaic virus. Proc. V. Conf. Microbiol. Cairo, 3:465-485.

Hussein, H.A.S. and Desouki, I.A.M. 1976. Mutation breeding experiments in (*Phaseolus vulgaris* L.) I-EMS and gamma ray induced seed coat colour mutants. Z. Pflanzenzuchtg, 76:190-199.

Hussein, H.A.S. and Desouki I.A.M. 1979. Mutation breeding experiments in (*Phaseolus vulgaris* L.) II-EMS and gamma ray induced mutants for yield and protein quantity and quality traits. Egypt. J. Genet. Cytol. 8:181-197.

Kamal, M.A., El-Motaz, M., Rashe, A.G., and Khalifa, H. 1973. The biochemical effects of GA 3 on some varieties of beans. Third Conf. Veg. Res., Alex. Univ.

Khalil, M.H., Rizk, S.A., and Hassan, F.M. 1970. Quality attributes of ten bean varieties. Agric. Res. Rev., Cairo, 48(5):171-181.

Lenormand, M., Barakat, S., and Abou-Zaid, N. 1978. Contribution studies on the premination and autolimitation mechanisms of *Pseudomonas phaseolicola* (Burkh.) Dowson in beans, and *Botrytis fabae* sard in faba beans. Sciences Agronomiques-Rennes France, 31-42. (In French.)

Mazyad, H.M. 1973. Studies on some factors affecting crosses in bean (*Phaseolus vulgaris* L.). 4 th Veg. Res. Conf., A.R.E.

Mazyad, H.M., El-Hammady, M.H., and Sabek, A. 1974. Occurrence of cucumber mosaic virus in bean plants in Egypt. First Cong. Egypt. Phytopath. Soc., Cairo.

Mohamed, A.H.,Ali, A.M., and Desouki, I.A.M. 1979. Success of some intergenetic crosses in the tribe Phaseoleae. Res. Bull. 105, Fac. Agric., Ain-Shams Univ.

Mohamed, A.H., Ali, A.M., and Desouki, I.A.M. 1979. Characteristics of the F_2 and F_3 hybrid progenies derived from intergenetic hybridization between cowpea and french bean. Ibid., Res. Bull. 1057.

Mohamed, Hosni, A., Abdelal, H.R., Fadl, F.A., Shatta, H. M., and Nagi, I.M. 1982. Reaction of bean cultivars to rust and its relation to stomatal aperture. 4th Egypt. Phytopathol. Soc. Cong. Alexandria (Abstract), p. 25.

Mohamed, Hosni A, Abdelal, H.R., Shetta, H.A., Fadl, F.A., and Nagi, I. 1983. Chemical control of kidney bean rust. Al-Azhar Agric. Res. Bull. No. 75.

Moussa, F.F., El-Gindi, A.Y., and Abd-El-Massin, M.I. 1981. Relative reaction of six bean cultivars to infection with certain populations of *Meloidogyne javanica* and *M. incognita* Fac. Agric. Zagazig Univ. Res. Bull. No. 421: 1-9.

Nagdi, M.A., Handi, U.A., Lotfi, M., Nassar, S.H., and Faris, F.S. 1971. Response of different varieties of common beans to certain strains of *Rhizobium phaseoli*. Agric. Res. Rev., Cairo, 49:125-130.

Nasr, M.S., Nassar, S.H., and Abdel-Fatah, M.A. 1974. Evaluation of some snap bean varieties for growth, flowering and yielding ability. Ibid., 52(3):107-125.

Nassar, S.H. and El-Shami, M.R. 1970. Introduction of a new pole bean variety. 2nd. Arab Conf. Ain-Shams Univ: 27-28.

Nassar, S.H., El-Shenawy, M.E., Farrag, M.S., Hammada, A.M., Fouda, S., and Khalifa, H. 1970. Studies on the effect of seed size of snap beans on the characteristics of green pods. Its availability for exportation and the dry seed yield. Second Veg. Res. Conf., Ain-Shams Univ: 241-251.

Nassar, S.H., Faris, F.S., and Tahoun, E.E. 1979. Giza 4, A multipurpose snap bean variety. Agric. Res. Rev., Cairo, 57(3):149-129.

Nassar, S., Hamdi, Y.A., El-Nady, M.A., Lotfi, M, and Faris, F.S. 1972. Nodulation failure of *Phaseolus vulgaris* in the vegetable cropped soil of Egypt. Ibid., 50(2):95-101.

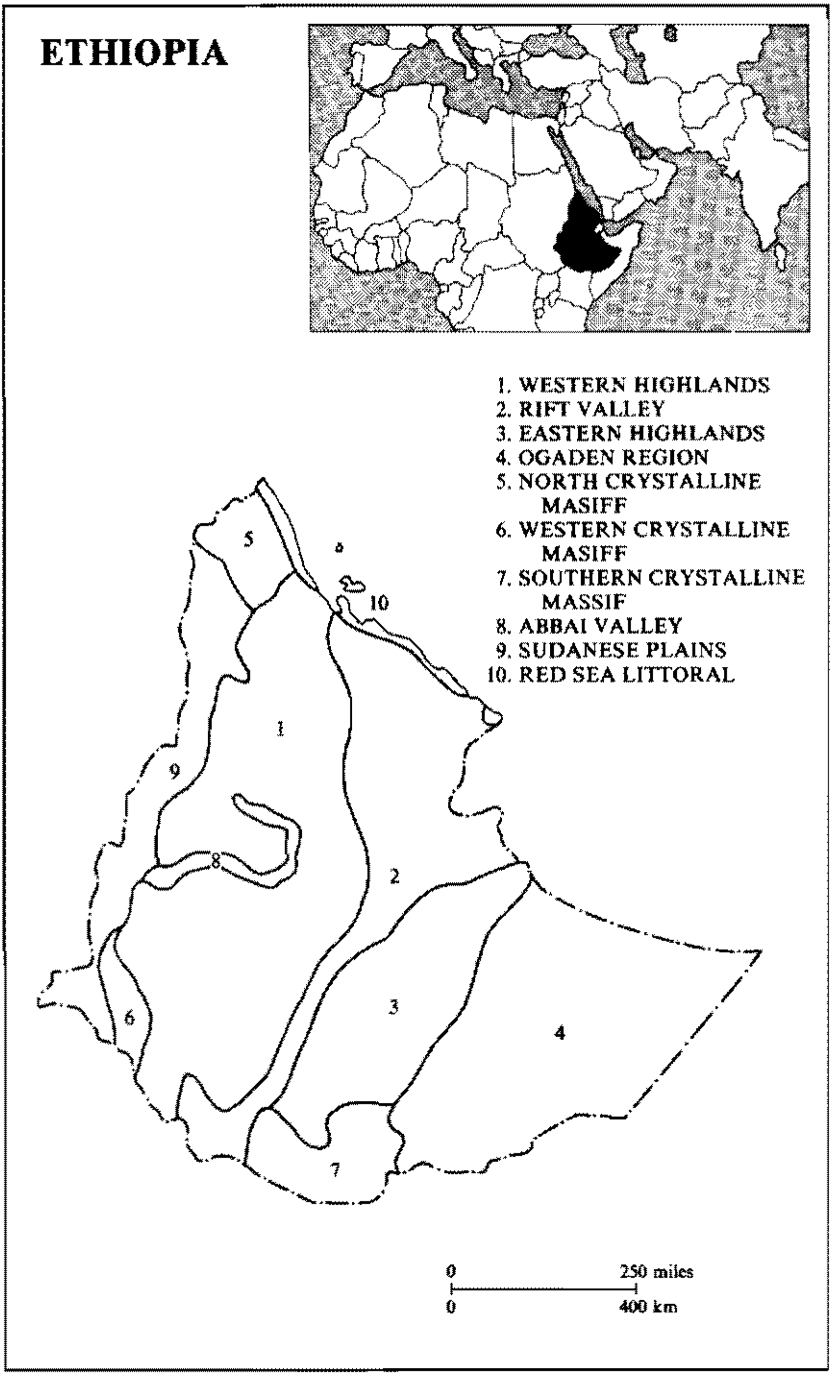


Figure 1. *Major natural regions.*

Bean Production in Ethiopia

Imru Assefa

Importance

A great number and variety of pulses are grown in Ethiopia, comprising from 12 to 14% of the cropped area. The total area planted in pulses is estimated at 760,000 ha, although some estimates are higher. (Ohlander, 1980). Pulses are rotated predominantly with cereals and are grown for both domestic needs and for export. They form an integral part of the daily Ethiopian diet, in which they provide a large proportion of the protein. More than 20 pulse species are grown, although only five (*Phaseolus vulgaris, Vicia faba, Pisum sativum, Lens esculenta, Cicer arietinum*) dominate production in the country.

Haricot beans (*Phaseolus vulgaris*) are considered one of the important "traditional pulses" grown in Ethiopia. (See regional map, Figure 1.) A variety of colors, shapes, and sizes is grown; those with white-colored seed are grown particularly as cash crops while dry seeds of the brown speckled and red kidney types are consumed locally. They are considered, however, an important export commodity, being one of the chief earners of foreign exchange. In 1973 and 1974 pulse exports from Ethiopia were very high (Table 1). This rapid buildup of exports during 1973 and 1974 was the result primarily of greatly increased production and fairly high prices offered for beans. In production and area they are the fifth most important pulse (Table 2). In terms of all crops grown in the country, they are fifteenth in area and thirteenth in gross output value (Table 3).

Origin and Distribution

Exactly when beans were introduced to Ethiopia is not known. Vavilov does not mention *Phaseolus vulgaris* in his list of Ethiopian cultivated plants compiled in his 1927 expeditions (Ohlander, 1980). A more likely period of introduction to Ethiopia is in the 16th century by the Portuguese.

Table 1. **Quantity of pulse exports, 000 t (1965-1975).**

Year	Haricot beans	Chick peas	Horse beans	Lentils	Field peas	Total
1965	19.7	9.5	17.8	5.8	2.3	55.1
1966	19.5	10.9	22.4	14.9	1.5	69.2
1967	17.9	10.7	24.7	15.0	0.9	69.2
1968	19.3	13.9	18.5	22.0	1.0	74.7
1969	16.7	8.0	27.4	24.5	2.0	78.6
1970	17.1	2.2	15.6	15.8	0.4	51.1
1971	22.6	6.3	16.6	18.0	0.2	63.7
1972	25.7	10.7	19.0	21.9	0.5	77.8
1973	79.1	8.1	29.7	22.29	2.4	141.5
1974	46.0	8.2	26.0	30.0	10.5	120.7
1975	41.5	1.0	22.2	37.3	-	102.0

SOURCE: Peter and Hash, 1976.

Table 2. **Estimate of area, yield, and production of major crops (1979-1980).**

Crop	Area (000 ha)	Yield (kg/ha)	Production (000 t)
Cereals			
Teff	1490	960	1429.7
Barley	790	1310	1033.7
Wheat	461	1130	521.8
Maize	827	1810	1527.2
Sorghum	1014	1620	1641.9
Millet	218	950	206.6
	Total 4800	Mean 1296	Total 6360.9
Pulses			
Horse beans	324	1500	486.6
Chickpeas	171	860	146.4
Haricot beans	19	1360	25.7
Field peas	210	1160	243.4
Lentils	42	730	30.6
	Total 766	Mean 1120	Total 932.7
Others			
Niger seed	113	460	52.1
Flax (linseed)	44	480	21.1
	Total 157	Mean 470	Total 73.2

SOURCE: Central Statistics Office, Addis Ababa, Ethiopia.

Table 3. **Ranking of major agricultural products by selected criteria.**

Rank	Extent of area (1971-1980)	Gross output value (1971-1979)	Foreign exchange value (1971-1978)
1	Teff	Coffee	Coffee
2	Barley	Teff	Vegetables (fresh frozen or simply preserved)
3	Sorghum & millet	Sorghum & millet	Live animals
4	Maize	Barley	Animal feed
5	Wheat	Maize	Sugar and honey
6	Coffee	Wheat	Meat and meat preparations
7	Horse beans	Horse beans	Meat (fresh or frozen)
8	Niger seed	Sesame seeds	Fruit (fresh) and nuts (fresh or dried)
9	Chickpeas	Chickpeas	Spices
10	Field peas	Niger seed	Cereals (unmilled)
11	Sesame	Lentils	Wheat (including spelt) and meslin (unmilled)
12	Lentils	Field peas	Food preparations
13	Linseed	Haricot beans	Fish (fresh or simply preserved)
14	Cotton	Linseed	Meal and flour of wheat meslin
15	Haricot beans	Rape seed	
16	Safflower	Castor beans	
17	Rape seed		
18	Ground nuts		
19	Potatoes		
20	Castor beans		

Beans are basic in cereal farming rotation and are grown mostly in rotation with maize in the Rift Valley area and with sorghum in the eastern and southwestern lowlands. Bean production is predominant in eight administrative regions in the middle Rift Valley.

Agro-ecological Zones

Ethiopia lies between latitudes 3° and 18°N and between longitudes 33° and 48°E, entirely within the tropics (Westphal, 1974). Characteristic of the Ethiopian topography are the great climatic differences caused by differences in altitude. For practical purposes, the following three different climatic and agricultural zones have been recognized.

1. The lowlands (Kolla), arid and hot in most areas (average temperature above 20°C) ranging from sea level up to about 1600 masl. Rainfall varies between 0 and 1200 mm annually. Haricot bean production is

quite common, mainly between 1200-1500 masl. This ecological zone is studied by the Kobo Research Station.

2. The medium highlands (Woyna Dega or "wineland") with optimum growth conditions (average temperature about 16° C), between 1600 and 2200 masl. Haricot beans are produced predominantly between 1600 and 1800 masl. The Nazereth, Awassa, Bako, and Jimma research stations are in this zone.

3. The highland (Daga) zone, with 1500 to 2000 mm of rainfall for the larger part of the year, elevation from about 2200 to 3000 masl, and lower temperatures (average 10-16° C). Haricot bean production is almost nonexistent mainly because of frost hazards.

The predominant growth area for beans in the Rift Valley is between 1200 to 1800 masl, where rainfall is recorded at between 750 and 1000 mm and temperature is 16 to 35° C between June and October. Beans are grown mostly in sandy loams or friable clays, often in red brown soils.

Cropping Systems

Most of the cultivated land in Ethiopia is in small subsistence farms, although recently large areas of government-owned farms have been incorporated. The average area cultivated per farm varies from 3.4 to 4.9 ha with a mean of 3.3 ha (Toborn, 1976). The 1974/75 survey indicates that 50 to 100% of the total holdings in this sector are under 1.0 ha in size, and that average plantings of individual pulses are about 0.33 ha (Peter et al., 1976). In other estimates, beans are planted on an average of 0.59 ha/holding (Toborn, 1976).

Both pure and mixed croppings are practiced in Ethiopia, with pure cropping predominant. In the Rift Valley where the terrain is more or less a uniform, flat area, sole cropping is the usual practice, while intercropping beans with either maize or sorghum is more common in the mountainous regions of the Chercher highlands, in the Harar and Konso region in the Gamogofa province, in the south of Ethiopia, and in the Gambella area in the west. Although bean-maize and bean-sorghum systems are the most common, sometimes beans are found unusually interplanted, perhaps through mechanical seed mixture, with field peas, horse beans, lentils, and pepper (Toborn, 1976).

Crop rotation

Ethiopian farmers appear to appreciate pulses more for their soil-enrichment capability than for their dietary value. Pulses are commonly planted first, followed by cereals the next year. Where double cropping is practiced, the pulse crop is planted during the small rains between February and May and followed by the main crop, which is usually a cereal, from June to December. Over a long period, there is a general tendency to cultivate pulses again to revitalize the soil. This usually takes from 3 to 6 years (Toborn, 1976).

Irrigation

Beans are mainly grown as a rainfed crop; however, when prices were high in the 1970's, beans were also produced under irrigation on commercial farms. In areas like the middle Awash Valley where other commercial crops are grown under irrigation, beans are also grown as a relay or double crop under irrigation.

Land preparation and seeding

The number of times a piece of land is plowed before being planted to pulses varies from place to place and from one pulse species to the other (Toborn, 1976). In a survey conducted in 1976 (Toborn, 1976), beans received an average of two plowings, and frequencies of more than two were not uncommon. The frequency of plowing for other pulses like chickpea and lentil, which are planted very late on residual moisture, was higher. These are never weeded.

Pulses are normally broadcast by hand and covered with the last plowing, which may also be the only plowing (Miller et al., 1969). This is done with a simple plow that consists of a bent wooden beam with a narrow iron point which only breaks or crumbles the soil. With very few exceptions, perhaps in larger state or commercial farms or in producers' cooperative farms, the local plow is used for land preparation. The hoe or spade may also be used (Westphal, 1975).

Planting time differs from place to place depending on the rainfall and the cropping system used. Where beans are planted as a sole crop, they may be planted during February-March in the small rains, June-July during the main season, and October-November in irrigated lowlands. The time of planting beans interplanted with either maize or sorghum is determined by the latter crop, which is planted at the beginning of the small rains (Westphal, 1975). Late planting is usual for most pulses including haricot beans.

Spacing and density

Plant spacing and population depend on the cropping system. The usual practice of planting beans is by broadcasting in sole crops, for which seed rates of 170 kg/ha (maximum), 67 kg/ha (minimum), and 130 kg/ha (average) have been estimated (Toborn, 1976). In general, this makes bean fields appear overseeded. In areas where bean-maize/sorghum interplanting is practiced, some form of ridging is done with the plow, and often the beans are interplanted by either broadcasting or by dropping seeds in some orderly fashion.

Fertilizers

Although by tradition pulses are planted on poor soils or on land that has been depleted after long years of cereal cultivation, there are indications that haricot beans are planted on relatively fertile soils (Toborn, 1976).

Depending on soil type and area, commercial fertilizers, manure, or soil burning are used by farmers to increase pulse yields, although fertilization is not common for pulses. However, it was learned that farmers have used commercial fertilizers at least sparingly to increase their haricot bean yields more than on other pulses (Toborn, 1976).

Weeding

With the exception of horse beans (*Vicia faba*), pulses are seldom weeded (Miller et al., 1969). When beans are weeded, it is usually done by hand and with small tools like hoes, the first weeding operation taking place 3-4 weeks after planting and the second, if any, occurring 5-8 weeks after planting (Toborn, 1976).

Haricot beans seem to be more frequently weeded than other pulses according to one survey (Toborn, 1976). No chemical weed control methods are used by farmers as these are expensive and quite complicated to use. Crop losses due to weeds are estimated to be quite high (Toborn, 1976).

Harvesting and threshing

Harvesting beans is very simple. It is usually done by hand pulling whole plants and rarely by cutting them with a sickle. Plants are heaped into small piles for drying before being transported to a threshing ground (Miller et al., 1969). Threshing is done with animals except when the harvest is very small or animals are not available. In such cases the beans are hand-threshed with sticks. Crop losses during harvesting and threshing, although small, are common. The time required to harvest and thresh 1 ha of beans is quite long, which has some bearing on the quality of seeds (Toborn, 1976).

Consumption and Production

The principal pulse crops in order of importance in Ethiopia are horse beans, chickpeas, field peas, lentils, and haricot beans, as shown in Table 2. With the exception of haricot beans, which are chiefly produced for export, the other major pulse crops are utilized largely for local consumption. Precise data on per capita consumption of pulses are unavailable, but estimates of the above five major pulses range from 16.2 kg to 25.0 kg per capita annually (Peter et al., 1976). Such data are useful in determining domestic pulse requirements and in planning for production of adequate quantities of cereals and pulses to provide a balanced diet.

Estimates of area, yield, production, and comparative importance (percentage of area) of pulse crops from 1974/75 to 1978/79 are shown in Table 4. Current information on yield, production, and area (1979/80) is presented in Table 2.

The estimate in the 1979/80 Institute of Agricultural Research (IAR) report showed 45 and 52% increases in production of cereals and pulses, respectively, over the previous years, while areas increased only 4 and 16%, respectively. The average yield for pulses was 1120 kg/ha in 1979/80, and 1300 kg/ha for cereals, an increase of 35 and 32%, respectively, over the previous years.

The increase in pulse production during the 1979/80 season came mainly from increased areas in horse beans, chickpeas, and field peas, while the increase in haricot bean production came mainly from increased yields. The acreage in the 1979/80 estimate (19,000 ha) was relatively lower but almost equal to the previous estimates in 1977/78 (21,000 ha) and 1978/79 (20,000 ha).

Trade

Major export of grains and pulses was started in 1942 under an agreement between the governments of Ethiopia and the United Kingdom (Thodey, 1969). While cereal exports have declined during the last 38 years, due mainly to a decline in the production-consumption balance, pulse exports have generally increased, peaking in 1965 with shipments of 116,000 t and export value of US $23 million (Thodey, 1969). In 1966, although the value of shipments was less than in 1965, it amounted to US $10.5 million. From 1948 to 1961, the average composition of pulse exports was 36% horse beans, 33% lentils, 13% haricot beans, 13% chickpeas, and 5% other (Peter et al., 1976). From 1961 on, haricot beans gained rapidly in relative position.

Table 4. **Estimates* of area, production, yield, and relative importance of pulses (1974-1979).**

Pulse	Year				
	1974/75	1975/76	1976/77	1977/78	1978/79
Area (000 ha)					
Horse beans	329.8	263.6	270.1	281.8	295.9
Chickpeas	151.8	181.3	152.9	138.5	141.6
Haricot beans	68.1	42.6	49.3	21.3	20.0
Field peas	102.3	103.7	134.4	122.2	127.3
Lentils	115.5	48.3	59.6	59.2	58.5
Total	767.5	639.5	666.3	623.0	643.3
Production (000 t)					
Horse beans	282.06	239.83	339.77	281.77	265.08
Chickpeas	93.37	97.23	100.72	99.54	77.19
Haricot beans	32.75	45.92	31.87	14.84	13.41
Field peas	44.73	46.09	102.09	85.94	87.41
Lentils	46.55	32.88	42.05	33.02	26.97
Total	499.46	461.95	624.50	515.11	470.06
Yield (kg/ha)					
Horse beans	860	910	1260	1000	900
Chickpeas	620	540	710	720	550
Haricot beans	480	1080	650	700	670
Field peas	440	440	760	700	690
Lentils	400	680	710	560	460
Mean	650	720	940	830	730
Percent of major crop area					
Horse beans	6.1	4.9	5.3	5.3	5.4
Chickpeas	2.8	3.3	3.0	2.6	2.6
Haricot beans	1.3	0.8	0.9	0.4	0.4
Field peas	1.9	1.9	2.6	2.3	2.3
Lentils	2.1	0.9	1.2	1.2	1.0
Total	14.2	11.8	13.0	11.8	11.7

* Estimates include holdings by peasant farmers, cooperative farms, and state farms.

SOURCE: Central Statistics Office, Addis Ababa, Ethiopia.

Ethiopian pulse exports have been among the most important earners of foreign exchange, ranging in FOB value from US $8 million in 1970 to over US $50 million in 1974. During the 10-year period beginning in 1965, export of the major pulse crops ranged from 51,100 t in 1970 to 141,500 t in 1973 (Table 1). The rapid buildup in exports in 1973 and 1974 was primarily the result of greatly increased production of haricot beans for the export market. Privately operated commercial farms were largely responsible for this increase (Peter et al., 1976). Reports in 1975, however, indicated a 35% decline in pulse export value compared to 1974, from US $51 million to US $33 million (Peter et al., 1976). Price fluctuations reflected in FOB return were the main reasons for the decline (Toborn, 1976).

On the world scene, Ethiopia's place as a pulse exporter moved rapidly forward from 1970 through 1974; in fact, it was reportedly the third largest exporting country in 1974, after only the USA and Morocco. In 1971 pulse exports from Ethiopia were over 70% of the total world imports (Toborn, 1976).

Europe in general, and West Germany, the Netherlands, and other Common Market countries in particular, have been the major outlets for haricot beans. A recent development has been the emergence of the USA, the USSR, and Yugoslavia as destinations for limited quantities of haricot beans. However, the pulse industry will suffer if the present trend of decline in the export market and in the production-consumption balance continues and appropriate measures are not taken to reverse this situation (Toborn, 1976).

Storage and Use

Beans are stored by farmers in their homesteads often in containers made from clay soil, grass straw, and manure, or in sacks, until marketed. Up to 500 to 600 kg are stored for a period of 6 to 7 months. High losses in storage approaching 6-18% and as high as 30% have been estimated, pointing to the benefits which might be derived from improved storage facilities (Peter et al., 1976).

Beans are grown mainly for dry seeds and exceptionally for green pods. Dry beans are consumed boiled alone or mixed with cereals like maize, or they may be prepared into a thick soup seasoned with salt, onion, and spices.

Production Constraints

Constraints to bean production in Ethiopia are numerous; they include lack of suitable cultivars for the different agro-ecological zones and for the export market, poor cultural and agronomic practices, diseases, insects, and unavailability of improved seeds. The most important needs and constraints are described briefly below.

1. Market quality: Color, shape, and size are important quality attributes in the local and export markets. While white pea beans and medium to large white kidney beans are desired by the export market, colored types of the large kidney categories are preferred by the local market.

2. Adaptability and plant type: Suitable varieties are needed for the Rift Valley area and the agriculturally important warm, moist region in the south and southeast. Plants with indeterminate habit and small guide or facultative determinates are needed for the erratic rainfall regions, while determinate, erect types amenable to combine harvest are needed for large-scale mechanized farms.

3. Diseases (in order of importance):
   - Rust (*Uromyces phaseoli*), cyclic in occurrence and potentially devastating
   - Bacterial blights caused by both *Xanthomonas phaseoli* and *Pseudomonas phaseolicoli*
   - Anthracnose (*Colletotrichum lindemuthianum*)
   - Bean common mosaic virus
   - Root rot, various fungi (important in irrigated lowlands)
   - *Phoma* and *Phyllosticta* spp., important in the warm moist zone
   - Ascochyta leaf spot, a minor disease

4. Insects
   - African bollworm (*Heliothis armigera*)
   - Bean fly (*Melanagormyza phaseoli*)
   - Bean bruchids, important in the irrigated lowlands

5. Utilization: Types with fast soakability and short cooking time are required.

6. Nodulation: Poor nodulation due to incompatibility with rhizobia strains can be a problem.

Agronomic problems

Late planting, inadequate land preparation, inadequate or no weeding, and improper seed rates are some of the important agronomic practices that reduce farmers' yields substantially. Recent studies have shown that by far the most important of these for increased yield is proper weed control, followed by early sowing (Ohlander, 1977; Ohlander, 1980).

Socioeconomic aspects

Socioeconomic studies of crop production are basic to understanding which species farmers chose to grow and to consume, and those in which they are willing to invest more time and resources. The farmer may be understood as a price-conscious individual with an inborn habit of wariness and risk-avoidance, especially farmers used to growing cash crops. Socioeconomic studies on these and many other aspects of bean production have just been started and results, though encouraging, are very preliminary.

Institutional aspects

The foremost institutional constraint is the lack of an adequate number of qualified staff in the most important disciplines such as pathology, entomology, and soil sciences, and the lack of adequately equipped research facilities. Also, as research results become available, they have to be taken to the farmers for use. However, the situation in this respect is very discouraging. Lack of staff and poor links between research and extension have slowed the rate of adoption of research technology.

With an estimated 80% of the rural population living in areas that are not readily accessible to modern transport, it is obvious that transportation is a pressing problem for marketing pulses and other farm products (Peter et al., 1976). In all of Africa, perhaps due to difficult terrain, Ethiopia is said to have the most critical need for both penetration and farm-to-market road transport (Peter et al., 1976). Presently, it is necessary, besides using available truck transport, to resort to slow and laborious transport by both humans and animals.

Research Activities

The Institute of Agricultural Research (IAR) is an agency established by governmental decree in 1966 and is nationally responsible for agricultural research in Ethiopia. It is the central body for planning, coordinating, and executing research on crops, livestock, and some aspects of agricultural engineering.

The IAR established eight major research stations and 21 substations throughout the country representing different agro-ecological zones, each with a certain degree of specialization as appropriate. Research activities were carried out by each of the eight major research departments (Field Crops, Crop Protection, Soil Sciences, Animal Sciences, Agricultural Engineering, etc.) as established in 1977. Following a review meeting on departmental functions, their role was reduced to administration and coordination, and to conducting needed basic research, which may not be crop specific. At the same time, a new research approach applicable only to crop research was introduced. This approach involved a team composed of a breeder, an agronomist, a soil scientist, a pathologist, an entomologist, a weed scientist, a food scientist, etc. Such a team can address the various facets of crop production problems by involving different research disciplines, as well as alleviate the shortage of trained manpower by involving the different institutions which do research in the country, like the Addis Ababa University. Fifteen such teams were created, among them the Pulse Research Team.

Nationally-coordinated pulse research work started in February, 1972, with the IAR-Nazereth Research Station given the overall responsibility for its coordination. It included pulses that grow both in the highlands and the lowlands. Prior to 1972, no coordinated research work on pulses had been done, although some trials and selection had been carried out at different places within and outside IAR, notably at Awassa Research Station and IAR-Nazereth Research Station on haricot beans; Debre Zeit Agricultural Experiment Station on chickpeas and lentils; and IAR-Holetta Reseach Station and CADU (now ARDP) Kulumsa on horse beans and field peas.

At a meeting held in Addis Ababa on March 1972, the Pulse Sub-Committee of the National Crop Improvement Committee (now Conference), NCIC, established the same year, decided that the responsibilities for research coordination and trial work on pulses should be divided as follows:

Station/Organization	**Crop**
1. Debre Zeit Agri. Exp. Station (AAU)	Chickpea, lentil
2. Chilalo Agri. Development Unit (now ARDP)	Soybean
3. IAR-Melka Werer Research Station	Peanut
4. IAR-Nazereth Research Station	Haricot bean and other pulses including horse bean and field pea

The overall objectives of the pulse improvement program when the sub-committee was created in 1972 were:

1. Establishing a nationally-coordinated research and trial program on pulse crops.
2. Identifying suitable species/varieties for the various agro-ecological zones in the country.

3. Determining the cultural practices and methods needed to increase pulse production and yield.
4. Training Ethiopian staff at all levels for the continuation of the program.

The objectives have remained essentially the same, but more recently emphasis has been placed on breeding for disease resistance, studies on bean-*Rhyzobium* strain compatibility and effectiveness, studies on acceptability and utilization, and demonstrations on farmers' fields.

From 1972 to 1974, the bulk of the work was on haricot beans until other species were introduced in 1973 and 1974. The program has suffered from the beginning from an acute shortage of staff and inadequate facilities. The allocation of some funds by the Ethiopian Grain Board expressly for expansion of the haricot program in 1974 allowed the program to employ more staff and purchase badly needed equipment. Starting in 1975, the program received material and personnel support through the USAID-supported "Pulse Diversification and Export Promotion Project."

Priorities for pulse research projects are reviewed at the pulse subcommittee meeting of the National Crop Improvement Committee. Since the start of the coordinated research work on pulses a considerable amount of work has been completed. A summary by disciplines follows.

Breeding selection

The bulk of breeding selection activity depended heavily on introduced materials, with some local collections. As shown in Table 5, the following white pea bean varieties were identified as having high yield and high overall disease resistance: Mexican 142, Ethiopia 10, Tengeru 16. The three highest rated black-seeded varieties were: Black Dessie, Negro Mecentral, and 15 R-52. The first two white pea bean varieties are already under commercial production in the country. On the basis of the national yield trials for 1972-1976, suitable locations for haricot bean production were identified. The middle Rift Valley area with an altitude of 1500-1900 masl is the best; good results have also been obtained in lower altitudes in the middle Awash Valley (irrigated) but only during the cooler parts of the year (October-December).

Agronomic investigations

Although efforts were made to coordinate trial work in agronomic investigations, they did not meet with much success, mainly because agronomic studies are unique to each location, and coordination is not as easy as when running uniform cultivar trials.

Table 5. **Haricot bean national yield trial (1972-1982).**

Trial year	No. of locations	Trial mean (kg/ha) High	Trial mean (kg/ha) Low	Overall country mean (kg/ha)	Variety yield (kg/ha) Highest	Variety yield (kg/ha) Next highest	Varieties Highest yielder	Varieties Next highest yielder
1972	12	3270	760	1860	2420	2360	Ethiopia 10	Tengeru 16
1973	22	3330	670	2140	2460	2370	Tengeru 16	Black Dessie
1974	18	2370	520	1500	2410	2010	Black Dessie	Brown Speckled
1975	19	3700	280	1940	2760	2550	Black Dessie	Mexican 142
1976	17	3400	450	1820	2300	2190	Black Dessie	Negro Mecentral
1977	5	2910	840	2120	2440	2370	Black Dessie	Negro Mecentral
1978	1	3400		2400	3180	2980	15 R-52	W-95-03
1979	3	2260	1000	1800	2140	1990	15 R-52	15 R-42
1980	7	2530	90	1500	1890	1730	15 R-52	15 R-66
1981	6	2040	400	1300	1790	1420	Negro Mecentral	15 R-195
1982	8	3840	440	2640	2970	2940	Negro Mecentral	15 R-52

SOURCE: Ohlander, 1977.

Cultural practice trials included such basic studies as sowing dates, plant population/density, fertilizer requirements, and weed control. Starting in 1977, pathological and entomological studies were added.

Sowing dates. Farmers have a tendency to plant pulses very late, after they are through with the most labor-taxing crops like cereals. Another reason for planting pulses late is that only one weeding or no weeding is needed. However, research findings from experiments with planting dates in several locations have indicated that early planting is advantageous (Table 6). Beans planted between the first week of June and first week of July gave significantly higher seed yields ($P = 0.01$), and planting after the first week of July gave lower yields, as much as 20 to 50%, depending on the rainfall during the season. Investigations on possibilities of double cropping have indicated that planting during the first week of October, after the main crop harvest, is optimal in irrigated lowland areas with high temperatures.

Plant populations. Ohlander (1980) summarized 28 plant population trials conducted from 1972-1975 and observed that 11 of these gave statistically significant yield differences ($P = 0.05$) between plant populations. Two trials gave significantly different yields for different inter-row spacings, while five trials showed significant interaction between plant population and other factors such as sowing date. Seventeen trials did not give any statistically significant yield differences for the different populations. However, all results point in the same direction, i.e., higher yields for higher populations. Yield appears to increase with an increase in plant population, indicating that maximum biological yield per hectare has not been achieved. Tentatively a seed rate of 60-70 kg/ha has been suggested with 250,000 plants/ha at a spacing of 40 x 10 cm.

Weed control trials. Such basic information as yield loss due to weeds was first investigated to establish the need for using herbicides, hand weeding, or machine cultivation. In 1972 and 1973 trials in different locations and soil types, some weed control treatments gave large yield increases over the unweeded (check) treatments (Table 7).

Systematic studies of weed competition on haricot bean yields have shown in recent investigations (1980-1982) that yield losses are substantial (Table 8). The studies used various weeding treatments on both heavy and light soils. The average yield loss to weeds in all treatments was 17.0% in heavy soil and 40.4% in light soil. However, yield loss due to weeds was higher in the unweeded check treatments, 37.0% and 64.0%, respectively, for heavy and light soil.

Table 6. **Effect of planting time on seed yield of beans (kg/ha).**

1972 (Melkassa)		1973 (Nazereth)		1974 (Ambo)		1975 (Bako)		1981	(Awassa)	(Arsi Negellie)
Sowing date	Mean yield	Sowing date	Mean yield	Sowing date	Mean yield	Sowing date	Mean yield	Sowing date	Mean yield	Mean yield
June 6	3830	July 3	2670	July 3	1130	June 5	980	June 5	2840	1970
June 30	3680	July 10	2610	July 13	1060	June 17	1010	June 15	2950	1470
July 7	3520	July 17	2280	July 23	620	June 26	490	June 25	2660	1210
July 14	2950	July 25	1630	August 2	490	July 9	240	July 5	2150	790
						July 19	300			
Mean	3500		2300		820	July 31	210	Mean	2650	1350
SE	130		90		60			SE	100	10
LSD (5%)	400		280		190	Mean	540	LSD (5%)	10	30
LSD (1%)	560		400		280	LSD (5%)	360	LSD (1%)	NS	90
CV (%)	17		18		15	LSD (1%)	500	CV (%)	5	30.0
						CV (%)	11			

SOURCE: IAR-Nazereth Research Station Progress Reports, 1972-1977, 1981.

Table 7. Weed control studies in 1972 and 1973 at Nazereth (Melkassa I).

Treatment	Yield (kg/ha)	Yield increase over control (kg/ha)
1972		
Control	1990	-
Hand weeding	3860	1870
Fluorodifen	3410	1420
Alachlor	2800	810
1973		
Control	1350	-
Early and late hand weeding	2500	1150
Late hand weeding	2480	1130
Bentazon (0.96 kg a.i./ha)	2190	840
Fluorodifen (2.0 kg a.i./ha) and late hand weeding	2060	710
Fluorodifen (2.0 kg a.i./ha)	1950	600
Early hand weeding	1720	370

SOURCE: Ohlander, 1980.

Soil fertility and *Rhizobium* inoculation. Investigations in 1981 and 1982 showed that, although yield differences were not statistically significant between the uninoculated (check) treatment and the inoculated, there was a significant difference in nodule fresh weight of the various treatments (Table 9). Invariably nitrogen showed a depressing effect on nodule fresh weight. Although not significantly different, it was lower in the inoculated treatment without nitrogen than in the check treatment. The trial results indicate a need for more in-depth study to select compatible and efficient local rhizobia. Studies on commercial fertilizer application have differed widely depending on locations. While yield increases of up to 50% over the check treatment have been obtained by application of phosphorus fertilizers, the response to nitrogen has been haphazard (Ohlander, 1980).

Pathology

Pulse pathological investigations have taken three approaches, i.e., cultural control, chemical control, and disease resistance screening.

That diseases were and are very important factors determining yield levels and yield differences between varieties is substantiated by the summary of the regression analysis in Table 10. In 65% of the cases where disease scores were reported, the regression of yield on disease score was

Table 8. **Effect of weed competition on haricot bean yield (kg/ha), Melkassa (1980-1981).**

Treatments	Frequency of weeding	Heavy soil (year)			Mean	Estimated yield loss (%)	Light soil (year)			Mean	Estimated yield loss (%)
		1980	1981	1982			1980	1981	1982		
Unweeded (check)		1090	1310	2330	1570	37.0	340	710	1030	690	64.0
Weeded as necessary for the whole growing season	3	1620	2490	2630	2250	9.0	1210	2470	1540	1740	10.5
Weeding during early season 10-15 days after emergence	1	1560	2280	2810	2210	11.0	990	2190	1540	1570	19.2
Weeding during mid season 30-35 days after emergence	1	1330	2300	2940	2190	12.0	720	1870	1720	1440	26.3
Weeded during early and mid season	2	1910	2560	2970	2480	0.0	1350	2540	1950	1950	0.0
Weeded during late season on the 60th day after emergence	1	1290	1450	2340	1700	32.0	540	830	1080	820	58.0
Weeded during mid and late season	2	1460	1930	2680	2020	18.0	900	1280	1600	1260	35.3
					Mean	17.0				Mean	40.4
LSD (5%)		290	230	470	350		430	250	420	620	

SOURCE: Rezene et al., 1982.

Table 9. **Effect of inoculation and fertilizer source of N (urea) on seed yield and nodule fresh weight of beans under two soil fertility levels.**

Treatments		1981		1982	
Fertility level	Source of nitrogen	Seed yield (kg/ha)	Mean nodule fresh weight (g)	Seed yield* (kg/ha)	Mean nodule fresh weight (g)
Maximum	Uninoculated	2000 c**	0.38 a	2052	0.29 a
	Uninoculated + N	2758 a	0.03 c	2177	0.01 b
	Inoculated	2208 bc	0.35 a	2247	0.25 a
	Mean	2322	0.25	2159	0.18
Farm	Uninoculated	1612 d	0.27 ab	2024	0.25 a
	Uninoculated + N	2387 ab	0.00 c	2459	0.01 b
	Inoculated	1912 cd	0.14 b	2229	0.29 a
	Mean	1971	0.14	2237	0.18

* No significant difference at 5% level in 1982 seeds yield.

** Means followed by the same letter in each column are not significantly different at 5% level of probability in Duncan's Multiple Range Test.

SOURCE: Abebe, 1982.

Table 10. **Regression of variety yield on disease score (national bean yield trials, 1972-1977).**

	Year						
	1972	1973	1974	1975	1976	1977	Total
No. of trials (locations)	12	22	20	19	18	4	95
No. of locations reporting any disease	10	18	15	16	13	3	75
No. of locations showing significant regression of variety yield on disease score (percent within parentheses)	9 (90)	10 (56)	11 (73)	12 (75)	6 (46)	1 (33)	49 (65)
Locations with negative regression	8 (80)	5 (28)	11 (73)	7 (44)	5 (38)	1 (33)	37 (49)
Locations with positive regression	1 (10)	3 (17)		4 (25)			8 (11)
Positive coefficients		2 (11)		1 (6)	1 (18)		4 (5)

SOURCE: Ohlander, 1980.

significant and negative (Ohlander, 1980). Although regression analyses were not done, Habtu (1982) confirmed the importance of diseases as the most determining factor on yield.

Chemicals generally were not effective in controlling common bacterial blight (CBB) on haricot beans except for a slight effect ($P = 0.05$) on the most susceptible variety.

Whereas intra-row spacing was found to be more important than condition of weeding in the spread of CBB in both years' trials (1981, 1982), the prevalence and severity of the diseases during the season were also important enough to indicate differences in the treatments.

The most important and common disease was bacterial blight followed by rust. Some of the other diseases were found to be location-specific while others appear to have wide geographic distribution. In this study varieties possessing specific and multiple disease resistance were noted. A more systematic approach will be used in the future to substantiate this.

Entomology

Entomological studies included screening for resistance to African bollworm (ABW) and bean fly, and chemical control methods on ABW,bean fly (seed dressing), and black bean pod weevil. Tests in 1981-1982 with seed dressing chemicals on bean fly population showed that Carbofuran 35% followed by Aldrin 40% WP gave the best control (Tsedke, 1982). Investigation of the effect of sowing date on bean fly infestation (Table 11) showed that earlier planting was advantageous and yield appeared to increase with the decrease in number of infected plants and pupae population (Tsedeke, 1982).

Table 11. **Effect of sowing date on bean fly infestation [mean no. of pupae per 20 plants (square root transferred)].**

Sowing date	Mean yield (kg/ha)	Mean no. of pupae/ 20 plants
June 15	1010	10.4
June 25	860	10.4
July 5	970	11.1
July 15	560	12.4
July 25	610	12.9
LSD 5%	1150	0.66
LSD 1%	1550	0.89

SOURCE: Tsedeke, 1982.

Very encouraging observations have been made in a bean nursery where lines with no bean fly attack or no pupae and no ABW damage were found at Nazereth (Tsedeke, 1982).

Seed Production and Distribution

Prior to 1976 much of the seed requirement was handled by the Agricultural Marketing Corporation (AMC) and through the importation of improved seed from neighboring countries. In 1977 the Ethiopian Seed Corporation, now Seed Enterprise, was established to look after improved seed requirements in the country. In the earlier years, it was the sole body in charge of increasing, inspecting for quality control, packaging, and distributing seeds in the country. Recently quality control was entrusted to the Ethiopian Standard Institute which has not yet taken over those duties.

Achievements

Since the beginning of the coordinated research work on pulses, and particularly on haricot beans, the following results have been achieved:

1. Identification of high-yielding, disease-resistant varieties and suitable bean production areas in the country.
2. Determination of the cultural requirements for increasing haricot bean yields such as sowing dates, seed rates, and weed control practices.
3. Identification of production problems in the areas of pathology, entomology, weed sciences, and soil sciences.
4. Preparation of guidelines for successful haricot bean production.

Future Plans

During the coming years the bean improvement program will concentrate on the following:

1. Better varietal development of the larger flat bean which has good export potential.
2. Validation of recommendations on some of the cultural practices, particularly fertilizer application and rhizobia strains.
3. More precise definition of the climatic and altitudinal ranges of haricot beans.

4. Intercropping, long-term rotation, and double and relay cropping studies.
5. Utilization and acceptance studies of haricot beans in the local diets.
6. Pathological work to keep track of the variations in pathogenicity of important disease organisms, and identification of faster methods for testing breeding lines for resistance.
7. Entomological work on the insect pest complex of beans, evaluation of effective and economical insecticides, selection of bean cultivars with resistance/tolerance to insects, and studies on the biology of insects attacking beans.

Summary

Haricot beans are one of the most important pulses grown in Ethiopia, chiefly for export. Production is concentrated in the south and southeastern part of the country, particularly in the Rift Valley area. The main factors limiting production are seed quality, incidence of diseases, insects, weeds, and poor agronomic and cultural practices.

The Institute of Agricultural Research, through the existing research stations, is conducting research on various facets of production problems using a research team approach. The accomplishments have been very encouraging, with more than four varieties released and economically important diseases, pests, and weeds recognized.

Publications

Abebe, Amare. 1982. Preliminary progress report for 1982-83 on the effect of inoculation and N-fertilizer on seed yield of *Phaseolus vulgaris* under different soil fertility levels. Field Crops Dept., Lowland Pulse Research Team. Nazereth, Ethiopia.

Central Statistics Office. 1980. Ethiopia statistical abstracts. Addis Ababa, Ethiopia.

Habtu, Assefa. 1982. Preliminary progress reports for 1982-83 bean program on evaluation of haricot bean lines for resistance to bacterial blights, rust and other fungal diseases. Field Crops Dept., Lowland Pulse Research Team. Nazereth, Ethiopia.

Institute of Agricultural Research (IAR). 1972-1983. Nazereth progress report on pulses (published yearly). Nazereth Research Station, National Horticultural Center. Addis Ababa, Ethiopia.

Miller, C. J., Ream,H. W., Back, F. V., and Wodajeneh, A. 1969. Production of pulses and grains in Ethiopia. Stanford Research Institute, Menlo Park, California.

Ohlander, Lars J. R. 1977. Assignment report. FAO, Rome.

Ohlander, Lars J. R. 1980. Research on haricot bean (*Phaseolus vulgaris* L.) production in Ethiopia 1972-1976. Swedish University of Agricultural Sciences, Dept. of Plant Husbandry, Uppsala, Sweden.

Peter, C. W. and Hash, C. T. 1976. The Ethiopian pulses industry situation paper. EPID Publication No. 32. Addis Ababa, Ethiopia.

Rezene, Fesseahye and Mariam, Etagenehu G.1982. Preliminary report for the 1982-83 bean program on the crop loss assessment due to weed on haricot bean yields. Field Crops Dept., Lowland Pulse Research Team. Nazereth, Ethiopia.

Tsedeke, Abate. 1982. Preliminary progress report for the 1982-83 bean program on bean fly and African bollworm on haricot beans. Field Crops Dept., Lowland Pulse Research Team. Nazereth, Ethiopia.

Thodey, A. R. 1969. Marketing of cereals and pulses in Ethiopia. Report No. 16. Stanford Research Institute. Menlo Park, California.

Toborn, J. 1976. Production and marketing of pulses in Ethiopia. A baseline survey. EPID Publication No. 36. Addis Ababa, Ethiopia.

Westphal, E. 1974. Pulses in Ethiopia, their taxonomy and agricultural significance. Wageningen, the Netherlands. Centre for Agricultural Publishing and Documentation. Agricultural research reports, no. 815. 275p.

Westphal, E. 1975. Agricultural systems in Ethiopia. Wageningen, the Netherlands. Centre for Agricultural Publications and Documentation. Agricultural research reports, no. 826. 278p.

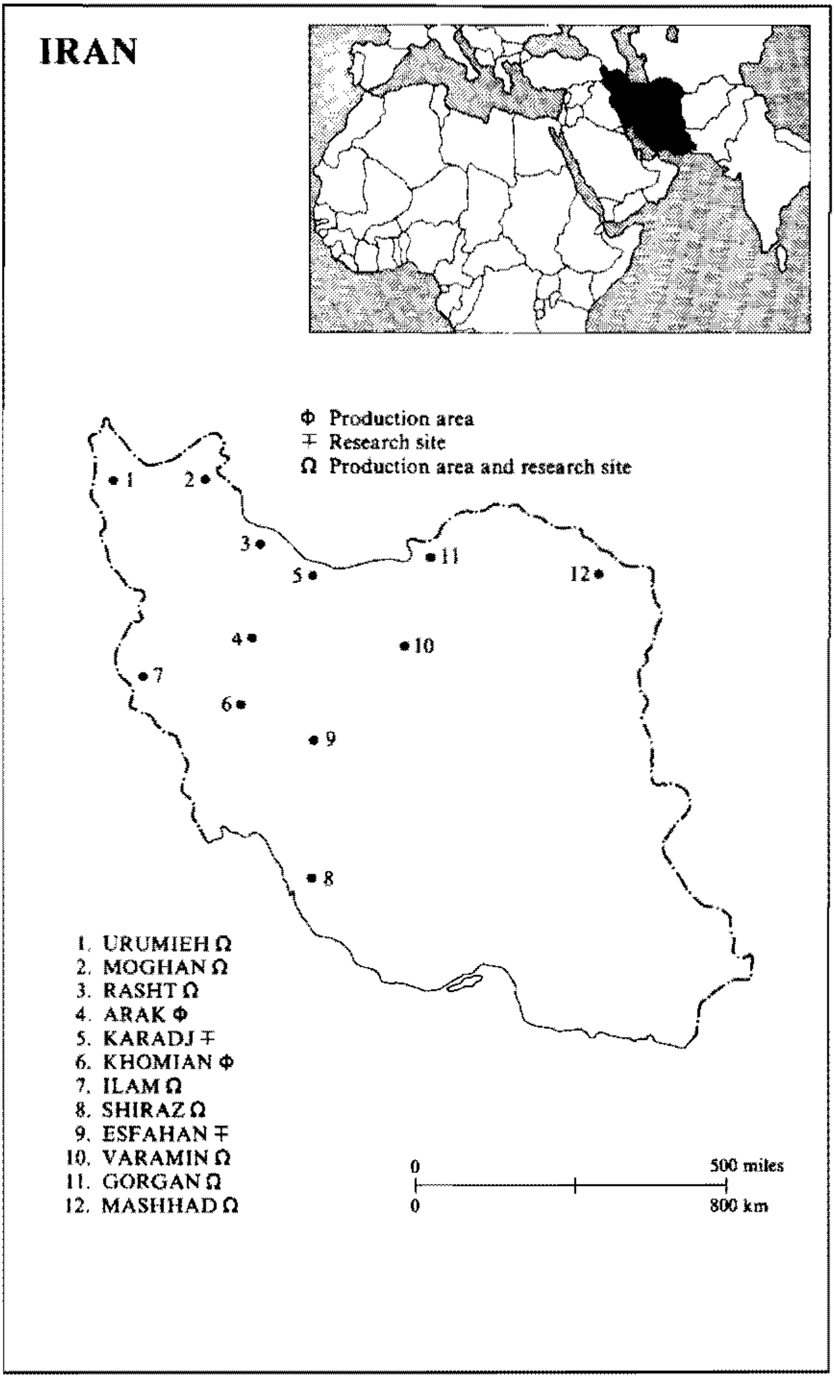


Figure 1. *Bean producing areas and research sites.*

Bean Production in Iran

B. Sadri

Introduction

Iran lies between 26° and 38°N latitudes and between 44° and 63°E longitudes (Figure 1). The total area of the country is about 165 million ha, of which about 20 million can be used for crop production. Iran has a wide range of climatic conditions, from cold and arid in the northern mountainous areas to hot and tropical in the south. Some 10 million ha of annual crops are grown every year, and food legumes account for about 200,000 ha of this area. The important crops in Iran and their area and production are given in Table 1.

Food Legumes

Food legumes (chickpeas, lentils, field beans, faba beans, cowpeas, and mung beans) are one of the main sources of vegetable protein in the diets of the majority of Iran's population, especially the rural people. The production of food legumes is about 200,000 t, with an average yield of 1 t/ha.

Lentils and chickpeas are the two most important food legume crops. They are grown mostly under rainfed conditions and are rotated with wheat or barley and a fallow period. Faba beans are grown mostly in the Caspian and Khuzestan areas. At the beginning of spring when they are

Table 1. **Area and production of important crops.**

Crop	Area (ha)	Production (t)
Wheat	6,000,000	5,000,000
Barley	1,200,000	900,000
Rice	318,000	919,000
Food legumes	200,000	200,000
Sugar beets	141,000	3,824,000

marketed, the green pods command a high price and the growers make a good profit. Mung beans are often grown as a second crop after cereals. Planting starts as soon as the cereal crops are harvested, that is, from early June to mid-July depending on the locality.

Cropping Systems

Field beans or dry beans are grown scattered throughout the country, usually on small farms, in plots ranging from 2000 to 5000 square meters. In some parts of Iran the farms are bigger and more specialized, with bean fields ranging from 1 to 5 ha. About 25% of the food legume area, or about 50,000 ha, is covered by field beans, all under irrigation. The average yield is about 1 t/ha.

The optimum sowing date is around the 10th of May in most of the cold areas and around the 10th of March in the warmer regions. The normal harvesting time in the warm regions starts the 1st of July and in cold areas it starts around 2 months later.

The cropping system in Iran is primarily monoculture. Field beans fit into a 2-year crop rotation with wheat or barley. After these cereals are harvested in the summer, the land is prepared for spring bean planting under irrigated conditions. Usually about 150 kg of diammonium phosphate/ha is added to the soil. The seed rate for beans is about 100 kg/ha. The extension service is responsible for distributing seeds among the farmers.

Three color types of field beans are common in Iran: white, red, and pinto. The weight per 100 seeds ranges from 13 to 30 g for white and red beans and from 18 to 45 g for pinto beans. Current prices for dry beans range from US $4 to 4.50/kg. No exports are made at the present time.

Production Constraints

Lack of adequate water and good soils are the two main natural constraints for agricultural production in Iran. Others are the lack of improved varieties, lack of disease resistance, (especially to root rots, *Fusarium* and *Pythium*, and possibly bean yellow mosaic virus), limited use of suitable production practices, lack of researchers in food legumes, lack of suitable machinery for planting and harvesting, and the absence of a seed production program.

Research Activities

The Food Legume Research Project was established at the Karaj College of Agriculture in 1965. This was a joint project between the

Ministry of Agriculture, the Plan and Budget Organization, the United States Department of Agriculture, and the College of Agriculture. During its 10 years of activity, a few improved varieties of food legumes were named and released. In the case of field beans, six varieties, all pure lines selected from locally collected mixtures, were released:

White beans: Marmar, Yas, and Sadaf
Red beans: Naz and Goli
Pinto beans: Shad

After the Islamic Revolution of Iran, the farmers became more eager to grow food legumes and looked for more improved seed. To meet their future needs, the government decided to establish the Food Legume Research Section at the Seed and Plant Improvement Institute. This research section is now in its fourth year, and since its establishment very good materials have been collected from the above-mentioned project, from different parts of the country, and from ICARDA (International Center for Agricultural Research in Dry Areas). Most of these materials have been tested in 20 different experiment stations throughout the country. Currently no crossing activities are done, but genetic improvement takes place through introduction and germplasm evaluation. The bean collection in Iran includes 3000 lines and varieties.

Future Plans

The first 5-year Development Plan of the Islamic Republic of Iran has been completed and will be put into effect next year. The policy of the government outlined in this development program is to lend support to the agricultural sector in order to attain self-sufficiency in most of the essential crops such as wheat, rice, food legumes, and forage crops. In the case of food legumes, the aim is to increase yield from 1 to 2 t/ha and also to increase the total cultivated area from 200,000 to 350,000 ha. At the present time the annual consumption of food legumes is about 6 kg/capita, and it is estimated that it will increase to about 8.5 kg/capita in a period of 10 years.

Publications

Kaiser, W. J., Danesh, D., Ockhovvat, M., and Mossahebi, Gh. 1972. Virus diseases of pulse crops in Iran. University of Tehran, Agriculture College. Karaj, Iran.

Moaddab, M. 1972. Classification of beans in Iran. University of Tehran, Agriculture College. Karaj, Iran.

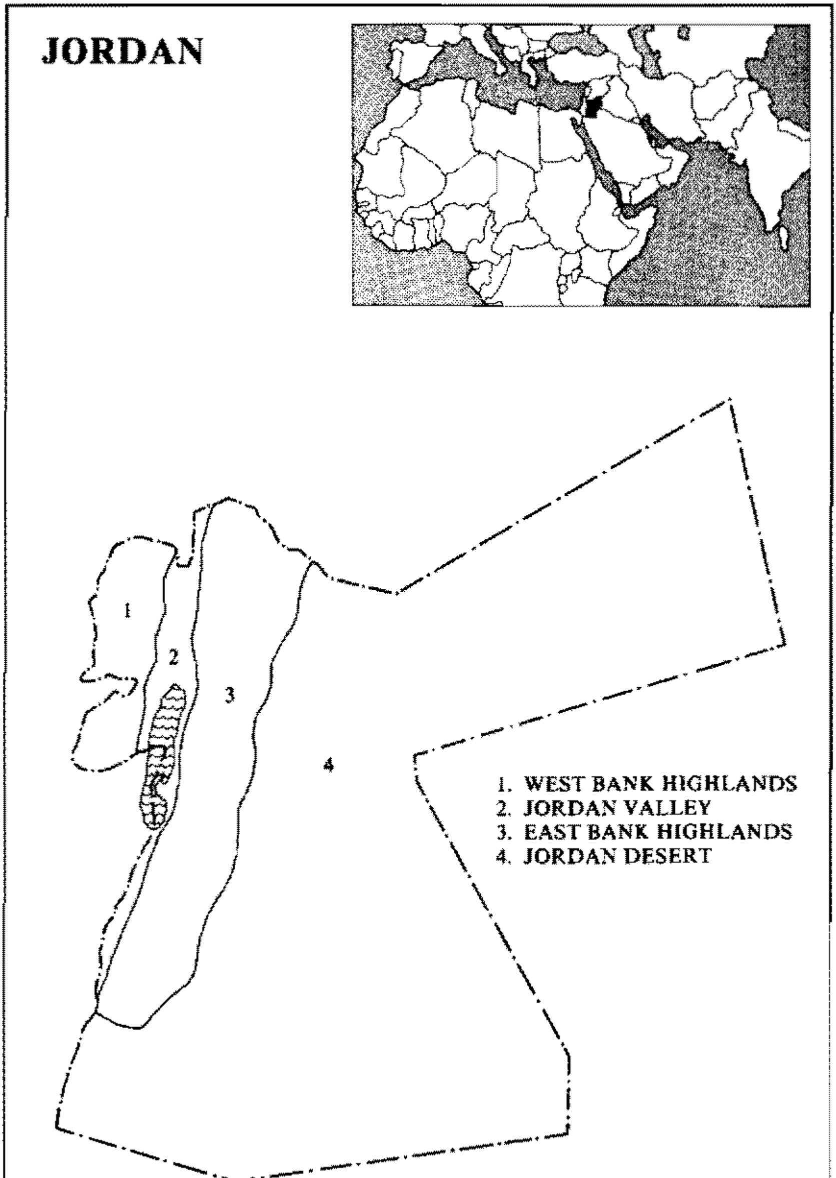


Figure 1. *Major natural regions.*

Bean Production in Jordan

Nasri I. Haddad

Importance

Dry beans (*Phaseolus vulgaris* L.) are consumed by a relatively small sector of the population of Jordan. The crop as dry beans is not grown in the country and is entirely imported. Imports of dry beans (medium to large white-seeded types) amounted to 1120 t in 1981 at a cost of about US $750,000. This quantity did not include beans entering the country through the UNRWA (United Nations Relief and Works Agency). However, field beans are widely consumed as fresh (green) pods and are planted in Jordan for that purpose using a variety called Belled.

This report will briefly describe the present status of fresh-pod bean production in Jordan, and the importance of introducing dry beans into the country.

Agro-ecological Zones

Jordan (Figure 1) has a mediterranean climate characterized by warm, dry summers and mild winters. The country is usually divided into three agro-ecological zones:

1. The highlands, with an annual rainfall between 300 and 700 mm, where rainfed crops such as wheat, barley, lentils, and olives are mainly grown.
2. The Jordan Valley, which receives about 250-360 mm of rain. This is the major area for irrigated crops, mainly vegetables.
3. The eastern desert, where rainfall seldom exceeds 100 mm.

Area, Production, and Yield

Area, production, and yield of fresh beans during the period 1971-1981 are presented in Table 1. The area planted to fresh beans increased three to

Table 1. **Area, production, and yield of fresh beans (1971-1981).**

Year	Area (000 ha)	Production (000 t)	Yield (kg/ha)
1971	20.0	132	6600
1972	14.0	156	11142
1973	23.8	158	6639
1974	13.9	114	8201
1975	22.9	182	7948
1976	42.3	209	4941
1977	35.4	279	7881
1978	30.5	169	5541
1979	89.3	636	7122
1980	94.8	818	8629
1981	58.3	426	7307

SOURCE: Department of Statistics, Amman, Jordan.

four times in the last 4 years. However, yields did not improve, mainly because little research has been done on this crop.

Cropping Systems

Bush beans are planted in limited areas whereas climbing beans are common in large areas. Fresh-pod beans are grown as a field crop in the Jordan Valley under irrigation. The crop is planted in furrows 60 cm apart; spacing between plants is 5 to 10 cm. There are two planting seasons: autumn sowing in October-November, and spring sowing in March-April. The spring planting is the most common and accounts for 70% of the cultivated area. Seeding rate varies and ranges from 25 to 45 kg/ha.

Two cultivars are widely grown: Astro and Wade. In the 1982 growing season 60 t of Astro seed and 30 t of Wade seed were imported by farmers.

Diseases

The major disease problem affecting this crop is fusarium root rot, *Fusarium solani* and *F. phaseoli*, which attack the seedling. The disease is more severe in the autumn sowing. There are other fungus diseases attacking the crop such as *Rhizoctonia solani*, anthrachnose, and rusts. Symptoms of bean yellow and bean common mosaic viruses also are frequently encountered. Farmers use fungicides for protection and apply nitrogen and phosphorus fertilizers, but there is no information about quantities used.

Research Activities

Little research attention has been given to this crop because of the small area it occupies. The Ministry of Agriculture did some research for varietal evaluation in the Jordan Valley which resulted in the identification of the two cultivars mentioned earlier. Recently some trials were conducted to evaluate growing fresh beans under plastic housing and using drip rigation. The following results were obtained:

Cultivar	Yield of fresh beans (kg/ha)
Lancer	69950
Wade	52000
Lamanalnean	31400
X P B 109	78600

Planting was done in September, 1980, and picking was started in mid-April and completed in mid-June, 1981.

Future Plans

There is a need for introducing a legume field crop into the Jordan Valley which would benefit crop rotation schemes, be fully mechanizable, and be capable of being stored.

The Faculty of Agriculture, through the Food Legume Project, started to work on soybeans as a possible crop for this purpose. However, utilization of soybeans for oil, food, or feed requires large investments which are not readily available. Therefore, dry beans seem to be a good candidate and should be promising under the Jordan Valley conditions. The crop is high-yielding, requires less labor, can be stored, and can be utilized directly. Research should be initiated to determine the feasibility of dry bean production in Jordan. As the whitefly is abundant in the Jordan Valley, bean virus diseases may become a problem when dry bean production increases.

Publications

Department of Statistics. Statistical yearbooks, 1971-1981. Amman, Jordan.

Ministry of Agriculture, Department of Agricultural Research and Extension. Annual reports 1979, 1980, and 1981. Amman, Jordan.

Qasem, Subhi. 1968. Diseases of vegetable crops in Jordan. Amman, Jordan

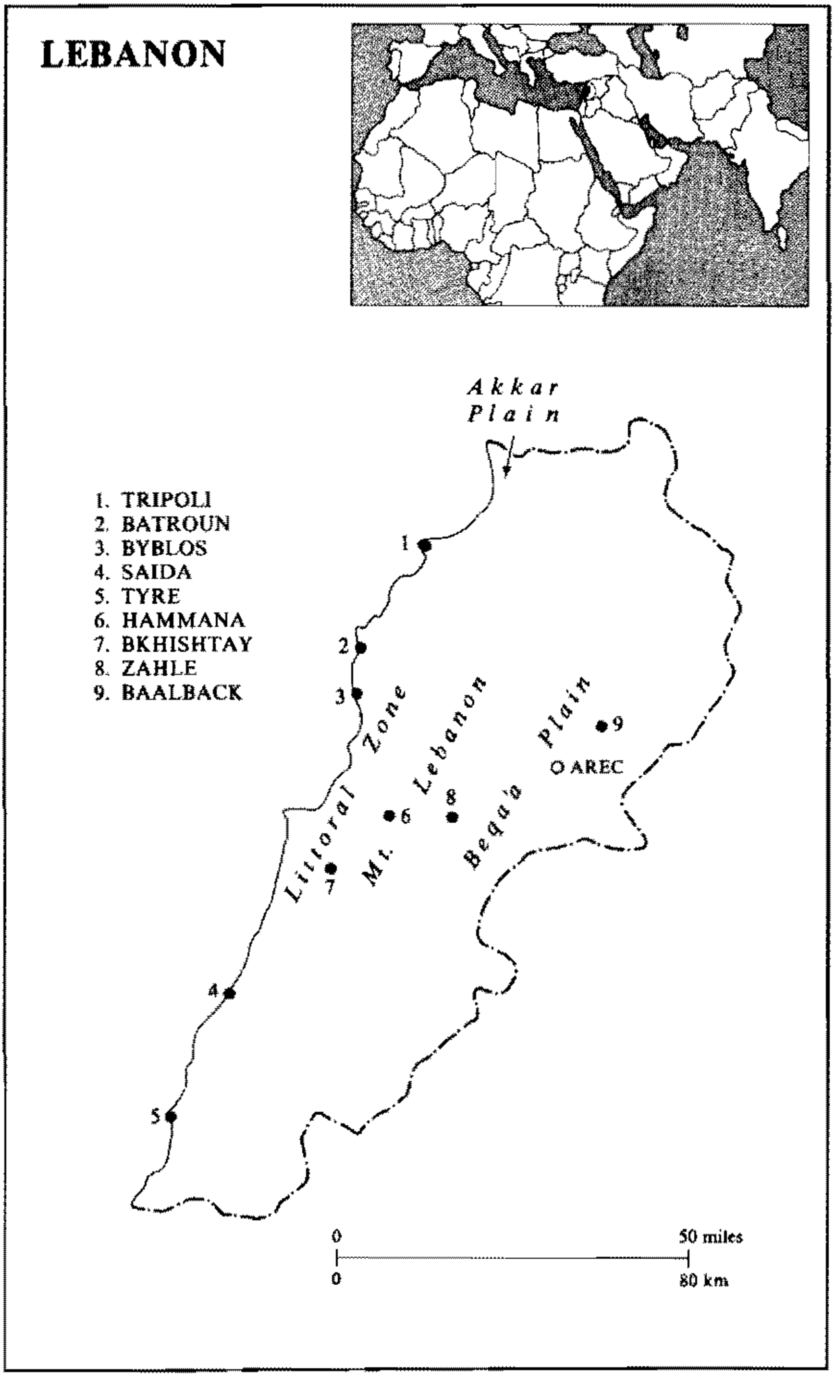


Figure 1. *Bean producing areas*

Bean Production in Lebanon

Mahmoud B. Solh

Importance

Legume crops in general play a minor role in the agriculture of Lebanon, when compared to the high-income fruit and vegetable crops. They occupy only 7000 ha, which is less than 4% of the land under crop production (ECWA/FAO, 1981). However, legume crops constitute an important portion of the daily diet. The domestic demand for any of the pulse crops listed in Table 1 is never met through local production. The self-sufficiency ratio for pulses was estimated at 47.6% in 1980 (ECWA/FAO, 1981). More than 70% (unofficial estimate) of the domestic consumption is provided by imports from South America and England.

Dry field beans (*Phaseolus vulgaris* L.) rank fourth among pulse crops in Lebanon (see Figure 1 and Table 1), after lentils, peas, and chickpeas. If fresh beans are included in the figures, *P. vulgaris* becomes even more important as a food legume.

Since 1974 there have been no official estimates of dry bean imports. But if production were considered to satisfy 30% of the domestic demand, then imports are probably about 2,300 t annually.

The price of dry beans ranges between US \$.60-1.00/kg; local beans are more expensive. Prices for green beans are between US \$.80-1.00 during the growing season, and as high as US \$3.00/kg during winter.

Agro-ecological Zones

Lebanon is the smallest country of western Asia with an area of 10,542 sq km. Out of 360,000 ha of arable land, less than 200,000 are put into production in an average year, and 87,000 are irrigated (ECWA/FAO, 1981). Climate ranges from semi-arid in the inland to sub-tropical across the coastal plains. Average rainfall varies from 250 to 1500 mm.

Table 1. Area, production, and yield of legume crops.

Crop	Scientific name	Area (ha)		Production (t)		Yield (t/ha)	
		1963-71[a]	1979-81[b]	1963-71[a]	1979-81[b]	1963-71[a]	1979-81[b]
Lentils	*Lens esculenta*	3067	4000	1232	3000[c]	0.40	0.75
Dry peas	*Pisum sativum*	161	2333	142	2000[c]	0.90	0.92
Chickpeas	*Cicer arietinum*	2769	100	1866	2000[c]	0.70	2.00
Dry field beans	*Phaseolus vulgaris*	908	455[c]	861	1000[c]	0.90	2.22
Faba beans	*Vicia faba*	572	300[c]	667	1000[c]	1.20	3.33*

SOURCES: a. Lahoud et al., 1978.
b. FAO, 1981.
c. Unofficial figure.
* This yield probably refers to fresh beans and not dry seed.

Precipitation is heaviest in the mountains, which may be covered with snow for 3-4 months of the year. Average daily temperature ranges from a minimum of -8° C in winter to a maximum of 36° C in the summer months.

Dry beans are produced mainly in the central and southern Beqa'a plain, the central part of Mount Lebanon (Hammana area), and the Akkar plain (Figure 1). Fresh beans are grown in these same areas, as well as in the littoral zone, where they are grown in summer and as an off-season crop in winter under plastic housing.

Cropping Systems

Beans are grown at elevations between 700 and 1600 masl as an irrigated spring crop. A rough seedbed is usually prepared using the primitive local plow or a tractor-driven 'Arabic' or 'Zahlé' plow. Planting is done in late April to early May when soil temperature is above 10° C. The seeds are hand-sown in rows 45-50 cm apart by dropping the seed behind the plow or by using a pointed tool. Intra-row spacing ranges between 15-25 cm. Fertilizer is seldom applied to the crop. Furrow irrigation is practiced at 1-to 3-week intervals depending on water availability.

All cultivars used are of the climbing growth habit, and they are usually staked with various types of trellis support, most commonly reeds. In certain villages the beans are allowed to twine around fences or trees. Harvesting is done exclusively by hand when about 80% of the pods turn yellow and start to dry. Plants are pulled, heaped, and then left for a few days to dry. Threshing is done by beating the dried plants with sticks after placing them either within jute sacks or on canvas. Plant residues are then removed by winnowing or sieving.

Fresh beans, grown under irrigation, are an important vegetable crop. They are planted by hand behind tractors in the coastal area throughout the year, and in early May in the Beqa'a plain and mountainous regions.

Almost all field bean production is done by small farmers on holdings averaging less than 2 ha. The produce is mainly consumed in rural areas.

Types

Seed characteristics of some dry beans grown and consumed in Lebanon are presented in Table 2. The bean seed types include white kidney, pinto, and cranberry, none of which is indigenous to Lebanon. There is a need to collect germplasm, although it is not expected to have much genetic diversity because of restricted seed movement and the limited environmental variation in the production areas. However, genetic variability does exist as indicated by the heterogeneity of the collected samples (Table 2).

Table 2. **Seed characteristics of some dry bean cultivars (1983).**

Entry number	Source	Seed lot variability	Seed color pattern	Seed color	Seed shape	Average wt/100 seeds (g)	Bean type
1	Bhamdoum market	Homogeneous	Solid	White	Elongated	52.4	White Kidney
2	Bhamdoum market	Heterogeneous	Mottled, some striped	Light brown to brown background; purple or dark red mottling, rarely black	Kidney	42.4	Cranberry
3	Faraya	Homogeneous	Solid	Light brown mainly, some buff	Oval	48.3	Cranberry
4	Faraya	Heterogenous	Mottled	Buff to light brown background; purple and dark red mottling	Kidney	36.9	Cranberry

5	Hasbayya	Homogeneous	Mottled	Buff background; purple and some dark red mottling	Oval	59.5	Cranberry
6	Hrajil	Highly heterogeneous	Mainly mottled, some striped	Light brown to buff background; mottling mainly purple, with some browns and black	Kidney	38.6	Cranberry
7	Beirut market	Heterogeneous	Solid	White	Elongated kidney and oval	30.6	Snouberieh (white, pine seed-shaped type)

SOURCE: Collected and compiled by the author.

Production Constraints

Production problems in field beans are similar to those encountered in other legume crops: poor cultural practices, low-yielding cultivars, and labor-intensive planting, harvesting, and threshing. Improvements in any of these production aspects should be mainly oriented towards small-size farming and should take into account the mountainous nature of bean growing areas.

Increases in yield may be achieved by adopting improved agronomic practices such as proper seedbed preparation, optimum seeding rate, adequate fertilization, and efficient pest management. Local cultivars are poor yielders and should be replaced by adapted cultivars with high-yield potential. Seed quality, particularly cooking characteristics, should be investigated. Introduction of bush types may have an important impact on the production of dry beans in the Beqa'a plain where relatively large-scale mechanization is possible. The bush types are expected to mature earlier than the climbing types, which usually mature late in the Beqa'a plain after the rainy season has started.

Diseases attacking field beans in Lebanon are presented in Table 3. However, none of these diseases appeared to be serious in the study made about 15 years ago. Assessment of disease losses has not been done since then. In a more recent work[1], several viruses have been isolated from

Table 3. **Fungal and viral diseases of *Phaseolus vulgaris* in Lebanon.**

Symptom	Pathogen	Location	Importance
Anthracnose	*Colletotrichum lindemuthianum*[a]	Littoral zone	Rare
Leaf spot	*Alternaria* spp.[a]	Bkhishtay	Very mild
	Alternaria tenuis[a]	Littoral zone	Minor importance
	Phyllosticta phaseoli[a]	Littoral zone	Not serious
Root rot	*Fusarium* spp.[a]	Littoral zone & Beqa'a plain	Minor importance
Mosaic	Bean yellow mosaic virus[b] (*Phaseolus* virus 2)	Littoral zone & Beqa'a plain	Moderate
	Bean common mosaic virus[b] (*Phaseolus* virus 1)	Littoral zone	Moderate

SOURCES: a. Saad, 1969.
b. Nienhaus, 1967.

1 Personal communication with Dr. K. Makkouk, virologist, working with the National Council for Scientific Research and the American University of Beirut.

leguminous and non-leguminous crops which were found to infect field beans under experimental conditions. These viruses are: bean yellow mosaic virus, bean common mosaic virus, zucchini yellow mosaic virus, and cucumber mosaic virus. The role of these and other viruses of common beans under natural infection in different locations in Lebanon is currently under study.

Some of the insect and mite pests observed in field beans (Kawar, 1979) include the bean aphid (*Aphid fabae*, Scop.), the bean fly (*Malanagromyza phaseoli*, Cog.), and the two-spotted spider mite (*Tetranychus urticae*, Kock.). A serious problem in stored seeds is caused by the bruchid beetles (*Callosobruchus* spp.). As in diseases, there is a need to evaluate the extent of damage caused by various insect and mite pests.

Research Activities

There are no national research programs on any of the legume crops grown in Lebanon, nor are there seed production organizations. Limited work is carried out on fresh and dry beans at the Agricultural Research and Educational Center (AREC) of the American University of Beirut.

Research is limited now to the evaluation in the Beqa'a Valley of introductions obtained from CIAT in 1981, and bulk populations obtained from the Bean Program of the University of California at Davis. The seed type of most of the introduced material did not appeal to the local consumer mainly because of color and small size. Future emphasis will be on introducing germplasm with seed characteristics similar to those of local cultivars. Because of financial constraints, it is unlikely that a hybridization program for the improvement of field beans will be established.

Publications

Economic Community of West Africa/Food and Agriculture Organization (ECWA/FAO). 1981. III Special review: Agricultural production and development in Lebanon. In: Agriculture & Development, 4:19-39.

Food and Agriculture Organization (FAO). 1981. FAO production yearbook, 35:120.

Kawar, N.S. 1979. Insect pests of food legumes in the Middle East. In: Food legume improvement and development. G.C. Hawtin and G.J. Chancellor (eds.). Proceedings of a workshop held at the University of Aleppo, Syria, 2-7 May 1978. International Center for Agricultural Research in Dry Areas (ICARDA), Syria, and International Development Research Centre (IDRC), Canada.

Lahoud, R., Mustafa, M., and Shehadeh, M. 1979. Food legume production and improvement in Lebanon. In: Food legume improvement and development. G.C. Hawtin and G.J. Chancellor (eds.). Proceedings of a workshop held at the University of Aleppo, Syria, 2-7 May 1978. International Center for Agricultural Research in Dry Areas (ICARDA), Syria, and International Development Research Centre (IDRC), Canada.

Nienhaus, F. and Saad, A.T. 1967. First report on plant virus diseases in Lebanon, Jordan and Syria. Z. Pflkrankh. PflPath. PflSchutz. 74:459-471.

Saad, A.T. and Nienhaus, F. 1969. Plant diseases in Lebanon. Z. Pflkrankh. PflPath. PflSchutz. 76:537-551.

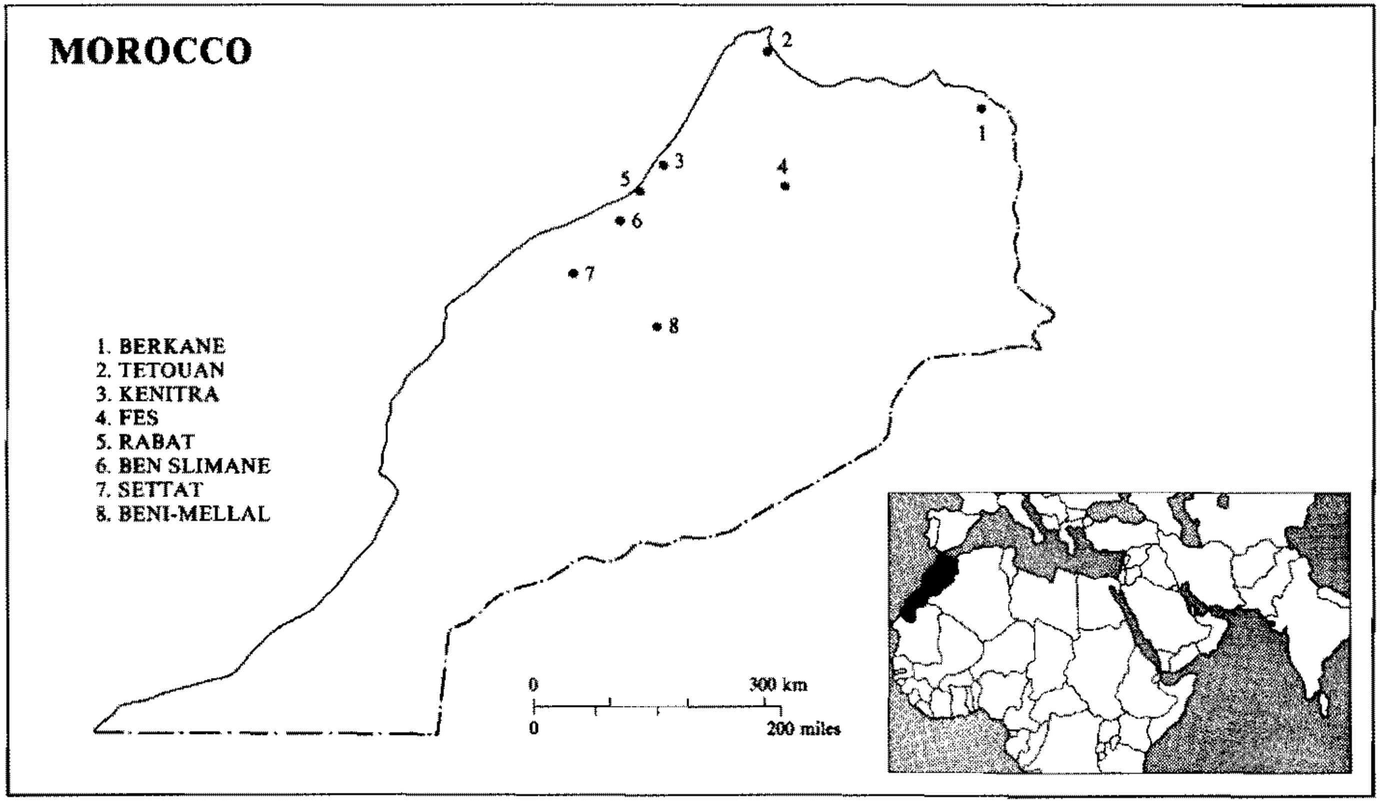


Figure 1. *Bean producing areas.*

Bean Production in Morocco

Sakr Bouazza

Importance, Distribution, and Production

The area in food legumes in Morocco is about 550,000 ha yearly. The main pulse species are: broad beans (*Vicia faba*), peas (*Pisum sativum*), chickpeas (*Cicer arietinum*), lentils (*Lens esculenta*), field beans (*Phaseolus vulgaris*), peanuts (*Arachis hypogea*), and cowpeas (*Vigna unguiculata*).

Field beans, with approximately 7000 ha in cultivation, are one of the least important legumes in Morocco. (For regional map, see Figure 1.) The major part (80%) of this crop is harvested as fresh beans, which are cultivated for either export or for local consumption (Table 1). Depending on their use, field beans are produced during either of two growing periods:

1. The main growing season (March to May), when beans are produced for local consumption (both dry and fresh) and for export as dry seeds. The main production regions are located in the north of the country where the rainfall is higher (Tetouan, Gharb), while in the south the crop has to be irrigated (Beni-Mellal).
2. The off-season production (October to January), when beans are mainly produced in the Rabat region for export as fresh beans.

Production Constraints

The national mean yield is low: 600 kg/ha for dry beans and 7000 kg/ha for fresh beans. This low yield is due to many factors, described below.

- Since beans are mainly cultivated under field conditions and are susceptible to climatic extremes such as frost and heat, bean production areas and seasons are limited.
- Of the many diseases and pests which attack beans, bean common mosaic virus (BCMV) causes the highest damage and can eliminate

Table 1. **Fresh bean area, yield, production, and export.**

Years	1978-79		1979-80		1980-81	
	(a)	(b)	(a)	(b)	(a)	(b)
Area (ha)	305	7176	351	-	378	1375
Yield (kg/ha)	*	4000	*	-	*	10000
Production (t)	2440	28590	2800	-	3096	14772
Export (t)	2440	-	2800	-	3096	-

a. Off-season cultivation regions: Skhirat and Témara.
b. Season cultivation regions: Loukkos, Berkane, Kenitra, and Beni-Mellal.
* Mean yield over 6 years is about 9000 kg/ha.

SOURCE: DAE, Service des cultures maraichaires, MARA.

the entire crop, especially because it is transmitted by the seed. Other diseases noticed on this crop in Morocco are rust and the peanut stunt virus. The latter can cause considerable damage but its importance in the country is localized.

- Manpower needs and water supply are other factors limiting field bean production.
- Varietal adaptation, yield potential, and pod quality are low and reduce export possibilities.
- Finally, the lack of an applied research program and extension activities limit the potential of this legume.

Research Activities

Germplasm collection

Current bean research is carried out by one scientist who is also responsible for other legumes. The field bean research program in Morocco started a long time ago. The first stage was to form the germplasm collection from local varieties and from introduced cultivars, followed by selection from local and introduced populations. The collection has at present 315 entries, all evaluated for their agronomical and phenological characters (Table 2). They were also classified according to their purpose as dry or green beans.

The first preliminary screening nursery for rust resistance comprised 116 cultivars (Table 3). Following preliminary evaluation, promising entries are tested for several years in yield trials to determine adaptation and yield

Table 2. **Range of variability in germplasm collection of bean cultivars.**

Characters	Samples (no.)	Mean	Range
Pod			
Length (cm)	1770	10.6	4.4-24.5
Plant			
Height (cm)	760	29.6	12.0-73.7
Length of stem until first pod (cm)	282	13.3	5.8-26.7
Phenological			
Days to emergence	1336	12	8-23
% of emergence	1325	79.5	10.0-100
Days to first trifoliate emission	1383	26.0	17-60
Days to first flower	2712	53.5	78-103
Days to end of flowering	2302	74.06	58-133
Days to fresh pod maturity	3566	67.28	53-108
Days to complete maturity	2226	104.31	75-148
Yield components			
Total branches/plant	691	4.8	1.9-10.9
Pods/plant	1830	9.44	0.3-51.8
Seeds/pod	968	4.1	1.6 - 7.2
100 seeds weight (g)	2547	34.7	11.0-68.0
Yield (kg/ha)	3937	570	20-2820

Table 3. **Preliminary screening for rust resistance in 116 bean cultivars.**

Cultivar types	Damage scale*					Total	Promising accessions
	1	3	5	7	9		
Fresh bean	0	4	23	11	1	39	Phv 371, 372 Phv H. 130 C6 Phv H. 230
Dry bean	4	16	30	25	2	77	Phv 307, 308 Phv V 140, 168, 268, 270, 241, 273, 188, 269, 244, 272, 191, 245

* 1 = resistant; 9 = susceptible.

potential in different locations. Table 4 shows some results of those yield trials.

Objectives of current research

Research objectives for this crop are detailed in the "Plan Directeur" of INRA. The most important of these research objectives is breeding,

Table 4. **Yield trial results in Oualidia (1981).**

Dry beans		Fresh beans	
Variety	Yield (kg/ha)	Variety	Yield (t/ha)
Phv 110	1190	Phv 122	23.60
Phv 116	1500	Phv 233	34.60
Phv 160	1680	Phv 247	27.60
III HI BR	1140	Phv 334	39.20
Phv H 161	2600	Phv 347	27.20
Phv 188	1660	Phv 376	22.20
Phv 216	2240	Phv 205	30.20
Phv 223	2500	Phv 209	29.40
Phv 232	1740	Phv 214	29.20
Phv 243	1600	Phv 218	30.80
Phv 246	1060	Phv 181	38.00
Mean	1760	Mean	30.0
LSD (5%)	840	LSD (5%)	6.8
CV (%)	23	CV (%)	25

although emphasis will remain on germplasm introduction. The following research activities are planned:

Breeding

- Improvement of yield potential and varietal stability through wide adaptation
- Development of disease-resistant varieties
- Development of mechanically-harvestable cultivars
- Improvement in the quality of green beans

Agronomy

- Determination of the place of beans in various Moroccan crop rotation systems
- Development of optimal cultural practices

Pathology and entomology

- Identification of the most important pests and diseases
- Development of efficient control measures for the important pests and diseases
- Weed control practices

In order to obtain maximum results from all the above-mentioned research activities, coordination between research disciplines is imperative.

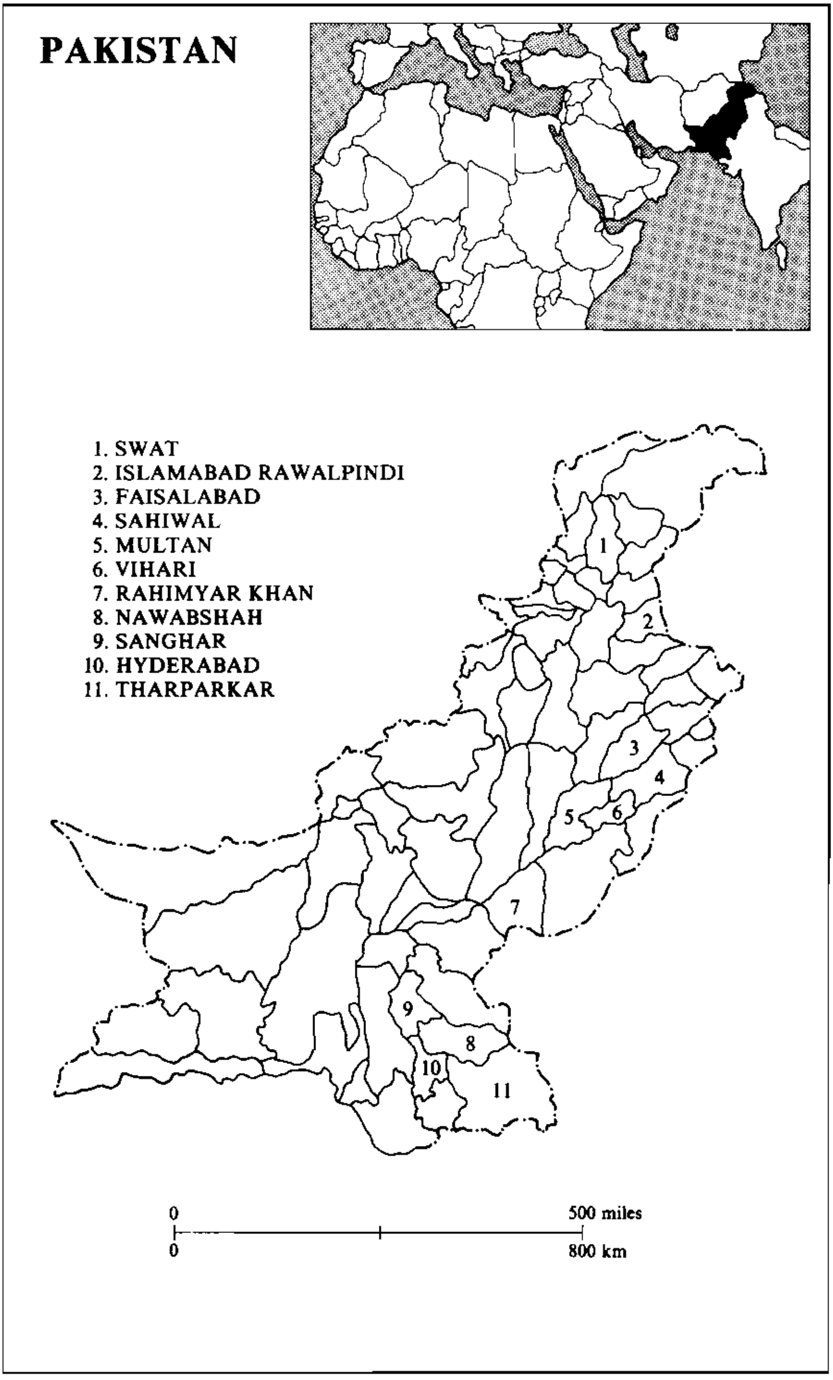


Figure 1. *Potential bean production areas, subject to appropriate genotypes.*

Bean Production in Pakistan

B. A. Malik
M. Tufail

Importance

The major food legumes (pulses) grown in Pakistan include chickpea (*Cicer arietinum*), lentil (*Lens esculenta*), vetchling (*Lathyrus sativus*), mung bean (*Vigna radiata*), and black gram (*Vigna mungo*). The first three are grown in winter either on residual moisture after rice or as rainfed crops. The area grown under irrigated conditions is negligible. Mung bean and black gram are mostly grown in summer as rainfed crops.

The minor pulse crops grown in summer have been grouped as miscellaneous summer pulses. These include moth bean (*Vigna aconitifolia*), pigeon pea (*Cajanus cajan*), field beans (*Phaseolus vulgaris*), and cowpeas (*Vigna unguiculata*).

Potential areas for the expansion of field beans are shown in the regional map of Figure 1.

Area, Production, and Yield

Some figures on area, production, and yield of pulses in Pakistan from 1965 through 1980 are given in Table 1. The area under chickpea increased by about 10% during 1976-1980 but productivity fell from 544 kg/ha to 484 kg/ha due to blight damage in 1980. Production of lentil and black gram increased due to increased area. Mung bean production remained stagnant, and production of *Lathyrus* and other pulses declined in 1976-1980. The population of Pakistan has been continuously increasing, hence per capita availability of pulses has declined.

Phaseolus vulgaris currently is not a major pulse crop in Pakistan. Area and production estimates are not recorded separately in the official record. Based on the authors' personal contact with the revenue department and

Table 1. **Area, production, and yield of major and minor pulses (1965-1980).**

	1965-1970 Mean/Year			1971-1975 Mean/Year			1976-1980 Mean/Year		
Crop	Area (000 ha)	Production (000 t)	Yield (kg/ha)	Area (000 ha)	Production (000 t)	Yield (kg/ha)	Area (000 ha)	Production (000 t)	Yield (kg/ha)
Chickpea	1064	538	507	1000	544	544	1123	543	484
Lentil	71	24	341	75	26	350	87	34	390
Mung bean	70	30	424	67	32	461	67	31	465
Black gram	35	17	470	42	21	498	55	28	510
Lathyrus sativus	216	97	452	184	83	452	174	78	448
Other pulses	57	25	443	53	25	471	33	16	500

SOURCE: Agricultural Statistics of Pakistan, 1980.

Table 2. **Approximate area and production of minor pulses in Pakistan (1980).**

Crop	Area (000 ha)	Production (000 t)
Moth bean (*Vigna aconitifolia*)	8	4
Field bean (*Phaseolus vulgaris*)	16	9
Pigeon pea (*Cajanus cajan*)	3	2
Cowpea (*Vigna unguiculata*)	2	1
Total	29	16

SOURCE: Authors' estimation. No figures available from Agricultural Statistics of Pakistan.

their experience, the area and production of beans were estimated for 1980 at 9000 t produced on about 16,000 ha (Table 2).

Types, Diseases, and Use

Beans in Pakistan are the climbing type, grown mostly by small farmers who plant them with maize and sorghum. The landraces grown are of two seed types: the big reddish seed and the small-to-medium white seed. Bean diseases and pests include mosaic viruses, cercospora leaf spot, and pod-boring insects.

The harvest is used by the population partly as green pods and partly as a dry pulse.

Production Constraints

The pulse yields from farmers' fields are low and highly unstable. The causes are many, but some prominent ones are as follows:

- High-yielding, disease-resistant cultivars are lacking. As a result, farmers are still planting landraces;
- Lack of appropriate production technology; thus, the yield per unit area remains stagnant (Table 1);
- Lack of trained manpower and necessary literature.

A particular production constraint for *P. vulgaris* is its price. It brings a comparatively lower price than chickpea, lentil, mung bean, and mash, primarily because it is not used as much.

Need for Pulse Diversification

Pakistan is greatly dependent on only one pulse species, chickpea, to meet the population's requirements. This dependence led to a pulse crisis in the country when the chickpea crop was devastated by chickpea blight (*Ascochyta rabiei*) for 3 consecutive years (1980-1982). The production of about 600,000 t dropped to about 269,000 t during 1981-1982. Prices in the local market rose from US $.50 to US $1.50 per kg. To overcome the shortage, the government had to spend US $50 million in foreign exchange money on the importation of pulses, mainly chickpeas, mung beans, mash, and lentils. A negligible quantity of field beans was imported.

To avoid such situations in the future, various steps are being taken to diversify production, such as introducing and testing nontraditional food legumes. Developing resistant cultivars of the conventional pulses is another alternative.

Research Activities

Activities to diversify and strengthen the country's pulse crop are aided by the National Agricultural Research Centre, Islamabad, which has a Plant Genetic Resources Unit. This unit has a gene bank and cooperates with the breeders of various crop commodities. Seed for new crop varieties is produced by seed corporations, and extension services also assist in introducing and growing new varieties.

A national program to improve and increase pulse production (Cooperative Research on Food Legumes Improvement in Pakistan) was begun in July, 1980. The program has six coordinating units spread over the country, with a principal investigator leading each unit. The objectives of the program are to:

- Breed and select for high yield and yield stability, and resistance to diseases including *Ascochyta rabiei* and *Fusarium* wilt in chickpeas, yellow mosaic virus in mung beans, and rust in lentils.
- Screen and evaluate pulse germplasm for high yield and other economically important characteristics.
- Develop and standardize production technology suitable for rainfed and irrigated conditions, with special emphasis on small farms, in different agro-ecological zones.
- Develop various cropping systems with legumes, such as mixed cropping, intercropping, and sequential cropping.
- Conduct economic evaluations of farm trials, and surveys of pulse marketing and use for comparison with other major food crops.
- Strengthen the national pulse program through local and regional training of research staff.

Potential for Field Beans

Among the new pulse species being investigated, there is good potential and feasibility for *Phaseolus vulgaris* in Pakistan in view of the suitable environments and ample availability of irrigation water. Potential production sites are the irrigated areas of Punjab and Sind and the high rainfall areas of Northern Punjab and the North Western Frontier Province. The new crop would not compete with or replace existing ones. It would be mainly intercropped with maize, which is grown on about 700,000 ha, or planted on fallow lands. Intercropping with sugar cane grown on 800,000 ha may also have promise. In this case planting would be in February-March.

Collection of bean germplasm and its evaluation under local conditions may provide suitable material to use directly as varieties, in addition to the material being tested from CIAT.

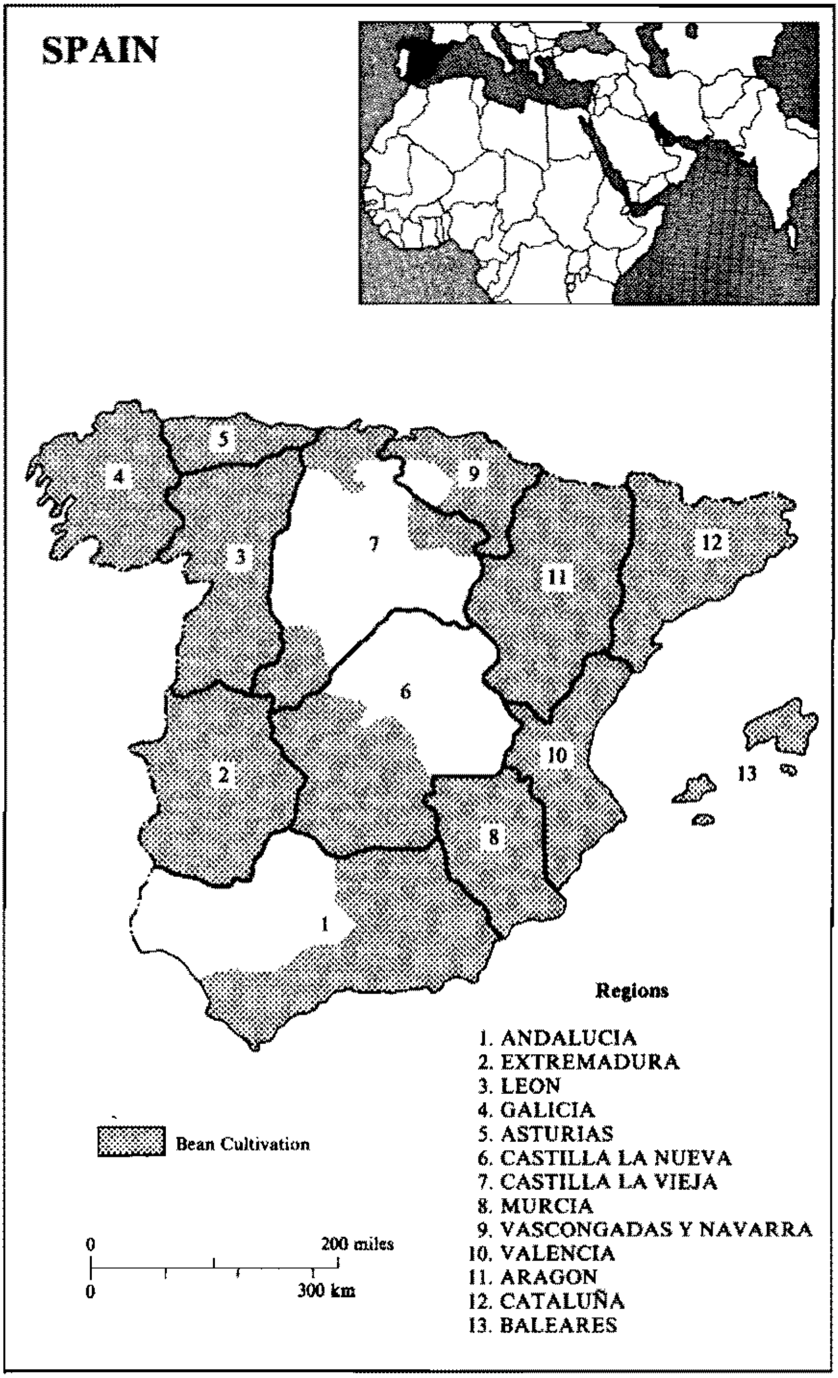


Figure 1. *Bean producing areas.*

Bean Production in Spain

María-Teresa Moreno
Amparo Martínez
José I. Cubero

Origins

Common beans, as well as many other crops, were brought to Spain (Figure 1) from America, probably soon after its discovery. Precise records of their arrival are difficult to find because they gradually mixed with the cultivated *Phaseoleae* of the Old World, which are classified now as *Vigna* and *Dolichos* genera. Farmers and agronomists saw the many similarities but did not pay much attention to the differences, and confusion still exists in botanical descriptions today. The mixing was so perfect that even De Candolle, the 19th century botanist who studied the origins of beans extensively, found it difficult to trace several of the *Phaseoleae*.

Thus, "common beans" received the same names given to the Old World beans, including faba beans and other pulses. This fact, plus the great number and variety of names, results in much confusing terminology.

A fairly complete list of names given to common beans in Spain follows. Many of these are also applied to other pulses. Names in general use are underlined. ("Frijol" is now restricted to a few regions, but it was in general use when America was discovered. It was the name given by Columbus to the first American beans he saw.)

> Alubia (for dry beans), bachoca, bachoqueta, bajoca, caparrón (for dry beans), caragilate, de "careta," chícharo (for dry beans), fasol, faséolo, frejol, feine, fejón, figüelo, fraijón, fregol, frejol, fresol, fríjol, frijón, frísol, frisol, haba blanca, habichuela (for green pods), judía (both dry and green products), judiera, judihuela, judihuelo, judión (for big-seeded varieties), mochetas (for dry seeds), pochas (in La Rioja for dry but not yet desiccated seeds), serugas. All these are (or were) Castillian names.
>
> In Galician and Portuguese: faba, feijao, feijoeiro, feixoeiro. In

Catalan: fesal, fesolera, mongetera, mongeta. In Basque: baba, illár, maikol, beberrum, potxa.

The large quantity of names indicates the popularity of this crop in Spain. Some 19th century authors wrote that common beans "occupy the first rank among the legumes in the same way that wheat does among cereals." Authors from the 18th and 19th centuries all mentioned the great variation found in this crop.

Economic Importance, Yield Trends, and Consumption Patterns

The area, production, and economic value of dry and green beans during the last 2 years is shown in Table 1. Similar information is given in Table 2 for dry beans alone from 1978 through 1982. The total economic value of dry beans, according to these tables, is not very high, but neither is it negligible. Spain imports 10% of its needs in dry beans, which indicates a demand that may lead to more cultivated area in the future.

The total area devoted to food legumes ranges from 500,000 to 600,000 ha (over 10% of the total horticultural area), with a production over 400,000 t. Of that production, 10% is canned or frozen, and 15% is exported as a fresh product. The same pattern applies to green beans: 10%

Table 1. **Area, production, and value of dry and green beans (1981 and 1982).**

Year	Use	Area (000 ha)	Production (000 t)	Value (millions $US)	$US /kg	Exports/Imports (000 t)
1981	Dry	129	78	3.43	.43	2.4 8.9
	Green	26	229	13.80	.60	19.3
1982*	Dry	126	76	5.37	.70	Unknown
	Green	25	235	23.33	1.00	Unknown

* Estimated

Table 2. **Area, production, and value of dry beans (1978-1982).**

Year	Area (000 ha)	Production (000 t)	Value (millions $US)	$US/kg
1978	150	98	4.64	.47
1979	142	100	3.56	.35
1980	132	81	3.26	.41
1981	129	78	3.43	.43
1982	126	76	5.37	.70

is canned or frozen, a portion of which (15%) is exported; another 10% of the total green pods harvested is exported for fresh consumption. The countries importing fresh pods are France, West Germany, Great Britain, and Switzerland. Denmark, France, and Libia import canned or frozen products. About three-quarters of the fresh export are round-podded varieties, and one-quarter are flat-podded ones.

The relative importance of common beans in comparison with other food legumes is given in Table 3. For the last 50 years common beans (both dry and green) have been the most important legume in Spain. However, the cultivated area in dry beans has been steadily decreasing, as is the case for most other food legumes as well. Yields have remained fairly low and traditional cultural practices have not changed much. On the other hand, an increasing demand for fresh beans has resulted in more area being planted in them, increasing yields, and improved fresh bean production practices. Table 4 shows some trends of food legume production in Spain.

Although the area in dry beans, as well as that in most other legumes, has decreased, the demand for some of those used for human consumption (green beans, chickpeas, and lentils) has increased, and market prices have risen greatly. Depending on quality and markets, chickpeas can sell for up to 300 pesetas*/kg, lentils for 250, and common beans for 700-800. It is paradoxical that the cultivated area is decreasing while large imports are being made (very large for chickpeas) and market prices are increasing. This situation could be the result of several factors, such as political decisions (importations in exchange for other products, price stability, etc.) and sociological factors (migration to the cities, for example).

Table 3. **Food legumes in Spain (1981).**

Food legumes	Area (000 ha)	Yield (kg/ha)	Production (000 t)	Exports (000 t)	Imports (000 t)
Dry beans	128.5	610	78.1	2.364	8.872
Green beans	25.6	8950	228.6	19.279	-
Dry peas	4.8	750	3.6	-	1.887
Green peas	10.0	4640	46.3	2.112	107
Chickpeas	83.5	400	33.2	388	43.204
Dry faba beans	64.5	740	47.5	164	1.020
Green faba beans	14.5	7850	113.9	4.058	-
Lentils	70.5	310	21.7	3.855	29.483
Total pulses	528	817	432	-	-

* 150 pesetas (pta) = US $1.00.

Table 4. **Trend of food legume production in Spain.**

Years	1925-1930			1977-1981		
Crop	Area (000 ha)	Production (000 t)	Yield (t/ha)	Area (000 ha)	Production (000 t)	Yield (t/ha)
Peas (dry)	61.8	40.8	0.66	5.7	5.0	0.88
Peas (green)	0.9	2.5	2.70	10.8	50.3	4.68
Beans (dry)	284.1	174.1	0.62	141.8	85.3	0.60
Beans (green)	5.6	47.0	8.43	24.7	244.4	9.07
Faba (dry)	207.2	189.2	0.92	86.4	86.6	0.99
Faba (green)	1.1	5.8	5.13	14.6	122.3	8.37
Lentils	31.2	23.8	0.75	71.7	49.4	0.69
Chickpeas	231.6	126.1	0.54	98.0	57.1	0.53
Almortas	34.3	19.2	0.56	1.6	1.1	0.68
Lupinus	16.5	11.2	0.68	2.3	1.2	0.51
Algarrobas	201.5	122.5	0.61	20.3	12.7	0.62
Yeros	76.0	61.9	0.83	51.0	41.4	0.80

The change observed during the present century is not only quantitative but also qualitative. It seems that common beans were grown in western Andalucía and other southern provinces some 60 years ago (much more than in the north, according to statistics) but the scarcity of this crop in these regions now is very pronounced.

The most important dry seed regions are listed in Table 5. This table includes not only the regions with the highest production but also some small provinces where the quality of the product is excellent, with well-known seeds and/or dishes appreciated all over Spain. The most appreciated seeds come from Grado (Asturias), La Bañeza (León), Barco de Avila (Avila), and Logroño (La Rioja). Table 6 shows similar data for green beans. Note the large area under plastic housing in Almería (eastern Andalucía).

Table 5. **Most important regions for dry bean production (1983).**

	Area (ha)		Yield (kg/ha)		Production
Regions	Rainfed	Irrig.	Rainfed	Irrig.	Total (t)
Galicia	69,930	11,467	219	306	18,836
Asturias	6,518	120	306	483	2,053
León	20	17,980	1,195	1,695	30,500
Levante	268	600	593	1,788	1,231
Avila	-	1,093	-	800	874
La Rioja	5	411	600	1,250	517

Table 6. **Most important regions for green bean production (1983).**

Regions	Area (ha)	Protected (ha)	Open (ha)	Production (t)
Almeria	5,000	1,800	3,200	50,000
Castellón	2,660	280	2,480	30,534
Málaga	2,346	476	1,870	19,720
Granada	2,320	165	2,155	18,000
Barcelona	900	10	890	10,530
Valencia	1,154	4	1,148	8,215
Tarragona	784	-	784	7,738
Baleares	291	-	291	5,402

Both fresh and dry products are popular in Spanish cooking. Dry seeds generally are boiled with meat, lard, and other food and seasoned in different ways. Green pods are boiled and eaten alone or mixed with other vegetables and seasoned with oil, vinegar, and salt, or also cooked with potatoes and meat. Consumers demand a high quality product both for seeds and green pods, which explains the high prices paid for products from certain zones.

Bean Types

Green beans

The main characteristics used to differentiate varieties are pod color (white, green, marbled), pod section (round, flat), seed color (varied), and growth habit (dwarf, climbing). Fiber content is also important for industrial purposes.

The main cultivars are:

White yellowish pods (mainly for export)

- Dwarf: Finder, Mantecosa de Rocquencourt
- Climbing: Cascada, Oro del Rin

Green pods

- Dwarf, round-podded: Kora (very well-known because of its mechanical harvesting possibilities; probably the most widely-sown variety in large-scale cultivation); Astro (fresh and industrial use); Gitana (canning).
- Dwarf, flat-podded: Garrafal. This name is used for a set of varieties or populations very much appreciated for fresh con-

sumption. Many commercial cultivars have been selected from these landraces. They are not used for industrial processing because of their sickle-shaped pods.

- Climbing, round-podded: Stringless Blue Lake, Perfection.
- Climbing, flat-podded: Garrafal Oro de Enrame (for fresh consumption), Peronas, Zondra (mainly for culture under plastic housing).

Marbled pods

- Coco de Praga, Lengua de Fuego (white and purple, climbing), Obelisco (green and purple).

In addition to these and other similar cultivars, there are many landraces, mainly (but not exclusively) in the north (Galicia, Asturias, Basque country, La Rioja). These are cultivated in small vegetable gardens, very frequently for domestic consumption or for the local market.

Dry seeds

As shown in Table 4, cultivation of common beans for dry seeds has been drastically reduced; the area sown during the period 1977 to 1981 is half of that sown from 1925 to 1930. An important loss of landraces is likely to have occurred. Probably they will be reduced to those fitting consumer quality requirements. In the same way, the total sown area is being restricted to the best zones.

In the late 1950's, J. Puerta collected and described about 300 landraces of common beans (Puerta, 1961). Almost 60% were being used for dry seeds. Probably many of them have been lost during the last 2 decades. The most important varieties in three zones known for their high quality are mentioned below. There are other landraces used for dry seeds, mainly in the humid areas, but they are of minor importance and only consumed in local markets.

1. El Barco de Avila

Riojana: White, large kidney-shaped seeds. Sown area is being reduced because of the crop's susceptibility to *Fusarium*. In spite of that, it is very appreciated. Yields from 1.2 to 1.4 t/ha. Farm price (October 1982): 120-150 pta/kg.

Garbancera: the most common; white rounded seed; yields from 0.8 to 1 t/ha; price: 90-100 pta/kg.

Arrocina: White, very small; sown in a small area, but of high quality.

Canellini: White; quality not as good as the other three but resistant to *Fusarium*; its name is Italian, but its origin is unknown.

Others: Fabes (large seeds), Frejón negro (black), Planchetas (flattened), Riñón (kidney-shaped), Blancas redondas (white rounded), Morada (deep red, different shapes).

2. Grado (Asturias). A huge variation is found because beans are produced for domestic consumption. White, large-seeded, high-quality beans predominate. They are sown in small plots and yield from 1 to 1.5 t/ha. The farmer receives 400-500 pta/kg.

Amarilla or chichos: Yellowish, good-quality seed.

Granja. White, elongated, large seeds; it is a climbing variety used for the "fabada" dish.

Panchina: Also a climbing variety; white rounded seeds; generally intercropped with maize.

Negritos or moritos: Dwarf, very early plant of good quality; generally consumed mixed with rice.

3. La Bañeza (León)

Riñón: The most typical and the best in quality, but very susceptible to *Fusarium*.

Canellini: See above. In this zone it is believed to come from Argentina.

Others: Redonda blanca (white rounded seeds), Pinta (marbled seeds), Plancheta (flattened seeds), Palmeña (red and beige seeds).

Other beans sown in Spain

Of much lesser importance but still sown in Spain are cowpeas (Spanish names: caragilata, mongetas, josefitas); lima beans, mainly on the eastern coast (Spanish names: gorrofó, judía, judía de manteca); and runner or scarlet beans, mainly in El Barco de Avila (Spanish names: judía pinta, judía roja o escarlata, bolillos, rodones). Most of these Spanish names are also applied to common beans.

Cropping Systems

Green beans

As a horticultural crop beans prefer well-drained, light or medium soils, with a pH of 7 or slightly below. In chalky soils on the eastern coast (Valencia) Mg, Mn, and Zn deficiency is frequently observed. Low temperatures delay germination and favor attack of the *Phorbia platura* fly.

Fertilizers used vary from region to region. In Valencia, current amounts are 50-69 kg/ha of P_2O_5, 125-150 of K_2O, and 50-60 of N (amonitrates as "starter"). If possible, these quantities are supplemented with 15-20 t/ha of manure. All these products are incorporated into the soil before sowing. For climbing varieties, some nitrogen and potassium are applied fractionally after germination.

Seeds are sown on flat soils or in furrows. Dwarf varieties are sown 50 cm between rows, and climbing ones 70-80 cm; three to five seeds are placed every 25 cm. The seed rate ranges from 120 kg/ha (climbing) to 160 kg/ha (dwarf).

Sowing and harvesting dates depend on the vegetative cycle of the variety, as follows:

Extra-early: Sowing in December-January under plastic or glass housing; harvesting in March (Almería and Málaga).

Early: Sowing in mid-February to mid-March; harvesting in May (Valencia). Mulching may be used.

Normal: Sowing in April; harvesting in late June.

Late: Sowing in mid-July to mid-August; harvesting in mid-September to even November, depending on environmental conditions.

Extra-late: Sowing in September to mid-October under glass or plastic housing; harvesting in early December (Almería and Málaga).

The soil is deeply plowed and then rototilled to prepare for sowing. Mainly in the case of early sowings, plastic mulching is used (150 kg/ha of polyethylene). The most frequently used herbicides are: Trifluraline, Eptan, and Metobromuron.

Climbing plants need to be staked. Reeds are preferred in Spain for that purpose, and they are placed in different ways as follows: a single reed per plant cluster; several reeds forming a cone or pyramid; or a hut-like structure formed with pairs of reeds over clusters linked by strings or horizontal reeds. Staking is expensive, and currently it is done in small gardens but not in large-scale cultivation.

Harvesting bush varieties is performed by combine in most cases. It has been estimated that manual harvesting could cost 50% of the total cost of the crop. Climbing varieties are harvested by hand. Hand harvesting is maintained for all bean varieties when grown in small-scale consumption (family or local), and when superior quality and higher total production are important. Efficiency of hand harvesting is estimated at about 5 kg of bean pods per hour.

Yields vary widely, but average figures are 10-15 t/ha for early and normal cycle dwarf varieties; 20-30 t/ha for early and normal cycle climbing varieties; 5-10 t/ha for late cycle dwarf varieties, and 10-15 t/ha for late cycle climbing varieties.

Dry seeds

As is very common for food legumes, improved horticultural practices are widely applied for green products but are scarcely studied for dry seeds. Common beans are not an exception. Considering that water is not a limiting factor for beans, since they are grown under irrigation or under high rainfall conditions, yields are relatively low for dry seeds.

In Galicia beans are sown intercropped with maize. Sowing is done in May with a simple and rudimentary machine (drawn by ox or cow), and a mixture of bean and maize seeds is used. Sometimes the two crops are sown in alternate rows. Weeding is by hand. The only fertilizer used is manure, rarely with potassium. Yields range from 0.8-1.0 kg/ha; manual harvesting is in September.

In El Barco de Avila, beans are sown in late May, also using a simple machine drawn by mule or horse. Sowing is done in rows 50-60 cm apart. The only fertilizer used is manure. The extension service recommends a 9-18-27 fertilizer, but it does not seem to be used widely. Treflán and other herbicides are used. Five to six waterings are applied, but the total amount of water is not known. Manual harvesting is in September, and threshing is also manual. Farmers prefer to keep the seeds within the pods for 5-6 months before threshing because they believe the seeds take a more brilliant color. The yield is about 1 t/ha.

In La Bañeza (León), sowing is done mechanically at the end of May, in rows 55-57 cm apart. Some farmers do not apply fertilizers at all. Others use about 50 kg/ha of nitrogen, or 300-400 kg/ha of 4-12-8, and others use town refuses. Beans are often grown on the residual manure applied to the preceding crop. In the opinion of the extension service agents, plowing is excessive. Herbicides are not used. Manual harvesting is in September, but threshing is by machine.

In Grado (Asturias), sowing is manual, from March to May, in rows 50 cm apart. The distance between clusters of seeds within rows is 30 cm when sowing is not continuous. Sometimes beans are intercropped with maize. The plots are very small: 1000-1200 sq m. Manure is the only fertilizer applied, and sometimes it is omitted because of the difficulty in finding it. The various cultural labors are performed using oxen or, sometimes, tractors. There is no application of herbicides. Harvesting is done by hand from September to October, occasionally to November. Beans or beans/maize are included in rotation with ray-grass or lettuce (in vegetable gardens). In most cases farmers keep their own seeds for future sowings.

Crop rotations

Rotations in vegetable gardens cannot be described definitively because of the extremely intensive use of the land. Beans (normally climbers) are associated or sometimes intercropped with other vegetables and can follow or precede other crops.

In large-scale cultivation under irrigation, beans can be included in rotations such as cereal-beans-cereal and cereal-beans-sugar beet, or sugar beet-beans-cereal, with the addition of potatoes and/or alfalfa in some zones such as León. Sometimes there is fallow period between consecutive crops. In other cases (El Barco de Avila) there is no rotation with other crops: beans-fallow-beans. In the northern border, under rainfed conditions, beans compete mainly with maize, and are scarcely included in rotations. In Galicia, beans are intercropped with maize, the latter used as natural stakes; winter crops in the region are potatoes, rye, or turnips.

Production Constraints

Biological

Insects: the fly *Phorbia platura* (cotyledons and hypocotyles), leaf miners, *Heliothis armigera, Spodoptera littoralis* (leaves and pods), aphids, the whitefly *Trialeurodes vaporiarum,* and the bruchids *Bruchus rufimanus* and *Acanthoscelides obtectus.*

Fungi: *Colletotrichum lindemutianum, Uromyces phaseoli, Erisiphe polygoni, Sclerotina sclerotiorum, Isariopsis griceola, Thielaviopsis basicola, Rhizoctonia solani, Fusarium solani, F. phaseoli,* and *Pythium debaryanum.*

Bacterial and viral diseases: *Xanthomonas phaseolicola* and *Pseudomonas phaseolicola* are the most important bacteria, and both yellow and common mosaic are important viruses.

Others: the red spider *Tetranychus cinnabarinnus,* the nematodes, *Heterodera* spp, gasteropods, and sowbugs *Porcellio.*

Bacterial diseases are endemic in León, and have produced heavy losses. Rust is more intense in Asturias and Tarragona. Resistance to rust and

Isariopsis was found by Puerta in several Spanish accessions. *Isariopsis* has not been very important; it was found in Asturias and León. *Colletotrichum* is more serious in humid regions like Asturias and Galicia. *Fusarium* has been recorded in El Barco de Avila. Resistance to the common mosaic was also found in some Spanish accessions.

Beans are not good seed yielders considering that they are grown in humid areas or under irrigation. There are no modern cultivars, but some of the landraces used for dry beans are of excellent quality, selected by the farmers themselves. Puerta started systematic work to determine and recommend the best yielders for each production region, and also set up a selection program for yield and disease resistance in Spanish materials. But this work ended in the late 1960's and has not been continued.

Green pods have no such constraints. Private firms have produced new cultivars by selection from Spanish landraces or by crossing with introduced ones (like Kora).

Cultural practices can be another constraint, as explained in the preceding section. Nodulation does not seem to be a problem, but technicians from the extension service think that expansion outside the traditional cultivation zones is meeting with difficulty probably because of lack of *Rhizobium*. To our knowledge, there are no studies on this important topic.

Environmental

Beans are a summer crop in Spain because of winter temperature limitations. Thus, beans are only cultivated under irrigation or under rainfed conditions where summer rains occur, such as the northern and northwestern coastal areas. Water is not generally a limitation, to the point that farmers do not know the total amount of water needed for their crops. Because of the dry spells Spain has been suffering since 1979, the water supply has been limited for short periods in some of the regions where water reserves were running out.

Temperature can cause germination problems in early sowings or harvesting problems in late sowings but in regions where this possibility exists, plastic housing or mulching is used.

Production costs

There are great cost differences among the various types of cultivation practiced. For example, the intensive cultivation in vegetable gardens of the eastern and southern coastal areas, the large-scale cultivation under irrigation in the Meseta, and the small farms on the northern coast all experience different production costs, and many intermediate cases exist as well. With the exception of the Valencian region, there are no systematic studies on this topic. The following results were collected from private firms and from extension service technicians.

Valencian vegetable gardens. Maroto (1983) made an excellent study about costs for climbing varieties in this zone (see Table 7). He estimated total investment per hectare for early crops at about $6665,* and $4665 for late ones, 70% corresponding in both cases to labor.

El Barco de Avila. Only very rough data were obtained. Total investment per hectare is about $135-335 (some respondents gave $665, but this figure seems too high). Average production is 1000 kg/ha and average price is $.65/kg so net benefits are around $665, but these figures are not very reliable. A great deal of hand work is used in this region for harvesting as well as for threshing, although the average sown area is only 0.5 to 1 ha per farm, rarely 4-5 ha.

Sowing is the only mechanized work done, using a simple horse-or mule-drawn machine.

La Bañeza (León). Sowing and threshing are done by machine, but harvesting is usually done by hand. The average sown area is 4-5 ha per farm. Total costs are $135-240/ha and total income is around $1200/ha. The price of farm land ranges between $8000-10,000/ha.

Table 7. **Man/woman/tractor hours required for intensive horticulture in Valencia.**

	Early crop	Late crop
Soil preparation	25 tractor hours	same
	25 man hours	same
Fertilizer application	10 tractor hours	same
	65 man hours	40 man hours
Sowing	85 man hours	95 man hours
Mulching	185 man hours	none
Placing reeds	450 man hours	same
Guiding climbers	80 man or woman hours	50 man or woman hours
Tilling	275 man hours	200 man hours
Watering	180 man hours	125 man hours
Applying pesticides	30 tractor hours	25 tractor hours
	120 man hours	100 man hours
Harvesting	4600 woman hours	2400 woman hours

* Costs are given in approximate US dollars.

La Coruña. In Galicia much work is done by hand, generally by family labor. Sowing is perhaps the only mechanized task. Total cost per hectare is between $200-265, and total benefits around $600-665/ha in current prices. These are very rough figures because beans are generally intercropped with maize, and the total cost per hectare (estimated around $500/ha for both crops) has to be divided into two unequal portions which vary from farmer to farmer.

Grado (Asturias). Data from Grado (Asturias) are very limited. The price of land is high ($10,000-20,000/ha) but the total income obtained by the farmer can also be very high: $2665-4000/ha (the price in the local market may be as high as $4/kg). Beans are cultivated exclusively on a family basis.

Central Andalucía. In Córdoba, Sevilla, and Jaén the cultivated area is not very large but the crop can be very promising where water is available. Cultivation is highly mechanized, but sometimes harvesting is done by hand to increase total production. Costs (harvesting not included) are estimated at $665/ha. If only the best pods are harvested, yield ranges from 5-7 t/ha, and from 7-15 t/ha if all kinds of pods are harvested. Mechanical harvesting costs $.03/kg, and manual harvesting costs $.33/kg (but in this case the yield is not less than 15 t/ha). Thus, total investment can range from $1165-5665/ha and income from $3335 to more than $10,000/ha. These figures vary greatly because of market fluctuations.

Institutional

Beans, green or dry, are used for home consumption or sold in local or other markets. To our knowledge, there are no constraints in this respect. The product is sold in the market, to traders, or to the canning and freezing industry. Typical dishes ("fabada" and others) are also canned. There are no co-operatives to commercialize beans.

Imports are the only constraint to bean production. Spain does not protect its own bean production, and there is free import of dry beans from Chile, Argentina, and the USA. The rise of the US dollar and the resulting higher prices for imports may be favorable for bean producers in Spain.

Research Activities

As mentioned, the only research program on common beans was carried out by Puerta until the late 1960's. One of his main achievements was the collection and description of about 300 Spanish landraces; 80 entries were determinate and 216 climbing. Among determinates, 53 were used as dry seeds, 26 as green beans, and 1 for both purposes. The respective figures for indeterminate ones were 122, 44, and 40. The most promising materials for each productive zone were sought, and a systematic selection for yield and resistance to *Pseudomonas* and viruses was also set up.

The reasons for discontinuing this work have to do with policies related to grain legumes in effect from the early 1960's until 1978. At this time renewed official interest in food legumes was apparent. However, priorities went to pulses for animal feeding. Legumes for human consumption were considered capable of thriving by themselves. Thus, up to now, research on common beans has been left in the hands of private firms and to the farmers' initiative. More progress has been made with the green product than with dry seeds, even though farmers have been able to produce dry products of outstanding quality. It is no surprise, however, that these materials are not good yielders. The Spanish market demands quality rather than quantity, and thus, farmers select cultivars for good quality rather than high yields. However, yields can be improved through better agronomic practices, but this aspect is not being studied, with the exception of agents from the extension service who are carrying out trials to recommend improved practices to farmers.

Conclusions

Spain is in a position to produce more dry beans, which can easily be absorbed by local markets. The potential is even greater for green beans, whose production is far below its ceiling. Fresh consumption, the canning and freezing industries, and exports are sources of demand to be explored.

Systematic work on breeding and agronomy is urgently required, mainly for the most neglected field: dry seed production.

Publications

Jiménez-Díaz, R. and Varés, F. 1983. Información preliminar para un inventario de las enfermedades de leguminosas de grano en España. In: Leguminosas de grano. Ed. by J.I. Cubero and Ma. Teresa Moreno. Mundi Prensa, Madrid. pp. 175-196.

Maroto, J.V. 1983. El cultivo de las leguminosas hortícolas. In: Leguminosas de grano. Ed. by J.I. Cubero and Ma. Teresa Moreno. Mundi Prensa, Madrid. pp. 95-120.

Mateo Box, J.M. 1961. Leguminosas de grano. Salvat, Madrid. 550 pp.

Puerta-Romero, J. 1949. Claves para la clasificación de las variedades de *Phaseolus vulgaris*. Savi. Boletín del Instituto Nacional de Investigaciones Agronómicas 21: 557-568.

Puerta-Romero, J. 1961. Variedades de judías cultivadas en España. Instituto Nacional de Investigaciones Agronómicas, Madrid. 798 pp.

Santiago, C. 1983. Inventario de plagas de leguminosas de grano. In: Leguminosas de grano. Ed. by J. I. Cubero and Ma. Teresa Moreno. Mundi Prensa, Madrid. pp. 197-210.

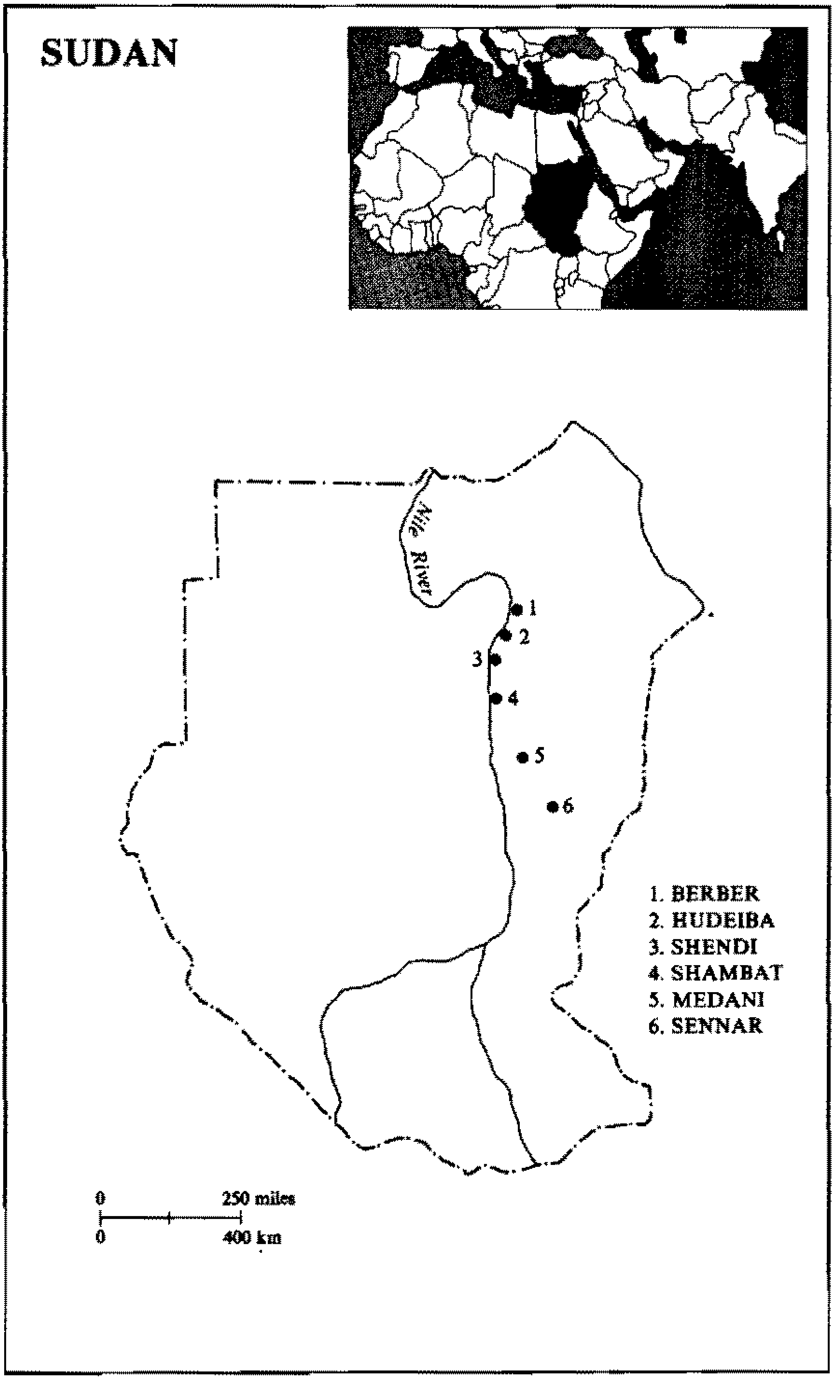


Figure 1. *Bean producing areas.*

Bean Production in the Sudan

Salih H. Salih
Farouk A. Salih

Importance

The northern region of the Sudan is the primary region for cultivation of food legumes. These legumes include: faba beans (*Vicia faba*), field or dry beans (*Phaseolus vulgaris*), chickpeas (*Cicer arietinum*), dry peas (*Pisum sativum*), cowpeas (*Vigna unguiculata*), lentils (*Lens esculenta*), pigeon peas (*Cajanus cajan*), lupins (*Lupinus termis*), hyacinth beans (*Lablab purpureus = Dolichos lablab*), fenugreek (*Trigonella foenum-graecum*), and, to a much lesser extent, chickling vetch (*Lathyrus sativus*).

The dry or field bean is second in importance—after faba beans—in both area and production. In the mid 1960's the area under this crop was comparable to that under faba beans (Table 1), but since then it has been declining. The area decreased from 7206 ha in 1965 to 3056 ha in 1980. The field bean area now is estimated to be about 15% of the area under food legumes in the northern region.

Cropping Systems

In the northern region, field beans are grown primarily in the Shendi (16°42′N, 33°26′E) and Berber areas (18°01′N, 33°59′E) where more than 90% of the crop is produced (see map, Figure 1). Meteorological data from the Hudeiba Research Station, which is located almost at the center of this region, are presented in Table 2.

The basic rotation in the region is the typical 2-year rotation:

Summer	Winter	Summer	Winter
Sorghum	Food legume	Fallow	Wheat

But often a more complex cropping pattern is practiced according to locality, soil, and marketing prospects (Babiker, 1982).

Table 1. **Field bean area, production, and yield (20-year period) compared to faba bean area (16-year period).**

Year	Area (ha)	Production (t)	Yield (kg/ha)	Faba bean (ha)
1961	5820	8259	1419	-
1962	5437	7664	1410	-
1963	5880	6006	1021	-
1964	6941	10197	1469	-
1965	7206	10037	1393	7350
1966	6720	11200	1667	7056
1967	5880	6202	1055	7644
1968	4200	4000	952	9618
1969	2940	2002	681	9492
1970	3360	4000	1190	9434
1971	3780	3996	1057	11424
1972	3360	4960	1476	18354
1973	2520	4002	1588	12185
1974	3361	4441	1321	14706
1975	4956	5475	1105	15699
1976	3864	5657	1464	18067
1977	4406	6294	1429	15966
1978	4603	6576	1429	17647
1979	2723	4279	1571	13025
1980	3056	4266	1420	23109

SOURCES: Department of Planning and Statistics, Ed-Damer.
Department of Statistics, Khartoum.

Table 2. **Meteorological data (1970-1979 average) for Hudeiba Research Station (17° 34'N, 33° 56'E), elevation 350 masl.**

Month	Temperature (C°) Mean maximum	Temperature (C°) Mean minimum	R.H. % at 06.00 GMT*	Evap.** (mm/day)
January	29.7	12.9	43	12.2
February	33.0	15.0	35	15.6
March	36.1	17.4	27	19.7
April	40.0	21.3	22	23.2
May	42.3	24.8	20	22.4
June	42.4	26.6	25	22.9
July	39.8	25.8	42	19.5
August	39.7	25.5	47	18.9
September	41.0	25.2	37	18.4
October	39.2	23.2	33	18.3
November	34.5	18.9	40	15.3
December	30.4	14.3	45	12.5

* Greenwich meridian time

** Evaporation average of 5 years.

The dry bean is best suited to the alluvial rich soils near the river (called *gerfland*) or on the basins formed by the receding water of the Nile. They are also grown on the islands laid down when the river meanders. Generally these soils are very fertile. Their salt content is low and they therefore give moderately high yields. But due to their scarcity, farmers tend to grow beans in the less fertile soils (called *karu*) away from the river.

In the river-flooded areas the crop is grown with minimum tillage; the seeds are sown by means of a digging stick with a foot-rest called a *seluka* (Tothill, 1952). On lands away from the Nile, soils are usually prepared using animals or tractors. Neither fertilizers nor chemicals for insect and disease control are commonly applied. Weeds are cut once, if at all, and the crop is irrigated four to six times.

The field bean in the Sudan is grown in monoculture and harvested in less than 100 days. The crop is usually harvested as soon as a considerable percentage of the pods are fully mature and have turned yellow. Usually the entire plants are pulled out, moved to a threshing floor, and left to dry. This threshing floor may be nothing more than a cleared area of well-beaten earth or it may consist of a mixture of mud and cow dung allowed to harden and dry. Threshing is done by an animal-drawn threshing machine with disc-like wheels fixed in a frame called a *norag*; or more frequently by a group of animals tied together and allowed to rotate fastened to a pole in the center of the threshing floor.

Types and Uses

The predominant cultivar grown, with white or cream-colored flowers, is a medium-seeded, vining variety with oblong solid white, somewhat glossy seeds. The seeds measure about 1-1.2 cm in length and weigh about 20-23 g per 100 seeds.

However, a black-seeded variety (fasulia zarga) of more erect habit with purple flowers gives a more tender pod for green use. These are grown on a small scale near towns, but there is no demand for them as dry beans (although they taste like the white ones) except for seed (Tothill, 1952).

A small amount of the seed is canned, but most of the beans are consumed dry. The common use is to cook whole dried seeds with meat and/or tomato sauce to form a stew, which is usually eaten with bread or rice. The straw is mainly used as forage.

Export

A sizable amount of the dry bean production is exported every year by a few merchant families. The exported amount varies from year to year as

Table 3. **Export of field beans over a 10-year period.**

Year	Exports (t)	% of total production	Total value (LS 000)[a]	Value/t (LS)
1971	1966	49.2	134.03	68.2
1972	1396	28.1	148.67	106.5
1973	3701	92.5	474.64	128.2
1974	418	94.3	864.74	206.5
1975	3316	60.6	459.48	138.6
1976	8406[b]	148.6	1191.96	141.8
1977	2843	45.2	392.00	137.9
1978	3431	52.2	480.08	139.9
1979	715	16.7	67.49	94.4
1980	885	20.7	304.88	344.7

a. LS = Sudanese pound. The rate of exchange varied over the period, averaging 1 pound = US 2.6 dollars.

b. In this year export exceeded production; the deficit seemed to have been supplied by previous years' stocks.

SOURCE: Department of Statistics and Foreign Trade, Khartoum.

shown in Table 3; sometimes it is as low as 17% of total production, as in 1979, whereas in other years it exceeds 90% of the production. However, the average yearly export over a 10-year period (1971-1980) amounted to about 61% of the production.

The crop is exported to Arab and European countries. In 1981 the export was sold to five countries, Iraq being the chief importer with 48.8%, followed by Egypt (24.6%), Belgium (15.7%), the United Kingdom (8.2%), and Holland (2.7%).

Production Constraints

The main constraints to bean production in the Sudan are the following:

1. Poor cultural practices by the farmers such as late sowing, infrequent watering, and no fertilization are among the main causes of low yields. Research results do not find their way to the farmers because the extension service is inadequate. Shortage of fuel supplies in many instances prevents adequate irrigation of the crop, which is usually grown on small, privately-owned holdings.

2. Field beans compete with other legume crops, especially faba beans, whose area has more than doubled during the previous decade. The faba bean is more commonly used than the field bean and probably brings a higher price.

3. In some years whiteflies inflict heavy yield losses; these insects are also the vector of curly top disease, which contributes to yield losses.

4. Among the soil factors, salt toxicity seems to be the most important constraint. This deters farmers from extending their planting in the so-called *karu* soils where sodium content is high. In some years farmers can lose their crop from salt injury combined with high temperatures.

5. Scarcity of certified seed is one of the main constraints. Production and distribution of pulse, cereal, and vegetable seed are the responsibility of the Plant Propagation Administration after the varieties are released by the Crop Variety Committee. However, the plant propagation station at Hudeiba is handicapped due to lack of facilities and is only able to provide a fraction of the requirements for certified seed to the farmers. Consequently, many farmers use seed from their own inferior stocks or purchase it from the market.

6. The lack of modern seed cleaning equipment to produce good quality seed that brings high prices in local and international markets is also a problem. Often there is no quality control of the exported seed, and in many instances it is of very low quality.

Research Activities

Research on dry beans has been conducted mainly at the Hudeiba Research Station since its establishment in the early 1960's. Currently, research is also conducted in other stations like Shendi and Wad Medani.

Research has been in the following areas:

Cultivar improvement
Agronomic research
Sodium toxicity
Control of insects, diseases, and weeds
Seed quality

Cultivar improvement

This program involves screening cultivars for high-yield potential and tolerance to stress conditions, especially salt toxicity and curly top virus. Promising genotypes are tested in regional variety trials for adaptation.

Screening for germplasm with high-yield potential. Much germplasm has been introduced from different countries for comparison with local material. The introductions have been grouped as follows:

- **White medium-sized seed lines.** This is the dominant variety grown, and it was hoped that by testing a group of introduced white genotypes, a variety that exceeded the yield of the local one could be found. However, the tests conducted over a number of seasons by breeders (Mutwakil, 1965-1968; Yassin, 1969-1973) showed that none of these introduced lines surpassed the yield of the local Baladi variety. Table 4 shows the performance of some of the lines in comparison with the local variety.

- **Pea or navy bean lines.** These small round-seeded beans are not consumed locally, and exports are mainly used for canning (Purseglove, 1968). Thus research on them has been done with that purpose in mind. Five pea bean genotypes were compared with the local Baladi variety over a number of seasons, and again, introduced lines proved to be inferior to the local check, as shown in Table 5.

- **Color-seeded lines.** Consumers in the Sudan do not like eating colored beans, but such material was tested to identify high-yielding cultivars that could be used directly for export or indirectly in the breeding programs. Many colored genotypes were tested in comparison with a local check. Some of them produced comparable yields to the local check (Table 6).

Since it was evident that most of the introduced material was inferior to the local varieties, a program was initiated to select superior lines within the landraces. Also included in the program was selection for salt tolerance, because the field bean suffered from an unknown wilt complex which was thought to be pathogenic, but was later found to be due to salt toxicity (Ayoub et al., 1974). Thus the aim of the program was to select

Table 4. **Seed yield (kg/ha) of introduced white-seeded beans compared to a local variety (Baladi).**

Variety	Season					Mean
	1965/66	1966/67	1967/68	1969/70	1970/71	
Baladi	1809	1204	1171	1940	1999	1625
Great Northern 31	1545	1149	1109	1733	1749	1457
Great Northern 59	1464	988	759	1668	1761	1328
Great Northern 123	1540	981	714	1640	1599	1295
Great Northern 1140	1380	1002	543	1678	1119	1144
SE ±	-	49.5	103.3	59.5	98.0	

SOURCES: Mutwakil, 1965-1968.
Yassin, 1969-1973.

Table 5. **Seed yield (kg/ha) of introduced pea beans compared to a local variety (Baladi).**

Variety	Season					Mean
	1965/66	1966/67	1967/68	1969/70	1970/71	
White Baladi	1818	1166	1342	1699	1971	1599
Saginaw	1554	678	847	1352	1345	1155
Michelite 62	1116	723	969	1533	1464	1161
Salinac	800	709	816	1211	1149	937
Gratiot	757	597	643	1100	1280	875
Seaway	659	497	695	942	1223	803
SE ±	76.2	80.9	-	88.1	80.9	

SOURCES: Mutwakil, 1965-1968.
Yassin, 1969-1973.

Table 6. **Seed yield (kg/ha) of color-seeded beans compared to a local white variety (Baladi).**

Variety	Season				Mean
	1965/66	1966/67	1967/68	1969/70	
White Baladi	2320	831	1297	2090	1634.5
Red Mexican 34	2149	795	1376	2168	1622.0
Red Mexican 35	2320	1026	1442	2178	1741.5
Pinto	1514	940	1328	2006	1447.0
Red Kidney	1011	512	562	1642	931.8
SE ±	70.4	185.6	70.0	92.8	

SOURCES: Mutwakil, 1965-1968.
Yassin, 1969-1973.

high-yielding, salt-tolerant lines. Many were selected, and one of them consistently proved to be superior and was recommended for release in 1969 under the name Ro/2/1 (Table 7).

Screening for resistance to curly top virus. This disease is thought to be a viral disease transmitted by whiteflies. More research is needed to correctly identify the disease and its transmission. In some years heavy infections and great yield losses occur. A program of selection of tolerant lines was started in 1969 from the local material (Yassin, 1969-73), and many of these selections were found to possess a high degree of tolerance. However, the screening is practiced under natural infection, which varies from season to season, so no conclusive results have yet been obtained.

Regional variety trials. Yassin (1969-73) initiated a program of regional variety trials to test the performance of the promising genotypes at

Table 7. **Seed yield (kg/ha) of selections from local genotypes.**

Variety	Season 1966/67	1967/68	Mean
Ro/2/1	1457	1637	1547
R1/5	1211	1568	1390
R1/7	1030	1473	1252
R1/25	1083	1173	1128
Baladi	981	1954	1018
R1/3	833	1211	1022
R1/13	812	1228	1020
R1/10	569	1040	805
R1/4	562	1035	799
SE ±	100	197	

SOURCE: Mutwakil, 1965-1968.

different sites in the Nile province. Salih (1976-79) extended this program to other localities in the northern province using additional lines. These tests showed that some of the entries were better than the released line Ro/2/1.

Other regional trials were conducted by Hassan (1969-75) in the southern nontraditional growing areas of Khartoum and central Sudan. Table 8 gives a two-season average for white and colored varieties grown at Shendi (north Sudan), Shambat (Khartoum province), and Gezira and Sennar (central Sudan). The yields in central Sudan, where land and water

Table 8. **Seed yield (kg/ha) of field bean varieties grown in different localities (two-season average).**

Variety	Locality Shendi	Shambat	Gezira	Sennar	Mean
Dark Red Kidney	1173	1547	750	572	1010
Great Northern	2330	1499	1130	948	1477
White Kidney	1979	1357	969	994	1325
Baladi S	2427	1357	1357	1234	1594
Pinto	2414	1309	1285	942	1487
White Bean	2362	1119	1100	1102	1421
Light Red Kidney	1393	809	719	686	902
Perry Marrow	2125	762	745	867	1125
Baladi	2506	-	1107	1201	1605
Mean	2079	1220	1018	949	

SOURCE: Hassan, 1969-75.

are abundant, are encouraging, although they fall below the average yields obtained in the north.

Agronomic research

This research concentrated on the effect of sowing date, plant spacing, method of planting, watering interval, fertilizer application, and inoculation with *Rhizobium*.

Many experiments were conducted since the 1961/62 season to determine the best sowing date. It was concluded that sowing during the last 2 weeks of October gives the highest yield (Table 9).

Planting on ridges of 60 cm gave higher yields than sowing on 120-cm beds. Spacing of 60 x 20 cm or 60 x 10 cm gave significantly higher yields than wider spacing. The adopted practice now is to plant at 60 x 20 cm spacing with two seeds/hole. This gives a population of about 167,000 plants/ha.

Regarding watering interval, it was consistently found that watering at 7-day intervals significantly increased bean yields in comparison to 2- or 3-week intervals (Table 10). However, Taha (1982) found that 7- or 10-day watering intervals gave similar yields.

The application of nitrogen fertilizers increased the seed yield significantly (Table 11), but phosphate fertilizers did not. Habish and Ishag

Table 9. **Seed yield (kg/ha) of field beans as affected by date of sowing.**

Sowing date	Season		Mean
	1969	1970	
September 15	442.9	1092.9	767.9
September 29	1340.5	1697.6	1519.1
October 13	1664.3	2209.5	1936.9
October 27	1826.2	2014.3	1920.3

SOURCE: Abdel-Gaber, 1969-71.

Table 10. **Seed yield (kg/ha) of field beans as affected by irrigation interval.**

Irrigation interval (days)	Season			Mean
	1969	1970	1971	
7	1845	2045	1507	1799
14	1095	1317	1133	1183
21	831	945	854	877

SOURCE: Abdel-Gabar, 1969-71

Table 11. **Seed yield (kg/ha) of field beans as affected by nitrogen fertilization.**

Nitrogen rate (kg/ha)	Season 1969	1970	1971	Mean
0	1257	1436	1164	1286
43	1695	1726	1419	1613
86	1781	1819	1471	1690

SOURCE: Abdel-Gabar, 1969-71.

(1974) reported considerable response to inoculation with *Rhizobium*. They found that inoculation increased yield more than applying nitrogen at 43 kg/ha, but not more than when double that amount was applied.

Sodium toxicity

Heavy losses in bean yields in the Sudan result from high death rates of plants (Ishag et al., 1974), which have been attributed to sodium toxicity (Ayoub et al., 1974). Two approaches were adopted to solve this problem: selecting tolerant genotypes, and amending the soil to lessen the injury to plants.

Inter-varietal differences in susceptibility to sodium toxicity could be detected (Ayoub, 1974) and these were attributed to the differential ability of the varieties to accumulate sodium in their stems and leaves. Breeders then were able to select lines from the local material that showed a high degree of salt tolerance.

At the higher external sodium level, gypsum and wheat straw mulch reduced the translocation of sodium from the roots to the stems and leaves. Thus, they can be used as amendments (Ayoub, 1975).

Control of insects, diseases, and weeds

Insect pests. The main insect pest of dry beans in the northern region of the Sudan is the whitefly. Its population varies from season to season, and in some years it can inflict heavy yield losses (Siddig, 1969-73). Several insecticides effectively controlled these insects and increased seed yield (Tables 12 and 13).

Diseases. Research concentrated on the control of three diseases: the wilt-like disorder, ashy stem blight, and curly top virus.

For the wilt-like disorder, believed to be a secondary rather than a primary infection, a strain of *Fusarium* sp. was isolated. Repeated seed dressing failed to lessen the disorder, which later proved to be due to sodium toxicity.

Table 12. **Effect of insecticides on the whitefly population in field beans (no. whiteflies per 10 plants transformed in $\sqrt{(x + 1)}$).**

Insecticide	Variety: Baladi	Ro/1/1	Pinto	Mean
Control	37.6	43.1	39.8	40.2
Endosulfan	1.0	1.2	1.2	1.1
Azodrin	2.2	2.4	1.9	2.2
Formothion	3.8	5.8	3.5	4.4
Mean	11.1	13.1	11.6	

SOURCE: Sidding, 1969-73.

Table 13. **Effect of insecticides on seed yield (kg/ha) of field beans.**

Insecticide	Variety: Baladi	Ro/1/1	Pinto	Mean
Control	884.8	1302.9	1103.6	1097.1
Endosulfan	1445.7	1651.4	1469.8	1522.3
Azodrin	1509.0	1734.3	1548.6	1597.3
Formothion	1320.0	1811.0	1457.9	1529.6
Mean	1289.9	1624.9	1395.0	

SOURCE: Sidding, 1969-73.

Ashy stem blight was attributed to the fungus *Macrophomina phaseolina* (Ibrahim, 1974). The disease increased with high temperatures. Seed dressing with different fungicides proved to be successful, and Captan and Benlate dressing gave a fair control (Freigon, 1975).

Control of curly top virus was tried through control of the whitefly vector and through selection of tolerant genotypes. Control of the vector significantly reduced the disease incidence in one year but not in another (Siddig et al., 1972-74).

Weed control. Chemical weed control was tested by Mohammed and Taha (1983). They compared a number of herbicides, i.e., Eptam, Preforan, Basagran, Treflan, and Tribunil, with hand weeding and an unweeded check. Weed control, yield, and quality were compared for four seasons. Results showed that Basagran gave the highest yield and the least number of weeds per square meter, while Treflan gave the poorest yield and weed control of all tested herbicides.

Seed quality

Research on quality aspects of the dry bean in the Sudan is meager. It seems that, apart from the work of Hassan and El Mubarak (1978), no other investigation was conducted. These workers studied nine cultivars in three localities for percent waste, undersized seed, rogues, non-soakers, canning quality factors, and seed count/100 g. Differences among cultivars and localities were detected; nevertheless, solid conclusions await more research.

Publications

Abdel-Gabar, A. 1969-71. Annual reports. Hudeiba Research Station, Ed-Damer, Sudan.

Ayoub, A. T. 1974. Causes of inter-varietal differences in susceptibility to sodium toxicity injury in *Phaseolus vulgaris*. J. Agric. Sci., Camb., 83:539-543.

——— 1975. Effect of some soil amendments on sodium uptake and translocation in dry beans (*Phaseolus vulgaris* L.) in relation to sodium toxicity. J. Agric. Sci., Camb., 84:537-541.

——— and Ishag, H. M. 1974. Sodium toxicity and cation imbalance in dry beans (*Phaseolus vulgaris* L.). J. Agric. Sci., Camb., 82:339-342.

Babiker, I. A. 1982. The Sudanese national programme. In: Hawtin, G. and Webb, C. (ed.) Faba bean improvement. Martinus Nijhoff Pub., the Netherlands, pp. 381-387.

Freigon, S. O. 1975. Annual report. Hudeiba Research Station, Ed-Damer, Sudan.

Habish, A. A. and Ishag, H. M. 1974. Nodulation of legumes in the Sudan. III. Response of haricot beans to inoculation. Expl. Agric., U.K 10:45-50.

Hassan, M. S. 1969-75. Annual reports. Gezira Research Station, Wad Medani, Sudan.

——— and El Mubarak, A. 1978. Processing quality of some dry beans (*Phaseolus vulgaris* L.) cultivars in the Sudan. Acta Hort. 84:123-129.

Ibrahim, G. 1974. Annual report. Hudeiba Research Station, Ed-Damer, Sudan.

Ishag, H. M. and Ayoub, A. T. 1974. Effect of sowing date and soil type on yield, yield components and survival of dry beans, (*Phaseolus vulgaris* L.). J. Agric. Sci., Camb., 82:343-347.

Mohamed, A. T. and Taha, A. A. 1983. Herbicide screening for economic production of snap beans in the Sudan. Presented in the 8th Africa Symposium held in Wad Medani, Sudan, March 1983.

Mutwakil, A. 1965-68. Annual reports. Hudeiba Research Station, Ed-Damer, Sudan.

Purseglove, J. W. 1968. Tropical crops: dicotyledons. Longman, London, U.K.

Salih, F. A. 1976-79. Annual reports. Hudeiba Research Station, Ed-Damer, Sudan.

Siddig, S. A. 1969-73. Annual reports. Hudeiba Research Station, Ed-Damer, Sudan.

——— and Abu Salih, H. A. 1972-74. Annual reports. Hudeiba Research Station, Ed-Damer, Sudan.

Taha, M. B. 1982. Annual report. Hudeiba Research Station, Ed-Damer, Sudan.

Tothill, J. D. (ed). 1952. Agriculture in the Sudan. Oxford University Press, U.K.

Yassin, T. E. 1969-73. Annual reports. Hudeiba Research Station, Ed-Damer, Sudan.

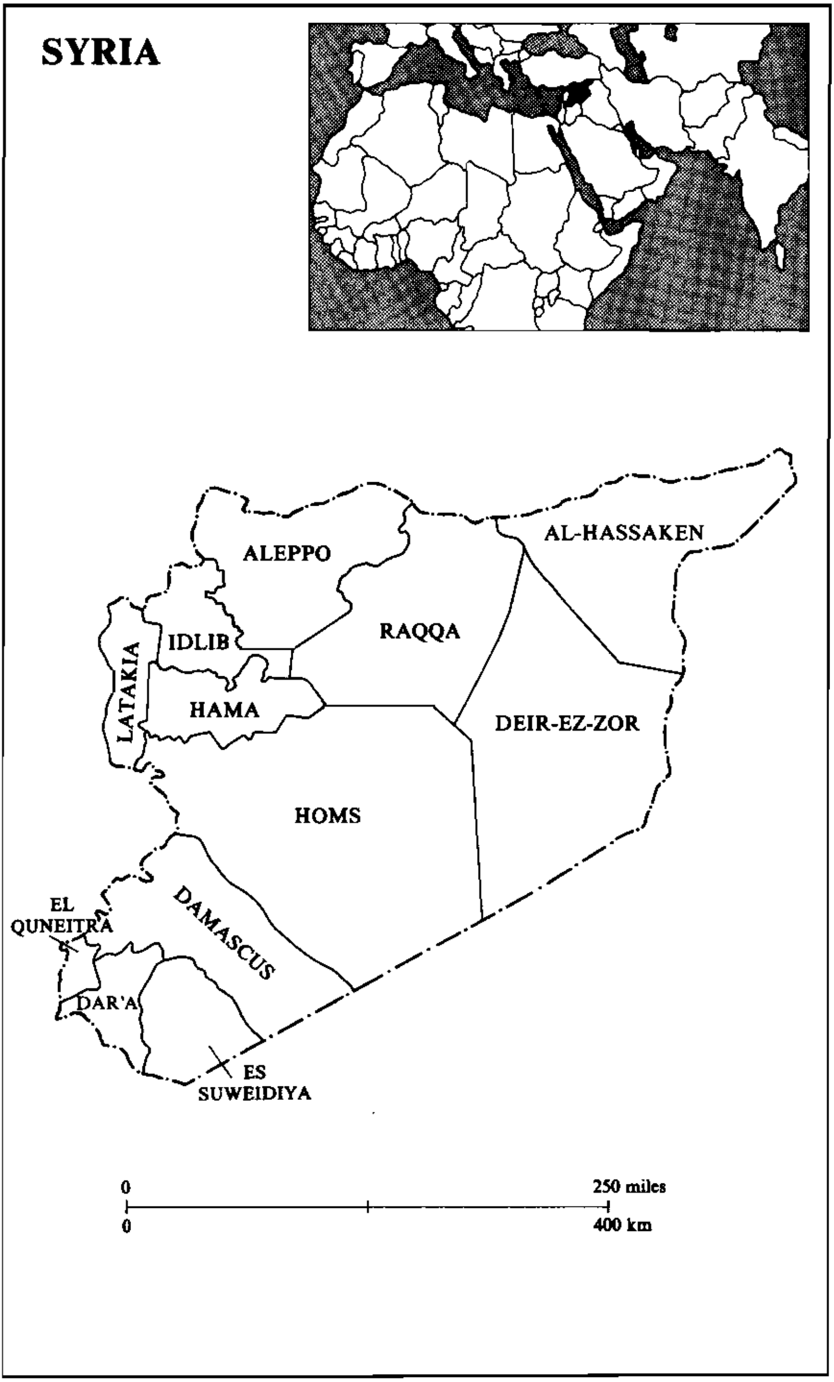


Figure 1. *Regional map.*

Bean Production in Syria

Munir Turk
Mohamed Agha

Area, Production, and Yield

In Syria, field beans (*Phaseolus vulgaris*) are grown in the summer, mainly under irrigation. (See Figure 1 for regional map.) The area planted in beans varies from year to year (from 2500 to 6000 ha), which is much less than the area planted in other legumes, such as lentils, chickpeas, and broad beans. Table 1 shows that the dry legumes produced in the greatest quantity by far are lentils, followed by chickpeas. However, yields per unit area are substantially higher for field beans than for the latter two crops (an average of 1.5 t/ha higher).

Beans are grown both for green pods and dry seed, with the area planted in each crop approximately the same (Table 2). Production data by year for 1971-1980, and by province for 1980, are given in Table 3 (green pods) and Table 4 (dry seed).

Types and Uses

Farmers grow both indigenous and introduced bean varieties in Syria. The indigenous varieties include: Mukarsaha and Aysha, produced for both green pods and dry seed; Malatya for green pods; and a broad bean type for dry seed. The introduced varieties are: Contender, Kentucky Wonder, King of Belgium, and Tender Crop, produced only for green pods; and Harvester, produced for both green pods and dry beans.

Field beans are grown for home consumption as well as for export. Local dishes take a variety of forms, such as pickling the green pods or frying them in oil with lemon and parsley to serve as an appetizer, or cooking either the green pods or dry seeds with meat and tomatoes to serve as a main dish.

Table 1. **Area, production, and yield of dry legumes (1970-79).**

Year	Broad beans			Chickpeas			Lentils			Field beans		
	Area (000 ha)	Production (000 t)	Yield (t/ha)	Area (000 ha)	Production (000 t)	Yield (t/ha)	Area (000 ha)	Production (000 t)	Yield (t/ha)	Area (000 ha)	Production (000 t)	Yield (t/ha)
1970	8.1	8.8	1.1	24.9	15.2	0.6	139.0	57.5	0.4	2.41	2.92	1.21
1971	7.4	10.1	1.4	29.0	23.6	0.8	111.5	61.3	0.6	2.49	3.71	1.48
1972	8.2	13.0	1.6	44.2	36.4	0.8	115.1	96.2	0.8	3.50	4.86	1.39
1973	6.7	7.1	1.1	68.5	27.8	0.4	92.1	23.7	0.3	3.46	4.66	1.37
1974	4.8	7.3	1.5	90.7	60.3	0.7	85.4	83.4	1.0	3.85	5.69	1.48
1975	5.8	9.3	1.6	55.2	26.7	0.5	97.8	66.6	0.7	4.42	7.15	1.62
1976	8.2	13.7	1.7	67.6	50.8	0.8	146.5	136.2	0.9	6.14	10.02	1.63
1977	8.0	12.6	1.6	41.1	25.0	0.6	178.3	117.3	0.7	6.09	10.67	1.75
1978	8.0	13.0	1.6	46.0	31.0	0.7	136.0	92.0	0.7	5.51	9.47	1.71
1979	8.0	14.0	1.7	17.0	11.0	0.6	89.0	43.0	0.5	3.77	6.47	1.75
Aleppo 1979*	2.0	3.0	1.5	6.0	4.0	0.7	39.0	24.0	6.0			

SOURCES: Central Bureau of Statistics. Statistical Abstracts, 1978-1980. Syria.
Bureau of Statistics. Aleppo Directorate of Agriculture. Syria.

* For Aleppo, 1979

Table 2. **Comparison of area and yield between green pods and dry seeds (1965, 1970, 1975).**

Year	Bean type	Irrigated Area (ha)	Irrigated Yield (kg/ha)	Rainfed Area (ha)	Rainfed Yield (kg/ha)	Total area (ha)
	Green pods	1096	5070	285	2180	1381
1965	Dry seed	1149	1070	381	430	1530
	Total area (ha)	2245		666		2911
	Green pods	2163	5590	488	342	2651
1970	Dry seed	2355	1230	54	440	2409
	Total area (ha)	4518		542		5060
	Green pods	4577	7100	189	2760	4766
1975	Dry seed	4362	1630	50	930	4412
	Total area (ha)	8939		239		9178

Syria both exports and imports beans. Exports (mainly dry seed) exceed imports. Table 5 compares green pod and dry seed export/import figures for a 7-year average (1968-1974) and for 1974. At present, the crop has limited importance in the canning industry.

Research Activities

Bean planting trials with different genotypes were conducted in May, 1982, with material from the International Bean Yield and Adaptation Nursery (IBYAN). Three IBYAN trials were planted at the International Center for Agricultural Research in Dry Areas (ICARDA) in Tel Hadya. Tel Hadya is located at 36°40'N latitude and 37°20'E longitude, with an elevation of 392 masl. The average monthly maximum and minimum temperatures over the growing period were as follows:

	May	June	July	August
Monthly mean maximum °C	29.4	33.8	34.5	36.0
Monthly mean minimum °C	13.5	15.8	19.3	20.1

Normal planting dates are in spring (March-April) under rainfed conditions. The July planting comes after wheat or barley, in a cereal-legume rotation. Insect attacks are severe, especially whitefly, while mildew may be the most severe disease.

Design of IBYAN trials

In two of the trials, 12 genotypes were used while in the third trial only 10 genotypes were evaluated. Each trial contained a local variety as a check.

Table 3. **Area, production, and yield of green pods by year (1971-1980) and by province (1980).**

Year	Irrigated			Rainfed			Total		
	Area (ha)	Production (t)	Yield (kg/ha)	Area (ha)	Production (t)	Yield (kg/ha)	Area (ha)	Production (t)	Yield (kg/ha)
1971	2624	16139	6145	375	1975	5266	3001	18114	6035
1972	2692	71815	6618	245	1424	5812	2937	19239	6551
1973	2965	13672	4612	303	668	2205	3268	14344	4389
1974	4348	30625	7043	273	695	2546	4621	31320	6778
1975	4577	32506	7102	189	522	2762	4766	33028	6930
1976	4104	32727	7974	214	1180	5514	4318	33907	7852
1977	3609	29397	8145	229	974	4253	3838	30371	7913
1978	4827	43170	8943	312	1228	3936	5139	44398	8639
1979	4831	37834	7832	275	1298	4720	5106	39132	7664
1980	5477	49455	9030	217	921	4244	5694	50376	8847
Province (1980)									
Damascus	795	6524	8206	-	-	-	795	6524	8206
Dara'a	265	2377	8970	-	-	-	265	2377	8970
Homs	571	4491	7865	-	-	-	571	4491	7865
Hama	474	3249	6854	24	92	3833	498	3341	6854
Ghab	153	885	5784	-	-	-	153	885	5784
Latakia	1679	16433	9787	106	530	5000	1785	16963	9503
Tartous	815	12063	14801	87	299	3437	902	12362	13705
Idlib	36	140	3889	-	-	-	36	140	3889
Aleppo	337	1563	4638	-	-	-	337	1563	4638
Al-Hassaken	59	266	4508	-	-	-	59	266	4508
Deir-Ez-zor	293	1464	1997	-	-	-	293	1464	1997

Table 4. **Area, production, and yield of dry seed by year (1971-1980) and by province (1980).**

Year	Irrigated Area (ha)	Irrigated Production (t)	Irrigated Yield (kg/ha)	Rainfed Area (ha)	Rainfed Production (t)	Rainfed Yield (kg/ha)	Total Area (ha)	Total Production (t)	Total Yield (kg/ha)
1971	2441	3685	1509	50	29	580	2491	3714	1490
1972	3462	4833	1396	38	25	657	3500	4858	1388
1973	3412	4622	1355	50	37	740	3462	4659	1346
1974	3759	5638	1500	86	49	570	3845	5687	1479
1975	4362	7100	1628	55	51	927	4417	7151	1619
1976	6074	9963	1640	68	58	853	6142	10021	1632
1977	5999	10589	1765	94	83	883	6093	10672	1752
1978	5422	9398	1733	89	72	809	5511	9470	1718
1979	3706	6409	1729	63	56	889	3769	6465	1715
1980	6976	12297	1763	33	19	576	7009	12316	1757
Province (1980)									
Damascus	1041	2290	2200	-	-	-	1041	2290	2200
Homs	2726	4265	1565	-		-	2726	4265	1565
Hama	601	1140	1897	1	1	1000	602	1141	1895
Ghab	892	1657	1858	-	-	-	892	1657	1858
Latakia	247	370	1498	-	-	-	247	370	1498
Tartous	64	91	1422	32	18	562	96	109	1135
Idlib	175	356	2034	-	-	-	175	356	2034
Aleppo	260	524	2015	-	-	-	260	524	2015
Al-Hassakeh	10	12	1200	-	-	-	10	12	1200
Deir-Ez-zor	960	1592	1658	-	-	-	960	1592	1658

Table 5. **Imports and exports of green pod and dry seed beans (1968-1974).**

Period	Exports (t)		Imports (t)	
	Green pod	Dry seed	Green pod	Dry seed
Average from the period 1968-1974	544	1106	116	32
1974	5	251	352	24

The design was a randomized complete block with three replications. Disc plowing, followed by irrigation, then another cultivation, ensured pre-sowing weed control. Sowing was done in rows 60 cm apart, 4 m long. Nitrogen and phosphate in the form of diammonium phosphate (100 kg/ha) were added at the time of planting; 50 kg N/ha were top-dressed after planting. The seeds were treated with Actylic, Calixin, and Benlate. The plots were kept weed-free by hand weeding. After planting, the plots were irrigated at regular intervals of about 10-12 days (nine irrigations were applied at the rate of 50 mm of water each time).

Yields were determined from the two central rows of the four rows per plot. All seed samples were dried to a uniform, constant moisture content before seed yield was recorded.

Results

Trial 1. Small-seeded bush beans, cream and brown. Results of this trial are presented in Table 6. Nine varieties out of 11 came to flower almost at the same time as the local check. Variety A 156 flowered much later and did not come to maturity. Variety A 328 failed to flower. There was no significant difference in time to maturity for the remaining 10 varieties. Two varieties, A 342 and A 90, significantly outyielded the local check, and the local check significantly outyielded A 304.

From these results it appears that two lines, A 328 and A 156, showed the least adaptability, followed by A 304, and that two lines, A 342 and A 90, showed the highest adaptability in terms of phenology and seed yield.

Trial 2. Small-seeded bush beans, cream and brown. Results are presented in Table 7. All the entries came to flower and maturity, with variety A 348 being the latest to flower. The difference in time to maturity did not appear to be significant. The local check was outyielded by all the other entries, but significantly only by five, with the highest seed yield coming from A 286. It would appear that in this nursery, the entries were well adapted to Tel Hadya conditions on the basis of phenology and seed yield.

Table 6. **Phenology and seed yield of IBYAN Trial 1, small-seeded bush beans, cream and brown (1982).**

Genotype	Origin	Days from planting to flowering	Days from planting to physiological maturity	Seed yield (g/plant)	Seed yield (kg/ha)
A 342	CIAT	56	93	8.27	1607
A 90	CIAT	58	89	8.24	1583
A 282	CIAT	57	93	6.59	1341
CENA 164-1	Brazil	59	93	7.37	1284
Local check		58	91	5.42	1016
BAT 1211	CIAT	59	93	5.03	978
A 357	CIAT	55	93	4.31	929
BAT 232	CIAT	59	93	6.45	829
A 359	CIAT	59	89	3.62	745
A 304	CIAT	59	94	0.57	120
A 328	CIAT	-	-	-	-
A 156	CIAT	75	-	-	-
CV %					52.8
LSD 5%					945

Table 7. **Phenology and seed yield of IBYAN Trial 2, small-seeded bush beans, cream and brown (1982).**

Genotype	Origin	Days from planting to flowering	Days from planting to physiological maturity	Seed yield (g/plant)	Seed yield (kg/ha)
A 286	CIAT	56	93	10.39	2209
Carioca	Brazil	56	89	9.98	1820
EMP-86	CIAT	56	89	8.10	1689
BAT 561	CIAT	56	94	7.96	16.22
A 140	CIAT	59	96	7.58	1527
A 357	CIAT	56	89	7.65	1486
BAT 874	CIAT	59	94	6.73	1485
A 293	CIAT	59	94	7.07	1404
A 83	CIAT	59	93	6.88	1385
A 162	CIAT	56	93	6.56	1359
A 348	CIAT	63	95	5.08	957
Local check		56	96	4.09	838
CV %					26.9
LSD 5%					674.2

Table 8. **Phenology and seed yield of IBYAN Trial 3, white bush beans (1982).**

Genotype	Origin	Days from planting to flowering	Days from planting to physiological maturity	Seed yield (g/plant)	Seed yield (kg/ha)
BAT 1198	CIAT	59	93	8.79	1758
78-0374	USA	59	93	8.83	1745
BAT 1257	CIAT	56	93	8.29	1588
Ex Rico 23	CIAT	59	87	6.33	1365
BAT 1061	CIAT	60	96	6.43	1227
BAT 1280	CIAT	60	93	5.17	991
BAT 1281	CIAT	56	93	2.70	907
Local check		56	95	3.84	819
BAC 38	CIAT	60	94	4.03	740
CV %					21.1
LSD 5%					452

Trial 3. White bush beans. Table 8 shows the results of this trial. All entries came to flower, and the differences in time to flower or to maturity did not appear to be significant. Four varieties, BAT 1198, 78-0374, BAT 1257, and Ex Rico 23, outyielded the local check significantly. The highest seed yield came from BAT 1198; 78-0374 (elite check) and Ex Rico 23 (international check) ranked second and fourth, respectively.

Discussion

Of the three nurseries only the first one contained some entries which showed lack of adaptation to north Syrian conditions. The performance of entries in the other two nurseries suggests that a few of the tested ones could be considered for further evaluation and eventual introduction into Syria. Table 9 gives a synopsis of the plant characteristics for the high-yielding genotypes in the trials.

It will be necessary to investigate the production agronomy of these new types. The inter-row space was never covered, and greater planting density may have increased the yield considerably. There was general lack of nodulation in these trials, suggesting that the local population of *Rhizobium* was either inadequate or ineffective. Rhizobial strains will have to be evaluated.

Production Constraints

One of the main constraints to bean production in Syria is competition for land with cash crops, primarily cotton and vegetables. Beans may have to compete with soybeans or maize as an irrigated crop. Other constraints are a relatively low price for the crop in the local markets; high summer temperatures resulting in abortion of flowers and young pods; and widespread lines of different fungus diseases, especially in irrigated areas. Unfortunately no previous comprehensive research on the crop has been carried out in Syria.

Table 9. **Plant characteristics of the high-yielding genotypes from the three IBYAN trials.**

Genotype	Description
A 342	Small leaf, erect type, shiny cream, medium seeds
A 282	Small leaf, erect type, cream, Carioca-type medium seeds
A 90	Small leaf, Carioca-type, cream opaque, small seeds
CENA-164-1	Brazilian, elite check, Carioca-type, cream opaque, small seeds
A 286	Prostrate, cream striped, opaque, small seeds
BAT 232	Elite check
Local check	Shiny white, medium seeds
Carioca	Well-known Brazilian variety, opaque medium seeds
EMP-86	Bred for resistance to *Empoasca* and leafhopper; Mulatinho, opaque, small seeds
BAT 561	Elite check, Mulatinho, cream opaque, medium seeds
A 140	Shiny cream, small seeds
BAT 1198	White, shiny cream, small seeds
78-0374	USA-developed elite check, resistant to disease, white opaque, small seeds
BAT 1257	White, medium-opaque, small seeds
Ex Rico 23	White, opaque, small round seeds

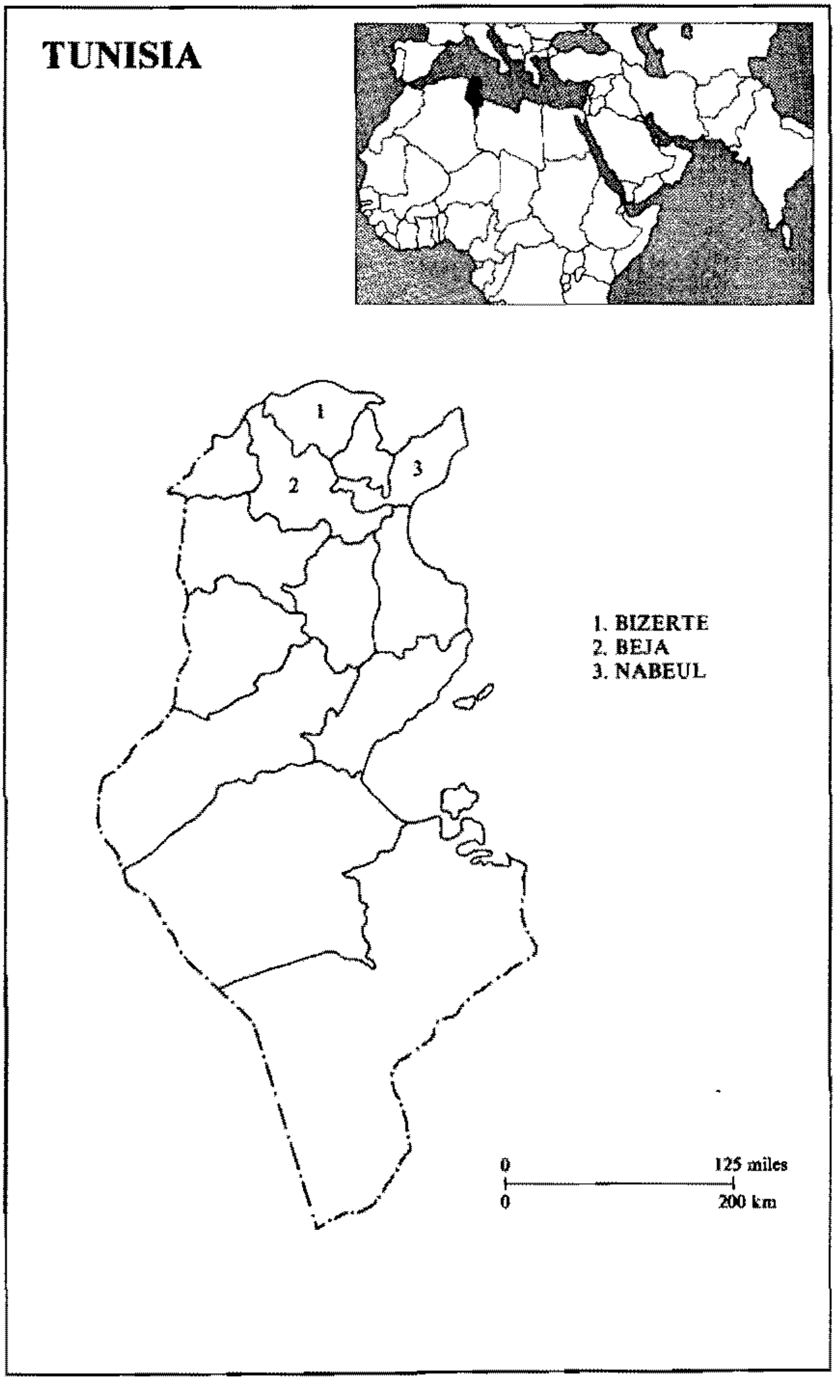


Figure 1. *Major growing areas for dry beans under rainfed conditions.*

Bean Production in Tunisia

Habib M. Halila
Mohamed Bouslama

Distribution and Production

Dry beans are a marginal legume crop in Tunisia. This crop is mainly grown in the northern part of the country where it is planted in March-April under rainfed conditions (Figure 1). Total rainfall in this area is around 400 mm. The area devoted to dry beans varies from year to year and represents a minor percentage of the total area in food legumes (Table 1). Beans are rotated with cereals. Total production as well as yield are low and fluctuate from year to year (Table 2).

Use and Marketing

Beans are mainly grown for dry seeds. The medium-sized white beans are preferred. They are consumed in many dishes after soaking and cooking, although a small proportion is used by the canning industry. Local production is far from meeting the needs of the country, and imports have to be made to satisfy the demand. Recent imports are shown in Table 3. The relative importance of fresh beans is not known.

Table 1. **Area under food legumes and dry beans.**

Year	Legumes area (ha)	Dry beans area (ha)	Dry beans as % of total legumes
1976/77	91,600	2200	2.4
1977/78	93,820	2500	2.7
1978/79	103,290	3669	3.6
1979/80	110,490	3220	2.9
1980/81	98,143	1470	1.5
1981/82	94,082	1292	1.3
1982/83	78,491	1619	2.0

SOURCE: Statistiques Agricoles, Ministere de l'Agriculture.

Table 2. **Production and yield of dry beans (1976-1982).**

Year	Production (t)	Yield (kg/ha)
1976/77	2180	490
1977/78	1500	600
1978/79	3096	840
1979/80	4570	1420
1980/81	1492	1020
1981/82	926	720

SOURCE: Statistiques Agricoles, Ministere de l'Agriculture.

Table 3. **Imports of dry beans in recent years.**

Year	Imports (t)
1980	1400
1981	2300
1982	-
1983	2485

SOURCE: Statistiques Agricoles, Ministère de l'Agriculture.

Prices fluctuate very much. The average price for dry beans is US $57/t, and US $40/t for fresh beans.

Production Constraints

Production constraints have not been fully identified. Lack of nodulation seems to be one of them, at least at the research station, where inoculation trials conducted during the past season emphasized this as a limiting factor.

Other constraints such as diseases and pests have been reported. The following ones may be the most prevalent:

- Bean common mosaic virus (BCMV)
- Rust (*Uromyces phaseoli*)
- Anthracnose (*Colletotrichum lindemuthianum*)
- Mites (*Tetranychus* spp.)
- Alfalfa black aphid (*Aphis craccivora*)

Rust and BCMV resistance may be the most important disease resistances needed. The lack of proper agronomic practices is thought to be another major constraint to the cultivation of dry beans.

Research Activities

Research on dry beans has not been done until recently. Within the food legumes program of the Institut National de la Recherche Agronomique de Tunisie (INRAT), preliminary observations of bean germplasm introduced from different areas of the world have not provided any satisfactory data, probably due to the lack of nodulation in the soils of the research station. Tunisian soils may be lacking adequate populations of *Rhizobium phaseoli*.

The main areas requiring urgent research are:

- Agronomic information: date of planting, plant densities, and fertilization;
- Microbiological research: inoculation and identification of efficient strains of *R. phaseoli*;
- Genetic improvement: selection for cultivars with high and stable yields, adapted to the production zones, and able to be harvested mechanically.

Publications

Djerbi et al. Food legume diseases in North Africa. *In*: Workshop Proceedings. University of Aleppo, Syria, 2-7 May 1973.

Institut National de la Recherche Agronomique de Tunisie (INRAT). 1982. Rapport d'activités.

Ministère de l'Agriculture. 1981. Legumineuses á graines. Etude des possibilités de développement. Tome 1.

L'Office Allemand de la Cooperation Technique (GTZ). 1976. ed. S.A.R.L. La défense des cultures en Afrique du nord.

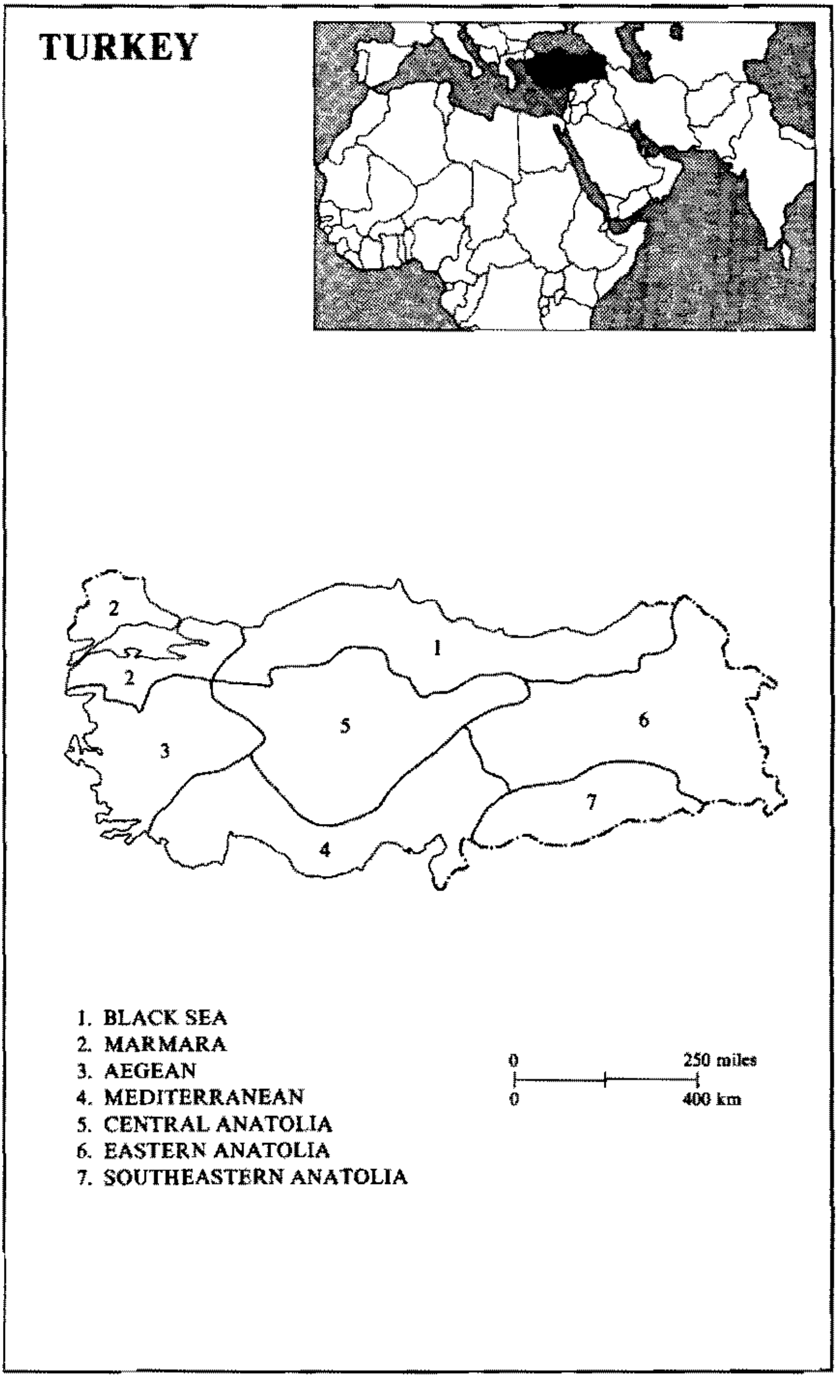


Figure 1. *Major natural regions*

Bean Production in Turkey

Dogan Sakar

Importance

Lentils (*Lens esculenta*) and chickpeas (*Cicer arietinum*) are the most important food legume crops in Turkey, followed by dry beans, *Phaseolus vulgaris*, which rank third in area and production. Approximately 110,000 ha are planted to beans each year, with an estimated production of 165,000 t. These figures do not include green beans, which are grown and consumed extensively throughout the country. Also, some runner beans (*Phaseolus coccineus*) are cultivated for export. (See Figure 1 for regional map.)

The area in bean cultivation has not changed much during the last two decades, although production increased from 130,000 t to 165,000 t in this same period, principally due to better agronomic practices and a switch from associated cropping to monoculture. The average per capita consumption is about 3.5 kg. A limited amount of beans is exported every year.

Lentils and chickpeas are grown as rainfed crops, sown in spring (February-March) without much input. Beans, on the other hand, often are grown under irrigation, except in the high rainfall area of the Black Sea coast. Irrigated beans usually receive intensive care including fertilizers, pesticides, and weeding, and compete very well with other crops under irrigation. Nonetheless, the area under beans per farm is very small, ranging from only a few square meters to seldom exceeding a hectare. All irrigated beans except those in home vegetable gardens are grown in monoculture. Some intercropping in fruit orchards (apples, peaches, plums) is practiced, especially in the transitional areas (between 300-800 masl).

Agro-ecological Zones

In Turkey, beans are grown in diverse climates and varying elevations. In the south, they are grown almost at sea level, but in eastern Turkey dry beans are grown up to 1500 masl. Bean production areas can be grouped into the following seven geographical regions (see Figure 1).

1. **Eastern Anatolia:** includes K. Marash, Malatya, Elazig, and Erzincan; it is the largest bean production zone.

2. **Central Anatolia:** includes Konya, Kayseri, Nigde, and Ankara; here beans are grown only in lower valleys between 600 to 1200 masl.

3. **Mediterranean:** includes Antakya, Mersin, and Antalya.

4. **Marmara:** Bursa, Balikesir, and Manisa.

5. **Black Sea:** Samsun, Adapazari, Ordu, Giresun, and Bolu.

6. **South transition:** includes Tokat, Amasya, Corum, Cankiri, and Kastamonu; (the southern part of the Black Sea region indicated in Figure 1).

7. **Aegean:** includes Eskisehir, Kutahya, Usak, and Afyon.

The maximum mean temperature in different bean production regions seldom exceeds 26° C and the miminum often drops down to around 15° C, which is ideal weather for beans. The average yield per hectare is very high, especially in irrigated highlands.

Although dry beans are grown in every province in Turkey, their production is much more concentrated in certain regions and provinces. In central Anatolia, which has cold winters and dry summers, Nigde, Konya, and Kayseri are the most important bean growing provinces. In the north, Samsum is the leading province where climbing beans are grown together with corn. In the Marmara region, Bursa and Balikesir are important for dry beans. In the transitional areas between central and eastern Turkey, K. Marash and Malatya are the two leading production areas of the country. To summarize Turkey's diverse agro-climates for the purposes of breeding activities and yield trials, the following three groups can be used.

1. **Irrigated high Anatolian plains** (elevation between 500 and 1500 masl). This area includes the eastern, western, and central Anatolian plains. Dry beans are grown in monoculture, predominately Derma-

son and Selanik type III* beans. The average yield of farmers is around 3000 kg/ha. Very few if any green beans are grown. Bean common and bean yellow mosaic viruses are present, but pose minimal production problems.

2. **Irrigated lowland or transitional plains** (elevation between sea level and 500 masl). The Mediterranean, Marmara, and southern transition regions are included here. Fruit trees and grapes are characteristic of the area. Farmers grow all types of beans, often on very small holdings and intercropped to some extent. Production problems are similar to those of the irrigated high Anatolian plains, but more severe. Average yields are much lower (approximately 1500 kg/ha), principally due to a shorter growing cycle, intercropping, and severe virus problems.

3. **Black Sea region** (elevation between 10 and 300 masl). This area is characterized by bean-maize associated cropping. Aggressive climbing varieties of both dry and green beans cause serious lodging of maize varieties. Viruses, rust, and *Chaetoseptoria* leaf spot are among the major production problems. Weeds also can be trouble, especially in bush varieties.

A potential fourth area could include non-irrigated high Anatolian plains. Lentils and chickpeas are planted in some of the cereal fields that would otherwise have been left fallow, and it is possible that these fields could be used for beans as well. There is a potential also to grow beans as a second crop in the south after the harvest of wheat. Bean varieties with a high level of drought and cold tolerance, early maturity, and suitability for mechanical harvesting will be required.

Cropping Systems

Growing time is determined by the period between the last frost in spring and the early frosts in fall. Beans are planted in February and March in the Mediterranean region, in late March or early April in the Marmara region, in late April or early May in central Anatolia, and in late May or early June in eastern Anatolia. However, the bulk of the sowing is done in the months of April and May. The crop duration is about 4 months and there is always a danger of frost after mid-September in eastern and central Anatolia.

---

* Bean types refer to CIAT classification of growth habits, summarized as follows:

Type I:	Determinate growth habit - bush type.
Type II:	Indeterminate growth habit - bush type.
Type III:	Indeterminate growth habit - prostrate.
Type IV:	Indeterminate growth habit - weak stem and branches, strong climbing ability.

Therefore, early maturity is a desirable characteristic, especially for eastern Turkey.

The most common method of planting beans (both for monoculture and associated cropping with maize) is broadcasting and then turning the soil by bullock-drawn plows, resulting in uniform emergence and low populations. In Bursa, in the Marmara region, beans are planted under plastic housing in February and in March the seedlings are transplanted to the field in order to reach market earlier for a better price.

Both type III and IV dry and green beans can be seen growing on stakes, especially in the Marmara, Blacksea, southern, and western transition regions. Green beans are harvested beginning in late May and continuing through October-November. Dry beans are harvested in September-October.

So far, there are no registered bean cultivars and all existing types are village populations which are mixtures and often grown with agronomic neglect. Harvesting is done by hand pulling. Pulled plants are dried 3-5 days in the field, and then the seeds are separated from the pods by beating or by a tractor-pulled disc harrow. The majority of the cultivars are prostrate and therefore suitable for adaptation to mechanical harvesting. Labor for harvesting is expensive and difficult to obtain in many cases. This might be one of the reasons why farmers tend to grow beans in small plots. Weeding is done by the farmer and his family since most of the bean fields are small (0.1-0.3 ha).

Types

Although there is large variation in bean types (some 10 or 12 different Turkish names: Cali, Tombul, Battal, Barbunya, etc.) for practical purposes they can be grouped in the following categories:

Dry beans

White

1. Horos (10%) - growth habit type I, large cylindrical seeds.
2. Selanık (25%) - growth habit types I, III, and IV; large kidney-shaped seeds.
3. Dermason (60%) - growth habit types III and IV, flat (Great Northern type), medium, and large seeds. This is a very expensive bean.
4. Seker (< 5%) - growth habit types III and IV, medium-sized elliptical seeds.

Cream mottled

1. Barbunya (< 5%) - growth habit types I, III, and IV, medium to large elongated seeds, cream mottled and striped. Green pods of these are used for canning.

Green beans

Green beans are mostly of growth habit types I, III, and IV (the most common type). They have fleshy and juicy pods, often flat but also cylindrical. Three to five harvests are made in climbing green beans and two to three harvests in type I green beans.

Production Constraints

Tolerance to low temperature and drought, early maturity, non-lodging tendancy, and insensitivity to photoperiod could be of immense value in both dry and fresh bean varieties in Turkey. This may help increase production areas. Presently about 50% of the Anatolian highland wheat region (over 9 million ha) is left fallow each year. The government is looking for alternatives to minimize the yearly area of fallow land and to increase bean consumption. An average Turk enjoys beans served in any form, but can only afford to eat them once a week because they cost twice as much as lentils and chickpeas (about US $.50 vs .25/kg).

Irrigated bean regions

While the average bean yield of Turkey is 1500 kg/ha, in the middle Anatolian highlands bean yields are around 3000 kg/ha. There type III and IV varieties of Dermason and Selanik are grown. These are free of diseases and insects, irrigated, and take 120-130 days to complete the crop cycle. Except for the Black Sea region (rainfall 800-1000 mm distributed throughout the year) Turkey is a very dry country. Some 300-800 mm of rain comes mostly in the form of snow between November and March. Rains during the spring, summer, and fall months are negligible. Except in a very few areas like Kazan (near Ankara), farmers use surface irrigation. As a result, fungal and bacterial diseases are nonexistent. The only exception is a relatively moist transitional region like Eskisehir, where halo blight has increased substantially over the last few years. Viruses are the principal production problem, and they are severe all over Turkey, both in farmers' fields as well as in research plots. Bean common and bean yellow mosaic viruses are the most prevalent. Root rots, powdery mildew, common bacterial blight, mites (both red and grayish black), and black aphids can also be problems in some areas.

Rainfed regions (Black Sea)

In this region viruses again are the most common production problem. However, rust (a disease completely unknown in all other regions of Turkey) can be equally frequent and devastating, causing up to 100% crop loss, especially in green beans. Also, *Chaetoseptoria* leaf spot occurs in many farmers' fields and in research plots at Samsun. Anthracnose and angular leaf spot are minor problems. Insect damage is minimal because Turkish farmers frequently use insecticides on their crops.

A summary of bean production regions, bean types, and their problems is given in Table 1.

Research Activities

Turkey has 11 agricultural research institutes located in different regions throughout the country. Each of them has a separate director but all are under the same General Directorate of Research with headquarters in the Ministry of Agriculture, Forestry and Rural Development, at Ankara, the capital city.

The first institute to initiate research (in 1965) in food legumes was Eskisehir in the western transitional region. The Agean Region Agricultural Research Institute at Izmir was the second. Both of these have collected some local bean germplasm (less than 1000 accessions). While the institute at Eskisehir has done some agronomic evaluation and hybridization in the last 20 years, no other institute in the country had done much work in beans until 1983. There are two scientists working at the Eskisehir Institute and they offered two bush bean varieties for registration in 1982. Because of severe halo blight incidence in the nurseries, a crossing program has been started to transfer resistant genes from *Phaseolus coccineus* and resistant *Phaseolus vulgaris* lines to the adapted local lines. One person in Erzurum is working on bean common mosaic virus and conducting yield trials in eastern Turkey. Two new people have been added to bean research, one in Sakarya and one in the Samsun Institute.

These are dedicated scientists, but they require better preparation, germplasm, and research information. It is hoped that through the National Coordinated Project, gradually more institutes will participate in bean research. Attempts will be made with regional and international centers such as CIAT to obtain the necessary collaboration for improved germplasm, training, and information exchange.

Table 1. **Principal bean production regions, bean types, and production problems.**

Production regions	Cropping systems	Bean types	Production problems
Irrigated high Anatolian plains (elevation 500 to 15,000 masl) Eastern, western, and central plains: K. Marash, Malatya, Konya, Kayseri, Nigde, Ankara	Monoculture	**Dry bean types I, III:** Dermason, Selanik; medium and large white	BCMV, BYMV, halo and common blight, late maturity, drought, low temperature, powdery mildew, aphids
Irrigated transitional plains (elevation sea level to 500 masl) Mediterranean, Marmara, and southern zones: Antakya, Antalya, Bursa, Balikesir, Tokat, Amasya	Monoculture and intercropping with fruit trees and horticultural crops	**Dry and green bean types I, III, IV:** Dermason, Selanik, Horos, Seker, Barbunya; medium and large white, cream mottled, and striped	BCMV, BYMV, root rots, common bacterial blight, mites, aphids
Rainfed Black Sea Region (elevation 10 to 300 masl) Samsun	Intercropping and some monoculture	**Dry and green bean types III and IV:** Barbunya, Dermason, and Selanik; medium-sized, cream mottled, striped, and white	BCMV, BYMV, rust, round leaf spot, anthracnose, angular leaf spot

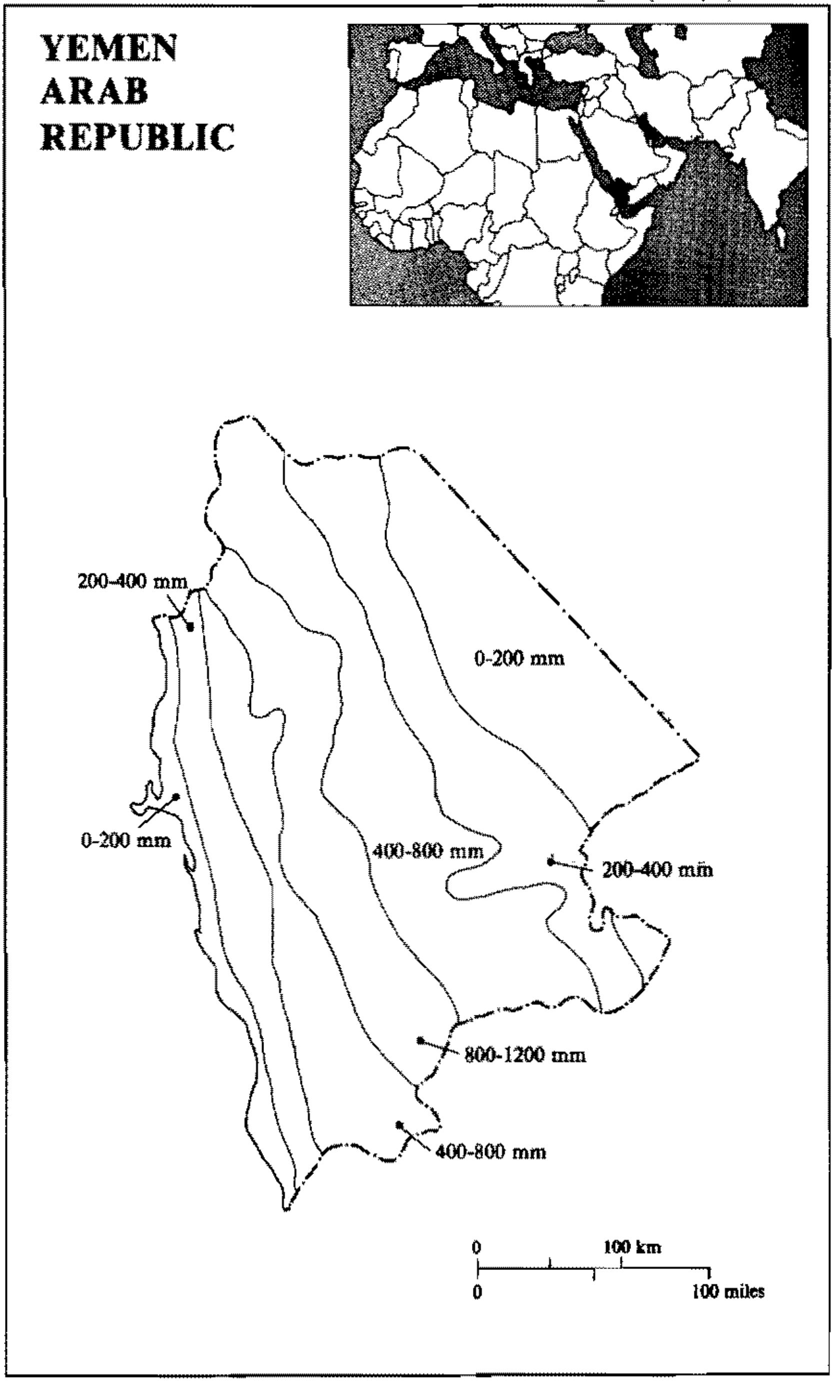


Figure 1. *Regional map with rainfall divisions.*

Bean Production in the Yemen Arab Republic

Hamoud A. Abdalla

Importance

Legumes come next after sorghum and pearl millet in terms of area cultivated (Table 1). The average area grown in legumes per year in the last 10 years (1972-1981) was about 72,000 ha, representing 6.5% of the arable land. The average production of food legumes was 75,000 t/yr (Table 2).

Field beans are considered the most important food legume grown, and their cultivation is widespread all over the country. Exact statistical data about the amount of area grown in this crop are not available.

Agro-ecological Zones

Yemen, situated in the southwestern Arabian Peninsula, lies between latitudes 12° and 17° N and longitudes 43° and 46° E, within the northern limits of the equatorial climate. It is bordered to the north by Saudi Arabia, to the south and southeast by the Yemen Democratic Republic, and to the west by the Red Sea (see Figure 1).

The country's area is 20 million ha, of which around 1.5 million ha are arable (about 7.5% of the total area). Eighty percent of the arable land depends on rainfall. Maximum rainfall occurs in two seasons: April-May and July-September. An almost completely dry period occurs immediately before winter. Irrigation water comes from seasonal winter rains as well as from artesian wells.

In the highlands, the most widespread soils are calcareous silt loams and silty clay loams. On mountain slopes, stony alluvial soils of high clay content are found. In the lowlands, soils in valley beds contain transported elements of the two above types of soils. All soils have a high pH (7.8-8.5).

The country can be divided into five agro-ecological zones as described below.

Table 1. **Annual area and production of main crops (1972-1981 average).**

Crop	Area (000 ha)	Area (% of total)	Production (000 t)
Sorghum and millet	802	72.1	666
Maize	28	2.5	43
Wheat	64	5.8	64
Barley	54	4.9	55
Dry legumes	72	6.5	72
Vegetables	23	2.0	212
Potatoes	9	0.8	99
Grapes	10	0.9	46
Coffee beans	3	0.7	3
Fruit trees	13	1.2	70
Alfalfa	3	0.3	41
Cotton	11	1.0	11
Tobacco	5	0.4	6
Sesame	10	0.9	6
Total	1112	100.0	

SOURCE: Central Planning Organization, Y.A.R.

Table 2. **Area, production, and yield of dry legumes (1972-1981).**

Year	Area (000 ha)	Production (000 t)	Yield (kg/ha)
1972	60	56	933
1973	65	64	985
1974	71	71	1000
1975	76	76	1000
1976	72	82	1139
1977	76	77	1013
1978	74	79	1068
1979	72	80	1111
1980	75	84	1120
1981	74	80	1076
Average	72	75	1045

SOURCE: Central Planning Organization, Y.A.R.

Coastal lowlands (Tihama plain)

This region is a strip of land 30-60 km wide, stretching the length of the country from north to south between the Red Sea up until the western side of the mountains. The elevation ranges from sea level to

200 masl. Tropical conditions of high temperature and humidity prevail. Strong winds cause sand storms throughout the year, but particularly in the summer. Since rainfall is scarce (50-300 mm), agriculture depends mainly on irrigation from run-off water in valleys that traverse the plain from the central mountain range on the eastern side to the Red Sea. Some irrigation from wells is also practiced.

Western slopes

Situated between the Tihama plain and the central highlands, the elevation of this area ranges from 200 to 1500 masl. The landscape is rugged and cut by deep valleys. Arable slopes are transformed into terraces. Rainfall ranges from 300-500 mm.

Southern highlands

This region comprises the southern part of the central mountain range exceeding 1500 masl. It is characterized by high rainfall which may reach up to 1200 mm per year.

Central and northern highlands

These highlands of the central mountains range in elevation from 1500 up to 3700 masl. Rainfall varies considerably, from 300 to 800 mm, and increases from north to south and from east to west. The area has a tropical highland type of climate with mild summer nights and cool winter nights. The arable land lies mainly in intermountain plains with some on terraced mountain slopes. Rainfed cultivation predominates, but well irrigation is increasingly practiced in the central plains.

Eastern plateau

This region falls between the central highlands and the desert (Al Rub Al Khali). Rainfall is between 100-200 mm, and the climate is that of a hot subtropical desert. This region has little agricultural potential. Most cultivation occurs along the valleys that flow eastward from the highlands.

The most important areas for field bean cultivation are the central, western, and southern highlands. The crop is intercropped with sorghum in the upper part of the Tihama areas and with maize or potatoes in the highlands and valleys. Small areas of beans are also grown at very high elevations.

Types and Uses

Almost all the beans grown are bush types. The leading variety is a local bush type (Baladi) with light brown medium-sized seeds. Beans are grown much more for the dry seed than for the green pod.

The primary local consumption of beans is in the dry seed form. Boiled dry beans are cooked with onions, spices, and tomatoes and served with bread for breakfast and supper. There is some consumption of green pods, cooked with onion, tomatoes, potatoes, and meat for a luncheon dish. Per capita consumption is unknown.

Cropping Systems

Field beans are sown in February during the spring in the highlands and harvested in May or June. The farmer follows simple and traditional management practices with beans. The land is tilled after the harvest of the previous crop using the locally-made plow. Very few farmers use modern tillage equipment.

The seed, mixed with sorghum or maize seeds, is sown in rows behind the plow. Farmers use a seed rate of 60 kg/ha, which is low because beans are usually intercropped with sorghum, máize, or potatoes. Table 3 gives the seed rate of beans and other legumes.

Beans are usually weeded once or twice. Farmers fertilize rarely, and use manure when they do. Hand harvesting is practiced, and it is considered expensive due to scarcity of laborers.

Production Constraints

Field bean production in Yemen faces the following constraints:

- Pests and diseases, mainly aphids, whitefly, rust, and viral diseases

Table 3. **Seed rates of field beans and other legumes.**

Crop	Seed rate (kg/ha)
Field beans	60
Faba beans	70
Cowpeas	40
Fenugreek	100
Lentils	50
Peas	50
Peanuts	70

SOURCE: Agricultural Economic Department, Y.A.R.

- Lack of improved cultivars
- High cost of production

Imports

According to Yemen Central Bank statistics, in 1981 Yemen imported 1387 t of dry beans at a cost of approximately US $680,000. In the same year, imports of canned beans cost about US $3.3 million.

Research Activities

Because of the nutritional importance of legumes in the population's diet and the integral part beans play in daily meals, the government created a special food legume section at the main research station. Its objective is to improve the productivity of field beans and other legumes and find solutions to the constraints facing these crops. Research started with the collection of local germplasm and its evaluation in yield trials. The average yield was good when compared to that of other countries. In one study, a random sample of farmers was visited and the average yield of field beans was 1200 kg/ha. Table 4 compares these results with those of other food legumes considered in the study.

Comprehensive research on beans is yet to start. Some varieties from CIAT were evaluated during the summer season in 1981 at Ibb, and the results were promising. It is anticipated that with the establishment of the Agricultural Research Authority in 1984, more effort will be directed to research on beans.

The extension service is interested in bean production but has little information to provide at present. There is no organized seed production for beans. Farmers usually keep their own seeds or obtain them from their neighbors.

Table 4. **Yields of various legumes in comparison to field beans.**

Crop	Yield (kg/ha)
Field beans	1200
Faba beans	1100
Cowpeas	900
Fenugreek	1200
Lentils	600
Peas	1100
Peanuts	1200

SOURCE: Agricultural Economic Department, Y.A.R.

Publications

Agricultural Research Service, Y.A.R. 1981. Annual report.

Al Thour, A.M. 1975. The soil of Yemen Arab Republic.

Central Planning Organization, Y.A.R. 1981. Yearbook.

Kambal, A.E., Abdalla, H.A., and Abdul Gabbar, H. 1982. Status of sorghum improvement in Yemem Arab Republic. Paper presented to the Regional Workshop on Sorghum Improvement in Eastern Africa, Ethiopia, 17-21 Oct. 1982.

Summary of Panel Discussions

Panel sessions were held to discuss a collaborative regional project with CIAT covering the following topics: genetic improvement, plant protection, agronomy and seed production, and training. Summaries of these discussions are provided below.

Genetic Improvement

A high priority for genetic improvement of bean varieties is to increase tolerance to high temperature and saline soil conditions. These are major production constraints in many bean growing regions. CIAT will collaborate with the national programs to collect germplasm in West Asia and North Africa with financial support from the International Board for Plant Genetic Resources (IBPGR). Additionally, CIAT will provide any number of accessions from its germplasm bank of over 32,000 entries to the national programs.

Varietal requirements

Cultivars to be used for green beans, for dry seeds, and for dual purpose are required by the different national programs in the region. Varieties must be developed for monoculture as well as for mixed cropping. Some participants felt that bush beans were good for both types of cropping practices, and that climbing beans were superior only in mixed cropping.

Breeding for resistance to bean yellow mosaic virus, salt, and heat was felt to be of highest priority. Other production constraints for which resistance should be obtained through breeding include rust, *Fusarium* wilt, root rots, bacterial blight, and whitefly.

Most countries in the region are attempting to identify superior cultivars through introduction and selection. Recently, hybridization programs were initiated in a few countries to develop improved cultivars. CIAT will provide finished material according to the specific needs of the country. Segregating populations, crossing blocks, or finished lines will be made available upon request. The need was expressed for placing one or two CIAT bean scientists at ICARDA to screen material derived from Latin America for local adaptation and tolerance to local production constraints.

Seed types

Most countries in the region prefer medium-sized seeds of white or cream color. However, some countries prefer large-sized seeds of red or pink color. CIAT will give priority to generating and distributing seeds with these characteristics.

Nursery requirements

CIAT provides three types of nurseries: segregating populations or advanced segregating lines, yield trials of finished lines, and screening nurseries of potential parents for tolerance to specific environmental conditions, diseases, and pests. Most national programs expressed a desire to obtain finished material, although a few wanted to receive segregating material. At least two months' advance notice should be provided when requesting nursery stock to provide ample time for transportation. CIAT headquarters in Colombia will furnish nursery material until a CIAT scientist is stationed at ICARDA, after which the nurseries for the region will be organized from there. The need was also expressed for CIAT scientists to make trips to the region to assist in evaluation and problem identification in the nurseries.

Plant Protection

The panel discussion of the phytosanitary problems of dry beans in the region resulted in the following recommendations.

Survey and identification. Insect and disease surveys and identification should be continued and expanded, with special emphasis on the identification of virus diseases and their vectors.

Determination of economic importance of pests and pathogens. Basic information on the relative importance of insects and diseases affecting field beans is still inadequate. Some countries need to quantify more precisely the economic importance of specific insect problems and plant viruses in order to set priorities for genetic improvement.

Screening and breeding for resistance. The identification of resistance sources to diseases and insects is a high priority. CIAT can provide germplasm to the national programs to identify resistance sources, and will make crosses for local breeding programs upon request. The handling of segregating materials could be carried out by national programs with the assistance of CIAT scientists. Methods and systems will depend on the individual needs, objectives, and resources of the breeding program.

Acquisition of equipment and research material. Upon request, CIAT can assist the national programs in acquiring basic equipment and material either by helping with information about importation regulations or by identifying potential funding sources.

Agronomy and Seed Production

The importance of field beans varies greatly among the countries that participated in the workshop. Financial and human resources available for legume research generally are very limited, so it is important to assign realistic priorities to the different aspects of bean crop improvement. Some countries need to detail current production practices and identify existing constraints, both of which tend to be location specific.

Improvement in agronomic practices was considered as important as genetic improvement, and both should be part of an interdisciplinary and cooperative research program. Although improved cropping practices are available in a number of countries, many farmers still use traditional methods. In the future, new methods should be clearly demonstrated in on-farm trials with the active involvement of the extension services. An economic assessment should be part of such demonstrations.

Several aspects of research needs were discussed in the context of how CIAT and the national programs could work together to improve bean production in the region. The following points were emphasized.

Environmental data. Assembling available climatic data and soil surveys from the countries would help in interpreting crop responses in differing environments.

Crop rotations and labor. The effect of beans in present and future crop rotations should be considered with respect to succeeding crops and possible labor constraints.

Trial design and analysis. CIAT scientists should interact with national programs in trial designs and analysis, particularly in long-term rotational experiments. Both dry seed and green pod production should be considered. Such trials should be conducted in the participating countries of the region.

Weed control. This is an important aspect of crop improvement and consideration should be given to distributing chemicals to national programs and to weed control trials.

Nodulation. Lack of effective nodulation was reported in many countries and CIAT could greatly assist in identifying and distributing suitable strains.

Mechanical harvesting. Mechanical bean harvesting presents problems in many countries, and CIAT can cooperate with the national programs to help overcome them.

Seed production. The production of high-quality seed from newly-identified superior germplasm is crucial to the success of the bean improvement programs.

Training

CIAT provides 4-month group training courses in Spanish for junior scientists. Similar training opportunities are available to non-Spanish speaking scientists at the individual level.

CIAT will develop training courses in English for the region after CIAT staff members are stationed there. Opportunities for advanced study are also available at CIAT, such as scholarships for the research part of higher degrees. Additional funds to support training activities for the Mediterranean region should be explored.

Conclusions and Recommendations

1. The average yield of *P. vulgaris* in the region is low but its potential is considered to be high.

2. It is necessary to identify the constraints to increased production, covering both genetic and agronomic improvement. The support of CIAT experts or short-term consultants may be required.

3. Germplasm collection and evaluation should be undertaken as soon as possible.

4. International nurseries should be more widely distributed in the region.

5. The shortage of bean specialists in the region necessitates that more national scientists be trained.

6. A workshop on beans for scientists in the region every 3 to 4 years would be particularly valuable.

The above objectives will be more quickly achieved if one or two CIAT scientists are stationed permanently in the region.

It is felt that the first priority should be for a breeder who would:

- assist national programs in evaluating and identifying constraints with particular reference to pests and diseases;
- coordinate international nurseries and assist in their evaluation;
- assist national programs in developing effective breeding strategies;

- assist in developing and coordinating training activities in the field of genetic improvement;

- stimulate the establishment of seed production facilities.

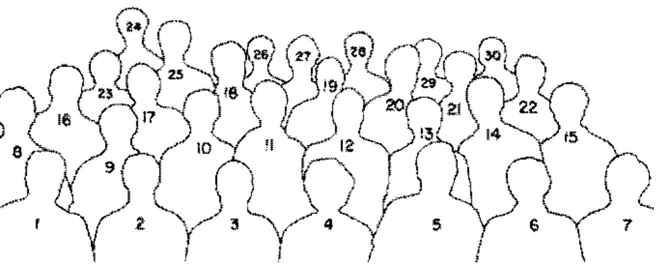
The second priority should be for an agronomist/cropping systems expert who would:

- advise and assist national programs on development of improved agronomic recommendations;

- stimulate the development of an on-farm trial network;

- assist in the development and coordination of training activities in the field of agronomic experimentation.

Participants



articipants at the Regional Workshop on the Potential for Field Beans in West Asia and North frica, ICARDA, Aleppo, Syria, May 1983

1. Dr. José Cubero	Spain	16. Mr. M. Kashani	Iran
2. Dr. S.B. Eldin	Egypt	17. Mr. Mohamed Hamui	ICARDA
3. Mr. Behrooz Sadri	Iran	18. Dr. Farouk A. Salih	Sudan
4. Ms. Oreib Tahhan	ICARDA	19. Mr. Asfaw Telaye	Ethiopia
5. Dr. Howard Gridley	ICARDA	20. Dr. Rajendra S. Malhotra	ICARDA
6. Dr. C. Cardona	ICARDA	21. Dr. A. van Schoonhoven	CIAT
7. Dr K.B. Singh	ICARDA	22. Mr. Bashir Malik	Pakistan
8. Dr. D. Laing	CIAT	23. Mr. Hamoud Abdalla	Y.A.R.
9. Dr. J. Gerhard	Ford Foundation	24. Mr. Imru Assefa	Ethiopia
0. Mr. Munir Turk	ICARDA	25. Dr. Habib Ibrahim	ICARDA
1. Dr. Salih H. Salih	Sudan	26. Mr. Abdi Amir	ICARDA
2. Dr. M. Tufail	Pakistan	27. Mr. Sakr Bouazza	Morocco
3. Dr. M.C. Saxena	ICARDA	28. Dr. Tessema Megenasa	Ethiopia
4. Dr. Mustaffa Hussein	Sudan	29. Dr. M.V. Reddy	ICARDA
5. Mr. Iqbal Soodi	Y.A.R.	30. Dr. S. Singh	CIAT

DIRECTORY

Egypt

Dr. Salah A. Baha Eldin
Director, Horticulture and Vegetable
Research Dept.
Ministry of Agriculture, Dokki
Cairo, Egypt

Ethiopia

Mr. Imru Assefa
Institute of Agricultural Research
Nazareth Research Station, P.O.Box 103, Nazareth
Shoa, Ethiopia

Dr. Tessema Megenasa
Addis Ababa University
Junior College of Agriculture
Debre Zeit Agricultural Experiment Station
Debre Zeit, Ethiopia

Mr. Asfaw Telaye
Institute of Agricultural Research
Holetta Research Station, Box 2003
Holetta, Ethiopia

Mr. Geletu Bejiga
Addis Ababa University
Junior College of Agriculture
Debre Zeit Agricultural Experiment Station
Debre Zeit, Ethiopia

Iran

Mr. Behrooz Sadri
Food Legume Researcher
Seed and Plant Improvement Institute
Karaj, Iran

Mr. M. Kashani
Vegetable Expert
Seed and Plant Improvement Institute
Karaj, Iran

Mr. Nosrat Zarepeyma
Food Legume Researcher
Seed and Plant Improvement Institute
Karaj, Iran

Jordan

Dr. Nasri I. Haddad*
Assistant Professor of Agronomy
University of Jordan, Faculty of Agriculture
Amman, Jordan.

Lebanon

Dr. Mahmoud B. Solh*
Faculty of Agricultural and Food Sciences
American University of Beirut
Beirut, Lebanon

Morocco

Mr. Sakr Bouazza
Food Legumes Breeder
Institut National de la Recherche Agronomique
(INRA) B.P. 415
Rabat, Morocco

Pakistan

Mr. Bashir A. Malik
Coordinator of Pulses
Pakistan Agriculture Research Council
P.O. Box 1031
Islamabad, Pakistan

Dr. M. Tufail
Director of Pulses
Agricultural Research Institute
Faisalabad, Pakistan

Spain

Dr. José I. Cubero
Escuela Técnica Superior de Ingenieros Agrónomos
Departamento de Genética
Apartado 3048
Córdoba, Spain

Dr. María-Teresa Moreno
Instituto Nacional de Investigaciones Agrarias
(CRIDA - 10)
Apartado 240
Córdoba, Spain

Amparo Martínez*
Instituto Nacional de Investigaciones Agrarias
(CRIDA - 10)
Apartado 240
Córdoba, Spain

Sudan

Dr. Mustafa Hussein
Hudeiba Agricultural Research Station
P.O. Box 31
Ed-Damer, Sudan

Dr. Farouk A. Salih
Shambat Research Station
P.O.Box 30
Khartoum North, Sudan

Dr. Salih H. Salih
Hudeiba Agricultural Research Station
P.O.Box 31
Ed-Damer, Sudan

Syria (see ICARDA)

Tunisia

Mr. Habib M. Halila*
I/C Legume Research
Institut National de la Recherche Agronomique de Tunisie
(INRAT) - 2080
Ariana, Tunisia

Mohamed Bouslama*
Ecole Superieure d' Agriculture du Kef
Kef, Tunisia

Turkey

Dr. Dogan Sakar*
National Food Legume Coordinator
Middle Anatolian Regional Agricultural Research Institute
P.K. 226 Ulusu
Ankara, Turkey

Yemen Arab Republic

Mr. Hamoud A. Abdalla
Agricultural Engineer
Ministry of Agriculture, UNDP
Agriculture Research Service
Taiz, Yemen Arab Republic

Yemen, People's Democratic Republic

Mr. Iqbal Soodi
P.O.Box 4429
Crater - Aden
PDR, Yemen

CIAT, Apartado Aéreo 6713, Cali, Colombia

Dr. D. Laing
Deputy Director General (Research)

Dr. A. van Schoonhoven
Coordinator, Bean Program

Dr. S.P. Singh
Bean Breeder

ICARDA, P.O.Box 5466, Aleppo, Syria

Dr. P.R. Goldsworthy, DDG (R)

Dr. G.C. Hawtin, (Int. Coop.)

Mr. Munir A. Turk, Food Legume Improvement Program, Research Associate

Mr. Mohamed Agha*

Dr. Howard Gridley, Legume Breeder, (Tunisia)

Dr. K.B. Singh, Chickpea Breeder (ICRISAT)

Dr. Willie Erskine, Lentil Breeder

Dr. Salim Hanounik, Pathologist, (Lattakia)

Dr. M.V. Reddy, Chickpea Pathologist (ICRISAT)

Dr. M.V. Murinda, Agronomist

Dr. C. Cardona, Entomologist

Dr. Larry Robertson, Faba Bean Breeder

Dr. Phil Williams, Quality Analyst

Dr. M.C. Saxena

Dr. Habib Ibrahim

Ms. Oreib Tahhan

Dr. Rajendra Singh Malhotra