Outlook for World Dry Bean and Pulse Production and Implications for Research

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With increasing population and production constraints, great challenges face the allied agricultural industries involved with dry edible beans and other crops crucial to our diet. Production of dry beans in Africa and Latin America by the turn of the century is expected to fall even further behind demand (Table 1).

Table 1. Expectations for dry bean demand for 2000 A.D.

Region	Demand	Current Shortage	Coming Shortage
	– million MT –		- % –
Latin America	6	0.34	34
Africa	4	0.76	73
Combined	10	1.10	

source: Doug Pachico, C.I.A.T.

Dry beans comprise the largest proportion of total world pulse production while dry peas are close behind (Table 2). Most dry peas are used for feed - especially in Europe and the former U.S.S.R. However, as the world protein supply becomes tighter, more dry peas may be consumed as food and they would compete with dry beans in some markets. As the standard of living decreases for some segments of society, foodstuffs such as dry beans are substituted for meat. Moreover, health awareness is spreading among developed nations with a trend toward less meat and more fiber-rich beans which lower serum cholesterol.

Table 2. Relative roles of dry beans and peas in World pulse production.

Region	Dry Bean	Dry Pea
	- % of pulses in 1984-86 -	
WORLD	29	26
U.S.A.	83	13
Canada	21	48
Mexico	86	NS
China	29	33
India	25	3
Europe	18	52
Africa	30	5
former U.S.S.R.	2	75

source: FAO Yearbook

World production of pulses is currently at about 55 million metric tons (MMT). India, China, the former U.S.S.R., and Europe, respectively, lead in production (Table 3. source: FAO Yearbook). Total production has increased steadily over the past decade, but has remained stagnant in some of the regions with the greatest need. Africa's decrease is largely due to recurrent drought. Europe's production, which is mostly dry peas for feed, is leveling off due to reduced price supports. The former U.S.S.R. production has declined since their dissolution. Asia is steadily increasing production. Efforts to increase productivity in Latin America have been partly offset by a trend to push bean production to more marginal land.

The largest exporters of dry beans are China and the U.S.A., respectively (Table 4. source: FAO Yearbook). Although China's population is comparable to India's and India imports substantial quantities of pulses, China, with roughly half of India's production volume, is a large exporter. The low quality of their production and internal demand may signify a peak to their exports.

Table 3. Trends in World pulse production.

Region	1979-81	1984-86	1990-92
		in k MT	
WORLD	40.9	51.7	57.3
Africa	5.4	6.0	5.9
Asia (other)	4.2	5.5	7.3
China	6.6	5.9	6.6
Europe	2.5	4.7	7.6
India	10.5	12.4	13.2
L. America	3.4	3.9	4.1
N. America	3.0	2.8	3.7
Oceania	0.2	0.9	1.7
U.S.S.R.	5.1	9.6	7.2

Table 4. Some major pulse exporting countries.

Country	1984-86	1990-92
	avg. k MT/yr.	
Canada	218	416
USA	489	647
Argentina	201	160
China	245	811

A major factor in the challenge to increase the role of dry beans in human nutrition is to keep them affordable while still profitable to produce. In the following model (Table 5), a combination of production efficiency and genetic gain in yield (2% per annum) result in a net improvement in the break-even price required by the producer. The model assumes a 4% inflation rate offset by a 2% production cost decrease for a net 2% annual cost increase. A substantial portion of the production efficiency gain can be realized from genetic improvements in disease tolerance resulting in fewer sprays required. Other gains should come from some of the cultural aspects discussed below.

Table 5. Dry bean production cost and profit models.

Year	Prod'n cost	Break-even Yield	Break-even price	Profit @ 2 prices $.16/lb.	Profit @ 2 prices $.20/lb
	$/Acre	lb./A	$ / A	$ / A	$ / A
1993	$200	1600	$.125	$56	$120

2000	$230	1838	$.125	$64	$138

Field operations must be minimized to reduce costs and compaction. Several root rot pathogens consistently rob yield and soil compaction increases the problem. Narrow rows and direct-harvest should now be more feasible than in the past. The advent of improved herbicides, upright varieties, floating heads, air reels, and axial flow threshing action should allow good managers to deliver clean, high quality beans by direct harvest.

Reduced tillage is likely to be mandated in many areas of the U.S. by the U.S.D.A. This will have long term benefits, but will bring some short term challenges such as weed pressure, colder seed beds, and disease carrying residues. Some varieties, especially white beans, will have difficulty in cool, wet soil. Varietal selection for cold tolerance will become more important. Most of the important diseases of beans can be carried on residues or regenerated from volunteer beans in the next crop. Timely sanitation (such as a 2,4-D spray on volunteers in nearby wheat) or early protective sprays on the beans will become more important until higher levels of genetic tolerance are available in commercial cultivars.

With the extensive interchange of breeding material internationally, bean breeding can be viewed as a large recurrent selection program. In this light, the frequency of favorable alleles for yield, architecture, and disease tolerance appears to place us at or very near the "selection cycle" where larger advances are made. However, a few gaps will remain. Gains in disease tolerance will be slowed by the necessity to maintain an acceptable or improved distribution for earliness and consumer quality at the same time.

Most past efforts in the U.S. on root rot research have focused on Fusarium solani. Rhizoctonia solani is also endemic in most of the world. Seedlings which are not killed often have lesions which widen as stems grow and facilitate entrance for fusarium. Increased research for genetic root rot tolerance and improvement and seed treatment chemicals would result in immediate yield gains.

Brown spot, caused by Pseudomonas syringae pv. syringae, is increasing in occurrence in the Great Plains and Min-Dak. Only moderate tolerance is present in a few varieties. More and more clones for broad disease resistance or anti-biosis are becoming available for transformation. Various genes have been found to express in multiple species. A more reliable transformation and marker system is needed.

White mold, caused by Sclerotinia sclerotiorum, is the most destructive disease of dry beans in the U.S. Current strategies for genetic control include avoidance through selection for upright architecture with an open canopy. Physiologic tolerance from 'Ex Rico 23' has been widely used, but such sources tend to have green stems after pod maturity. This creates a problem for harvest since the stem sap smears the beans. Smearing is even worse with direct harvest. Sources of tolerance need to be identified with better stem dry-down.

Diseases such as bean rust (caused by Uromyces appendiculatus) and anthracnose (caused by Colletotrichum lindemuthianum) are governed by gene-for-gene host-pathogen interactions. The presence of single genes for resistance in cultivars will, over time, result in selection for hypervirulent pathogen strains. Deployment of additional vertical genes, such as the Mexique 2 anthracnose gene, and especially horizontal rate reducing genes, such as slow-rusting genes, will then be needed.

The outlook for dry bean production is strong. Efforts which focus on the main production constraints and quality will enhance the supply, marketability and profitability of the crop.