

and Ministries of Agriculture can improve research potential to some degree

Not only was the lack of research scientists mentioned but also the lack of extension officers and the communication gap between them which was considered of great importance and one of the reasons why improved technology has not reached the farmer

Besides the limitations in personnel the level of training the availability and exchange of scientific information were considered inadequate. Better access to literature and easier dissemination of information are needed. Research support at the experiment station is generally insufficient. Existing language barriers in Eastern Africa also limit free exchange of scientific information.

Research Achievements

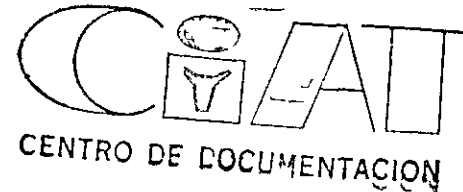
Despite the small size of programs much has been achieved over the past years. Production methodologies have been developed to overcome some of the constraints mentioned. New varietal introductions, individual plant selections or progenies from hybridization programs have been released but have received varying degrees of adoption by farmers. Unavailability of seed and commercial unacceptability may have contributed to the lack of adoption. Despite such and other achievements much more will be needed to increase bean production in this region.

Conclusions

FAO estimates of bean production in Africa indicate that over the last 10 years bean production increased in Africa but this was due only to area increases. In most cases this increase in area under production was partially offset by a productivity decrease of over 2% per year in some countries. Only in few countries like Tanzania were area increases accompanied by productivity increases. Part of the reason for reduced productivity is the replacement of beans by other less risky crops like cassava and plantain — as reported for Uganda — which provide less protein to humans. In these cases bean production often was displaced to more marginal areas. To insure a growing population with a steady supply of adequate affordable protein rapid solutions must be found to overcome the bean production constraints outlined in this report.

20054

Summary of Panel Discussions

20054 Regional

Agronomy

The panel discussed the wide area covered by agronomy which includes regional yield trials of promising materials, plant density, cropping systems, research, fertilization, weed control, crop physiology and stress studies, irrigation, and mechanization of the small producer. Out of this wide range of activities the following list of priority research areas was proposed:

Regional yield trials To be carried out on a permanent multicational basis with new releases from breeding programs. By deleting poor performers and adding new releases such systematic regional trials should result in recommendations to farmers and to the seed industry of superior new genetic materials. Such trials should be conducted under the principal cropping systems and input levels used by the farmers. As a result different varieties can be recommended for mono and associated cropping systems and for different ecological zones. Cropping practices of small farmers should receive adequate attention.

Farm survey The panel assigned high priority to conducting detailed farm surveys to obtain knowledge on major production systems and production constraints. The survey should also include storage practices and losses during storage as well as sales of surplus production.

Weed control Most bean plantings suffer severe losses from weed competition and weed control costs reduce profitability of bean

production Thus studies on weed competition should be conducted to give weed control recommendations to farmers Depending on availability and cost of labor and the possible enrichment of soils by incorporation of weeds herbicidal recommendations should be formulated

Plant nutrition Priority research should be directed to the use of *Rhizobium* for N₂ fixation ability of cultivars to fix nitrogen and inoculation techniques

Cultivars should be tested for tolerance to low soil phosphorus an important limiting factor while the use of cheap phosphorous sources like rock phosphates should be studied The use of farm manure and other organic matter and their long term effect on soil fertility texture and bean yields need to be studied Profitability and risk of fertilizer applications should precede recommendations

Cropping systems Associated cropping patterns should be studied to improve bean yields since these are usually produced under such cropping patterns Relative planting dates plant populations fertilizer and pesticide recommendations should be developed for such systems

Plant population Farmers usually plant at low densities in hill plots thus saving seed and labor Research is needed on the effect of plant type or growth habit on yield and varying densities in order to develop the plant type acceptable to farmers

Low priority research areas include crop physiology (most national programs are too small to have this type of scientific expertise available) stress studies (acidity drought irrigation) and mechanization The last two concern large estates Studies on small scale production mechanization like the use of oxen for land preparation planting and cultivation could result in high pay off in certain areas

Breeding and Selection

Each country delegate presented information regarding the present production situation in their countries information which appears in detail in the preceding country reports they also described existing breeding programs and their capabilities facilities for exchange of genetic material technical assistance needs and future plans mention was made of the experiment station and other publications in each country and their availability to other scientists in the region

The main points extracted from the panel discussions were

Generally genetic improvement programs are actively involved mostly in breeding for multiple disease resistance genetic improvement is needed in both bush and climbing types often resistance sources are not available further training of research scientists is needed preferred seed types are generally large to medium sized seed of red red mottled or brown mottled types

CIAT agreed to send free of charge for one year literature abstract cards to all participants

Universities in the Eastern Africa region should be encouraged to compile and publish research findings from undergraduate research projects

Routine practices of *Rhizobium* inoculation in screening trials was supported

Screening of disease reaction should be preceded by a thorough identification of all races of the pathogen

A newsletter containing review articles and short notes should be produced and circulated regularly to Eastern Africa scientists

The possibility was discussed for arranging annual meetings of bean researchers in the region

Plant Protection

Participants discussed the range of bean diseases and insect pests reported to occur in Eastern Africa The major diseases included anthracnose halo and common bacterial blight rust and angular leaf spot Other diseases (minor or in restricted areas) included scab web blight powdery mildew floury leaf spot *Ascochyta* leaf spot bacterial brown spot and viruses (BCMV)

Bean fly and storage insects are considered to be very serious in many areas Little mention was made of nematodes which probably reflects lack of trained personnel Little mention was made of the presence of bacterial wilt even though this disease occurs in various regions according to Dr C L A Leakey

Various countries have conducted some type of disease survey however it appears that little effort has been directed towards obtaining more specific disease incidence and severity data required to firmly establish priorities. Various countries have conducted specific studies on pathogenic variability of pathogens such as those causing anthracnose, rust and angular leaf spot.

Table 1. Summary of priority diseases and pests of field beans in Eastern Africa

Country	BCMV	Hl blight	GBB	Anthracnose	ALS ¹	Rust	Root rots	Asc	hyta	Bean fly	Bean beetle
Burundi		x		x	x	x	x	x			
Kenya	x	x		x	x	x				x	x
Malawi		x			x	x					
Rwanda	x		x	x	x			x			
Tanzania	x			x	x	x				x	
Uganda		x	x	x	x	x					
Zambia	x			x	x	x					

BCMV=Bean common mottle virus; GBB=Green bean blight; ALS=Angular leaf spot

The panel of participants then discussed research priority needs for Eastern Africa and recommendations for CIAT's assistance. The major points covered include the following:

Training of national program personnel by CIAT is the most important and urgent need in Eastern Africa. Regional workshops should also be planned on a regular basis every 2-3 years.

The participants strongly urged CIAT to develop differential varieties to screen local populations of pathogens, to identify effective sources of resistance to monitor pathogens over time, and to help identify diseases actually present. These varieties would be an important tool to supplement needed country surveys of weeds, diseases, insects, and nematodes affecting bean production.

The International Bean Rust Nursery (IBRN) and a similar nursery under development for anthracnose resistance may satisfy this request.

The participants strongly urged CIAT to develop standard scales for measuring disease and insect damage as well as for evaluating disease resistance.

Disease inoculation and evaluation procedures should be standardized to facilitate exchange of results and germplasm throughout Eastern Africa.

High quality disease free seed production was considered to be vital and should receive much attention and support within every local program and country. However, many people felt that the farmers should be encouraged and trained to produce and maintain high quality seed on their own farms. Most seed production programs are oriented towards the European system which may not be able to handle the demand and distribution problems.

Additional studies are required on other disease/pest control measures, epidemiology, biology, inheritance of resistance, storage pests, and effect of different cropping systems. The latter topic did not receive support from all participants.

Priorities identified may be summarized as follows:

Immediate priorities

Identification of pests, diseases and weeds and their economic importance (see also Summary of Country Reports);
study of variability of pathogens;
use of IBRN recommended for Eastern Africa;
germplasm and evaluation; standardization of screening methods and keys for pests and diseases; screening for resistance to pests and diseases; genetics of resistance in collaboration with breeders;
Promotion of production and distribution of disease free seed;
studies on storage pests and their control.

Long term priorities

Studies on the biology and ecology of pests and disease epidemiology;
studies on effects of mixed cropping on pests and diseases;
regional and international cooperation in development of bean protection practices.

General priorities

Regional and international cooperation in development of bean protection practices;
regional meetings every two years.

Seed Production and Marketing

The seed production and marketing schemes of the following countries were briefly presented Kenya Uganda Malawi Tanzania Rwanda and Zambia They seemed to fall into somewhat different categories In Kenya a commercial seed company Hortiseeds is responsible for seed production of beans and other vegetables for which it makes some profit which goes to the organization and to the contract growers Tanzania and recently Malawi were using a scheme whereby a national company produces seed on its own farms first and later on contract with large growers In these cases the seed cost to the farmers is heavily subsidised in order to reach a price level above or very close to the ware price In Tanzania for example 10 kg bags cost 10 sh vs 5.7 sh ware price in Malawi prices are 20 t/kg and 12.20 t/kg respectively*

In Malawi the subsidy is paid by the government marketing organization ADMARC the price of production and treatment of the seed was reported to be about 75 t/kg Contract growers are paid a price high enough to be economically worthwhile

Zambia has a farmers cooperative crop seed association which produces seed during the early stages of multiplication on its own farms later on it is contracted with suitably trained growers

Seed certification schemes exist in all countries and are managed by governmental or semi governmental organizations Obviously the crops are inspected by the producing organization to ensure that they meet government certification standards

Both a seeds act and plant breeders rights exist in Zambia However no production of certified bean seed has taken place due to recent political changes in the country

In Uganda and Rwanda seed was produced entirely by the government mainly on their farms and sometimes under contract with growers In Uganda the seed was sold by the Uganda Central Cooperative Union However after a period of success the seed scheme broke down due to serious inflation which caused the market ware price to rise many times above the price paid for seed

In Rwanda the seeds were produced entirely in central and regional government farms and plots The seed was sold at the same price as the ware crop Rwanda has no seed certification schemes but has the

following quality requirements for their seed crop Genetic purity (minimum) 99.5-99.9% seed transmissible disease (maximum) 0.1-0.5% diseased seed except for *Corynebacterium* with 0 tolerance level

In some cases government pathologists assist with disease quality checks of the crop It was generally agreed that production of disease free seed is the most serious problem in all countries breeding for increased disease resistance is seen as a long term objective However isolation from other bean crops is generally used to try to reduce the spread of disease and possible outcrossing A comment was made that excessive inspection for genetic purity which involved much handling of plants could greatly expedite the spread of disease Isolation was also considered very difficult to obtain in the densely populated countries such as Uganda Rwanda Burundi and Malawi

There was considerable discussion on whether marketing of the seed should be subsidised It was said that there is demand for seed by both countries giving and not giving subsidies However there is such a shortage of quality seed in all countries that demand always exceeds supply so there was no conclusion to this discussion It was generally agreed that financial assistance would be needed in the earlier stages of multiplication to ensure enough quantities of basic or foundation seed

The size of the seed package sold to the farmer varied considerably ranging from 100 g to about 10 kg the latter a more common size It was suggested that the large packages may be too expensive for the farmer who wants to try a small amount Small ones obviously have higher production costs

In Kenya Hortiseed uses a seed bag with detailed agronomic instructions printed on the back with pictures and text which was found to be very promising for the use of quality bean seed It was considered that the use of quality seed accounts for less than half of the yield improvement of a good agronomic package In Malawi a package consisting of credit for improved seed and fertilizer is available

The most striking need in all countries is for more quality seed When small amounts of disease free seed are introduced the crop is easily infected by surrounding unimproved crops Possibly efforts could be made to concentrate the limited efforts available in certain areas providing them with an adequate supply of seed

Most countries need more storage facilities if more seed is to be produced

A good extension system to explain the benefits of improved seed and how to grow it was considered to be vital. It was also suggested that farmers be taught the best ways to save their own seed. This could become a major practice. The situation must be avoided whereby a farmer is converted over to use improved seed only to find that there is not enough seed for him to buy the following year, putting many farmers off. Publicity should be geared to the amount of seed available. It was hoped that the small farmer's success with hybrid maize led them to try improved bean seed. A note of caution was sounded on the widespread use of improved seed in that this could lead to the takeover of the crop by a single variety with the usual risks associated with it. This situation has been frequently observed in many other crops. Also in bean production varietal mixes are often used with good success but these are not produced by the seed industry. Genetic purity may be therefore much less important than genetic identity. Obviously seed companies find it easier to produce a single variety rather than several.

In summary one of the major constraints in bean production within the region is the non availability of high yielding disease and pest resistant clean seed at reasonable prices in the areas of production. Therefore the panel concluded that the main needs are

- Production and storage of larger amounts of good quality seed
- extension information to farmers on the use of this seed
- reliable and regular supply of quality seed located in convenient production centres
- more emphasis on production of seed for the small farmer as opposed to large farmers as well as teaching farmers how to produce and store high quality seed

Training and Extension

Introductory remarks on training Close examination of the information presented in the country reports shows that training of manpower in the various fields of agriculture is of crucial importance. For instance the Malawi report indicates that there has not been a permanent breeder for grain legumes and that the program is currently without the services of an entomologist. The research assistants employed are high school graduates without agricultural training hence requiring close supervision to obtain reliable research results. Also noted is the lack of trained personnel devoted to extension in beans. On the other hand Tanzania had 25 officers in 1975 who were expected to cope with bean extension in 13 regions of Tanzania. The story is similar in the other

countries where in some instances expatriate workers are recruited on short contracts and when they leave gaps in the various disciplines of agriculture are created or projects are abandoned altogether. Such are some of the constraints to improvement programs in grain legume production in Eastern Africa.

Training needs They can be broken down as follows

- High level manpower research scientists both at universities and ministries
- technical staff based at both universities and ministries
- extension workers
- farmer education

High level research scientists It was recommended that countries strive to establish a grain legume program with at least one well trained high level research scientist of at least MS calibre or its equivalent with experience to lead the program. This staff member must preferably be a senior person responsible for grain legumes preferably a breeder to be supported by an agronomist a plant pathologist an agricultural entomologist an extension worker an economist and a rural sociologist. Economic constraints and lack of personnel require that programs attend all legumes and not beans alone.

Technical staff It was noted that this kind of staff should be recruited at high school graduate level or better. Technical staff at this level must be encouraged and rewarded by attendance to short refresh and in service training courses and other incentives to pave their way for promotion beside improving their performance.

Extension workers Figures like those quoted above whereby 25 officers are spread over 13 working regions hamper production to a great extent. In such circumstances the need for training of more officers is obvious. Extension work is demanding and important. Thus the extension worker must be of a high caliber. He is under the obligation to translate the research findings and to be able to disseminate these findings to the farmer. Therefore it is important that scientists be involved in courses to ensure that the extension officers are updated on modern techniques of agriculture and the research scientists are informed of shortcomings in new technology. Besides in order to assist the extension worker the scientific staff must participate in preparation of extension bulletins that help extension workers make good recommendations.

Farmer education The best way to train a farmer is to do so in his land. However, when manpower resources are limited, it is advisable to have a training center for selected farmers who will later be expected to share the knowledge they have acquired with their neighbor farmers. It is recommended that research workers spend some of their time at the farms collaborating with the extension staff in their demonstrations. Thus, translation of findings can be done and a two-way communication is achieved.

The role of extension It was emphasized that the extension agent at the grass roots level performs a dual role: he (or she) communicates improved methods to the farmer, identifies farmers' problems, and communicates them to the research worker. In order to do this effectively, the extension agent must know and understand the farmer's situation in order to relay problems to the research staff and he (or she) must have confidence in and respect for the research staff so that their recommendations are delivered with confidence.

Deficiencies were noted in each of these relationships. Thus, it was recommended that contacts and communication between research and extension workers be improved in order to make research more relevant and easier to communicate to farmers and vice versa. Each country will have a hierarchy of extension personnel, but the grass roots personnel must be informed of farmers' problems and communicate them to the research workers. An extension research liaison unit at research stations was considered one of the possible ways to bridge such a communication gap.

In summary, the researcher, extension worker, and the farmer should be integrated at all phases of bean production in order to eliminate unnecessary delays and the waste of resources in the development and release of varieties and their economic production packages.

Defined targets Different packages are required for small and commercial farmers. The latter have greater access to higher level extension personnel and research workers. The extension service should serve both types but should concentrate on the small farmer, who is often neglected and who makes an important contribution to increased agricultural production; that contribution should be recognized and encouraged. The importance of production for the domestic market should also be emphasized.

Cropping or farming systems Extension workers should know the various farming systems, identify the most limiting factors, and

communicate them to the research staff. Small and large farmers have different constraints; the extension agent should be able to understand

Methodology Demonstrations in farmers' fields after variety trials should be done in various locations throughout the country. A long discussion ensued as to whether field demonstrations are the responsibility of the research worker or the extension worker, as to whether successful farmers' fields should be chosen (with possible increase in income inequality) or average farmers' fields, and the advantages and disadvantages of each. After a long discussion, the following alternatives were suggested:

The extension agent supplies inputs at cost to farmers who provide labor and follow instructions; the farmer gets crop in return. The extension agent provides inputs and hires labor using a farmer's field; crop pays for labor. A given farmer volunteers to plant the new variety in some central location, providing inputs and labor; an example is the National Marketing Board in Zambia. The Ministry puts the demonstration plot in neutral ground, hiring labor and doing its own supervision. Demonstration plots must be supported by visual aids, literature, etc. Extension workers may need further aids including radio forums, field days, etc.

Personnel A general discussion followed concerning the number of farmers the grass roots extension agent is expected to visit with inadequate logistic support. Both the quality and quantity of extension personnel may be inadequate; also, they may be alienated from research workers, supervisors, and farmers; some are inadequately motivated and may not be respected by the farmers.

Several suggestions were made regarding this topic:

Influential persons in the community could be utilized. Individuals from each village could be selected as liaison persons between extension workers and farmers and demonstrate the new packages; they could or could not receive payment for their services. Different persons could be selected periodically. Morale could be improved by more contacts with research workers at special workshops, field days, etc. Should extension workers be encouraged to have their own farms? Alienation may stem from poor pay, lack of transport, poor supervisors, etc. Young extension workers could gain experience from contacts with experienced farmers and older extension workers.