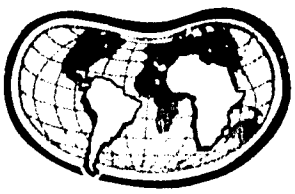
PD-ABK-698
93714

THE BEAN/COWPEA COLLABORATIVE RESEARCH SUPPORT PROGRAM (CRSP)

Bean/Cowpea CRSP
200 Center for International Programs
Michigan State University
East Lansing, Michigan 48824-1035 USA

Telephone: (517) 355-4693
Telex: 810 251 0737 MSU INT PRO ELSG



Funded through USAID/BIFAD Grant NO. AID/DSAN-XII-G-0261

REPORT OF THE EXTERNAL EVALUATION PANEL

Bean/Cowpea CRSP Five-Year Review

January 19-24, 1986

Michigan State University
East Lansing, Michigan

TABLE OF CONTENTS
REPORT OF THE EXTERNAL EVALUATION PANEL
BEAN/COWPEA CRSP FIVE-YEAR REVIEW

REPORT OF THE EXTERNAL EVALUATION PANEL
BEAN/COWPEA CRSP FIVE-YEAR REVIEW
Michigan State University
January 19-24, 1986

Introduction

To guide the External Evaluation Panel's Five-Year Review of the Bean/Cowpea Collaborative Research Support Program, the CRSP Management Office provided a scope of work[1] designed to determine " . . . what really has been achieved. . . ." The scope of work indicates clearly that the evaluation should be made in the context of constraints identified when the CRSP was organized and which are guiding features of a global plan. To insure such an evaluation, the Management Office organized the review meetings around the following six constraint areas:

I. Insect Pest Limitations

II. Disease Limitations

III. Plant Response Limitations

IV. Physical Response Limitations

V. Storage Problems, Nutrition, Food Preparation and Health

VI. Farming Systems, Production-Consumption Economics and Socio-Cultural Factors

The evaluation was made from written reports, presentations by Principal Investigators and discussions with available CRSP participants and officials. In 1985, there was only one site visit by the EEP to evaluate CRSP field research activities in the United States or in collaborating countries. This can be a major deficiency in the evaluation of crop research, especially in developing nations, where a variety of often unavoidable circumstances may influence the nature and usefulness of research results, as well as the CRSP collaboration process. A 1986 EEP site visit report of the Kenya CRSP project underscores this circumstance.

An agricultural research program with global aspirations must be evaluated in relation to similar research in process throughout the world; therefore, an evaluation of the Bean/Cowpea CRSP should be made with reference to the nature, magnitude and impact of significant bean and cowpea research activities (or lack thereof) worldwide. For this reason, the EEP chair asked the Management Office to secure and make available such information for use during the review.

---

[1]See Attachment A.

The time available for the evaluation, the number of constraints to be reviewed for two crops, the time provided for separate discussions with project Principal Investigators, the unavailability of several written reports of the CRSP constraint groups to the EEP, and the general lack of factual knowledge concerning the status of bean/cowpea research worldwide on the concerned constraints all combined to make the assessment of the contributions of CRSP projects, individually and collectively, to the reduction or removal of the identified constraints to bean and cowpea production and utilization less than fully satisfactory.

Nevertheless, with the full cooperation of all concerned, the EEP did its best to carryout its "scope of work." To be sure, the overall evaluation of work related to constraints falls short of what had been hoped; but, on the other hand, the ratings of the performances and contributions of individual projects (which were based on previously received written reports and discussions during the review with US and Host Country Principal Investigators) were of satisfactory quality and should be useful to CRSP and USAID officials.

Program Evaluation: Overview

As the review of "constraints" has proceeded, it seems true that the only programs of global importance and significance on the two crops are those of CIAT (beans), IITA (cowpeas) and the Bean/Cowpea CRSP. It also appears true that the number of bean and cowpea researchers and production specialists worldwide is rather small, relatively and absolutely, and that a large portion of these people are involved in the Bean/Cowpea CRSP, except in Asian countries. Of course, CIAT and IITA are responsible for the world's largest single programs on beans and cowpeas, but the level of work on these crops may not be commensurate with worldwide needs. The level of research and development on beans and cowpeas, particularly in Africa, is probably insufficient to support rapid advances in production and utilization of the crops. Moreover, constraints in the technical domains relating to the production of the crops are often less important than constraints in the wider environment of the producers--effective domestic or market demands; output delivery systems including storage and processing as well as transport, markets and marketing; scarcities of production resources and competition for them with other enterprises in the biological production sector or with other sectors of the life systems of producers; and policies, difficulties and practices of governments. Against this background, improvements in knowledge and knowledge services (including research) may be a necessary condition for advances in the quantity or profitability of production and the quality of products, but they are seldom or never a sufficient condition, particularly in the less developed nations. Important as it is, natural science-based research must beware of claiming too much.

At the end of five years of activity and financial support, what are the contributions of the Bean/Cowpea Collaborative Research Support Program?

Production

The CRSP has not yet had a measurable impact on the production of beans or cowpeas. Senegal seems to be the exception but, through Dr. Hall, the CRSP had a head start in Senegal. Five years is usually too short a period to substantially impact crop production through research and training, especially when the required arrangements are weak and/or virtually non-existent as they were in some of the CRSP collaborating countries when the CRSP was organized.

Knowledge/Technology Generation

The CRSP has produced valuable, useful additions to knowledge and production technology. In certain areas of bean and cowpea research--biological N-fixation; breeding for drought and disease resistance; socio-economic studies and gender issues; collection and study of landraces biological control of insects; epidemiological studies and serological diagnostic screening; and processing procedures to improve nutritional and taste qualities--the CRSP is the most significant, sometimes the only, contributor.

Training and Institution Building

When the CRSP was initiated, there was a dearth of well-trained, experienced scientists, technicians and workers engaged in bean and cowpea research and development in most, if not all, collaborating countries. Man of the national programs were quite weak and lacked adequate leadership, staff, facilities and financing. Over the past five years this circumstanc has been substantially improved, at least partially, through CRSP stimulus support. In the area of capacity building, the numbers of persons who have received training under CRSP arrangements have been substantial, especially the graduate and baccalaureate levels. Training has been a major contribut of the CRSP.

Support for Research

In the short period of less than five operational years, the Bean/Cowpea CRSP has helped to pull together disparate, often isolated, efforts of US university researchers into collaborative, mutually-supportive arrangements, domestically and internationally. There is a growing community of interest among bean and cowpea researchers in the US and Host Countries, which bodes well for the future of bean and cowpea improvement. Certainly, this is an important addition to the work of CIAT and IITA. At the conclusion of one o the presentations during the Five-Year Review, one US CRSP researcher of not exclaimed, " . . . the CRSP has been the best thing to happen to me in years

Program Evaluation: Summary Statements on Global Constraints

I. Insect Pest Limitations

Work on insect pest control, a significant part of the Global Plan, is limited in the Bean/Cowpea Collaborative Research Support Program (CRSP). No project deals with the insect constraint as a primary concern in the production of beans. In cowpeas, in which insect damage tends to be more severe than in beans, two projects include the management of insect pests. The Brazil/Boyce Thompson project is developing insect pathogens as biological pest management tools compatible with traditional insect control practices. Extensive screening tests indicate that select isolates of entomopathogenic fungi have considerable potential for microbial control of cowpea insect pests at low cost. This work is still in the stage of controlled testing.

The Cameroon/University of Georgia project has had to concentrate on the development of resistant varieties, study of insect biology, cropping systems, insecticides and their use, and with storage problems in order to provide producers with materials and procedures to control cowpea insects. By necessity, most of the information and materials are location specific to the Cameroon; however, some of the research, such as the work on the cowpea weevil, an insect of worldwide importance, seems likely to be widely useful. Boyce Thompson Institute determined the mechanism and consequences of dispersal polymorphism in the adult stage that enables the weevil to infest cowpeas both in the field and in storage. This research provided the first information on the mode of attack by the poorly known "active" or dispersing form. These results may pave the way to developing effective control measures against this important cowpea pest.

II. Disease Limitations

The contribution of the Bean/Cowpea CRSP toward the control of diseases is significant in beans but not in cowpeas.

Five of the twelve bean projects are primarily concerned with the disease constraint. The Brazil/University of Wisconsin/Maxwell project has developed improved techniques to inoculate bean cultivars sequentially with four major

bean pathogens. The use of detached, trifoliate bean leaves maintained in culture in vitro and the use of "natural" dry inoculant are promising techniques which will help breeders to develop bean cultivars resistant to several diseases. The Dominican Republic/University of Nebraska project has developed methods for simultaneous genetic research on the host plant and its pathogens. It has also developed a semi-selective medium (MXP) which is considered an important breakthrough in methods of isolating the common blight bacterium. Such studies are basic for improving the effectiveness of breeding for resistance to bean diseases.

The related projects involving the Dominican Republic and Honduras with the University of Puerto Rico have identified potential sources of resistance to several diseases of worldwide importance, including web blight and bean golden mosaic. Also, these projects are among the few research efforts attempting to increase resistance to several diseases simultaneously in red-mottled, large-seeded bean cultivars.

The diagnostic procedures using monoclonal antisera developed in the Tanzania/Washington State University project have greatly facilitated strain identification and monitoring of bean common mosaic virus. This is considered to be a technological breakthrough in improving breeding for BCMV-resistant beans. This contribution by the CRSP is of worldwide significance and illustrates the kind of contribution US university scientists can make through the CRSP.

III. Plant Response Limitations

This constraint is being addressed by the Bean/Cowpea CRSP through genetics and breeding work in Brazil, Mexico, Malawi and Senegal. It is related to the physical response constraint discussed in the next section.

The Brazil/University of Wisconsin/Bliss project represents the only effort in the world focused specifically on the development of bean genotypes with enhanced BNF ability. The research output of this project shows that BNF can be increased in bean cultivars by appropriate breeding methods. This is a major accomplishment of immediate benefit to national breeding programs, and it will also stimulate the development of research networks on BNF in bean producing countries of Latin America. Superior bean lines with high BNF

potential and reliable methods to increase the rate at which atmospheric nitrogen is fixed are now available to national bean research programs.

The genetic variability in landrace populations of beans grown in small farms has been sampled and analyzed by the Malawi/Michigan State University project. Landraces of beans generate and maintain genetic variability through natural crossing and perhaps under little or no selection pressure in farmers' fields. These findings are of worldwide relevance since the limited genetic variability available in the vulgaris species is believed to be a constraint that precludes the development of superior bean varieties. The comparative analysis of the performance of highly uniform varieties versus landraces may encourage bean breeders to explore ways to develop new varieties with wider adaptation and larger yield, using genetic pools of unselected bean populations.

Physiologic and agronomic traits are being studied by the Mexico/Michigan State University project to identify bean genotypes with high and low levels of tolerance to moisture limitations. Rhizobium strains are also being screened for ability to fix high levels of nitrogen under drought conditions. The genetic knowledge derived from this research is expected to be used in developing breeding strategies to produce bean genotypes which combine high yield and adequate levels of BNF under drought stress. The outcome of this research could help growers in the important semiarid areas of Mexico and other countries where limited rainfall keeps bean yields below 300 kg/ha. Significant advances have been achieved in the identification of promising bean germplasm while the Rhizobium results are still inconclusive.

The combined effort of the bean projects in Brazil and Mexico may lead in the near future to significant contributions of global impact when appropriately adapted combinations of legume hosts and Rhizobium strains are found. This will then represent a breakthrough for bean production with minimum inputs.

Plant response limitations in cowpea are being addressed by the Senegal/-University of California-Riverside project, through breeding for early maturity, drought adaptation and heat tolerance. Significant results have been achieved in the research work of this project which reveal that appropriately designed testing in the US can identify materials of benefit to other countries.

The impact of this project in the US and global contexts, as related to plant response limitations, can be summarized as follows:

1. Development of new cowpea varieties with improved canopy architecture to meet the requirements of the US mechanized farm production.
2. Stimulation and guidance to establish cowpea breeding programs in other countries.
3. Development of early and heat tolerant lines now being tested in Senegal and other African countries.
4. Development of a screening technique to compare differential root growth of cowpea varieties under drought stress using herbicides.
5. Development of a network, with the assistance of IITA, to test cowpea germplasm and exchange research information among cowpea programs in the US, Africa, South America and the Caribbean basin.

IV. Physical Response Limitations

General Agroclimatic Information:

All crops, everywhere, are affected by constraints imposed by physical factors of the environment. A research or development worker must therefore know the agro-ecological attributes of the localities in which he or she works. This helps to interpret variations between places and years and to guide transfers of information and plant material between locations. All annual reports should start with statements of the weather characteristics of the season and of its departures from the longer-term modal climatic values, supported by the essential numerical data. A useful base-line source is the reports of the Agro-Ecological Zones Project of FAO, which cover all countries of the developing world in respect of soils and terrain as well as climate.

Constraints in Particular Environments:

Soil conditions. Differences in texture and workability between different soils in Botswana have led to new techniques for managing minimal tillage and ridging for cowpeas on sandy soils. The simple equipment, of intermediate technology type, could be drawn by donkeys rather than by oxen. This enables the operations to be carried out by women and should lessen their physical workload.

Temperature. Though populations of beans are known, from both CIAT and CRSP programs, to vary in growth habit at different elevations in similar

latitudes, we have no precise information on this agronomically important topic. It is related to the Cornell component of the Guatemala project discussed below.

Warm or hot temperatures affect the fate of reproductive buds in both beans and cowpeas. In general, heat tends to promote abscission. It has been shown in the Senegal/UC-Riverside project that some genotypes of cowpeas are better able to tolerate heat than others. The genetic nature of the differences has been determined so that it is now possible to breed for tolerance of hot temperature, a useful attribute in some extreme environments in Senegal. This is a significant and novel achievement.

Water relations and drought. The projects in Tanzania, Kenya and Mexico on beans, and in Botswana and Senegal on cowpeas, include the search for types of these crops which are adapted to dry conditions. The most valuable type of adaptation has been short season length, which enables the crop to evade or escape drought by completing its life cycle within the period during which water is available.

This work has helped to advance understanding of the nature of drought in different environments: drought in Nigeria is a very different phenomenon from drought in Nebraska. This is a valuable intellectual achievement.

The simplest method of screening populations for adaptation to dry conditions is to grow them during several seasons in a number of places in which dry conditions are usual. This method is tedious and imprecise; and it often returns apparently inconsistent results because the dry conditions vary in detail from place to place and season to season. The Mexico, Kenya and Senegal projects have all investigated other methods. In Mexico, rain shelters and other methods of preventing water from entering the soil were used to screen beans for adaptation to dry conditions. At Riverside, herbicide was placed at depth in the soil to identify types of cowpeas whose roots penetrate the soil more rapidly. This could be a useful adaptation in those dry environments in which the pattern of rainfall and evaporation and soil conditions are such that a reserve of water exists in lower parts of the profile. Measurements of water potential, stomatal conductance and other biophysical attributes of leaves do not appear so far to have helped to identify drought-adapted types of either beans or cowpeas--though in correctly chosen conditions they might be able to do so.

The C13 discrimination technique may be useful in indicating plants which assimilate more CO_2 than others per unit of water transpired, but such plants still have to acquire water before they can use it efficiently and they must still be bound by the time limits imposed by the seasonal course of the water balance.

The most useful methods of testing employed in the Senegal/UCR project seem to be controlled irrigation and the sprinkler line technique (which has also been used in Kenya)--although further experience with both is needed to ensure that the experimental conditions match those to which adaptation is desired. In combination with field testing in Senegal, those methods have helped to select superior types of cowpeas for dry conditions. All of this adds up to important progress in methods.

The tepary bean (Phaseolus acutifolius) and tepary-dry bean crosses seem to include materials better able than most bean populations to withstand some types of drought. The CRSP management should ensure that this work is continued, perhaps in Tanzania or Mexico. That these crosses have been made and that testing has begun is one of the CRSP's important achievements.

Interaction between photoperiod and temperature. The effects on bean populations of photoperiod and temperature and their interactions are a set of ecophysiological adaptive devices to locate flowering and podfilling at favorable times in the crop season. This topic has been studied for a number of years at Cornell and is included in the Guatemala/Cornell project. The observations and data seem to be valid, but a serious attempt should be made to reconcile the terminology and interpretation used by the Cornell workers with those which have been used for many years by ecological plant physiologists elsewhere.

V. Storage Problems, Nutrition, Food Preparation and Health

Storage problems. Bruchid weevils cause serious losses of cowpeas during storage in many countries. The most promising approaches to alleviating this constraint have been undertaken in the Cameroon/University of Georgia project. Information on the biology of the bruchid weevil has been obtained in studies at Boyce Thompson Institute, and the mechanism for bruchid resistance has been described in advanced cowpea lines derived at IITA from a bruchid-resistant

accession, Tvu 2027. Resistance to larvae by the advanced lines was expressed as delayed growth of four geographically different strains of bruchid, unlike Tvu 2027 that increases larval mortality. Because infestations during storage are initiated by low densities of larvae in harvested pods and seeds, strains of bruchid were examined for their propensity to produce the "active" or dispersing form that is responsible for infestation in the field. Bruchid strains varied in production of the "active" form, but ability to produce the "active" form was inherited additively when population crosses were studied. These two approaches are expected to provide bruchid resistant cultivars and lead to biological methods to control bruchids.

Both beans and cowpeas, stored as whole seeds, become increasingly hard-to-cook. The INCAP/Washington State University project has shown that pretreatment with steam for ten minutes or soaking in a salt solution for five hours, followed by solar drying, prevents this change in dry beans that are to be stored for short periods. The Kansas State University portion of this project developed a method to determine the tendency of beans to undergo hardening during storage. They also developed a tactile method to determine cooking time in beans.

Automated equipment to measure hardness of cooked beans was designed at the University of Georgia and is available for use in screening cooked single beans for degree of hardness.

Nutrition, food preparation and health. Achievements in these areas include considerable data on protein quality and digestibility of cooked beans and cowpeas and changes in cooking quality due to differences in length of storage and temperature during storage. In the Nigeria/University of Georgia project, village level technology has been developed to dehull cowpeas efficiently and to grind dry, dehulled cowpeas to a meal that has suitable functional characteristics for preparing akara, a preferred food in Nigeria. This meal can be stored for at least four months without changes in quality. Good quality dry bean flour, from dehulled dry beans, has also been prepared by the INCAP/WSU project.

Twenty-three types of dry beans of known genetic background have been recommended for use as standards in accumulating research data on beans. A monograph containing standardized laboratory methods is being prepared for use of food scientists, nutritionists and plant breeders.

Information has been exchanged among researchers in projects within the Bean/Cowpea CRSP and among food scientists and nutritionists with similar interests in the Sorghum/Millet, Peanut and Nutrition CRSPs, as well as with US agricultural experiment station research workers. Interaction with personnel in bean and cowpea programs at CIAT and IITA has been strengthened during the four years that the Bean/Cowpea CRSP has been active.

Baseline data from Tanzania, Nigeria, Guatemala and Malawi include information on methods of home preparation of beans or cowpeas, the relative importance of beans/cowpeas as sources of protein in the diet, and taste preferences among varieties. These data plus information on nutritional quality and cooking quality before and after storage will enable plant breeders to make choices among cultivars for those acceptable to target audiences as well as for those with other characteristics related to increased production. Baseline information on weaning practices and child-feeding practices has given some direction also to research in food science and nutrition.

VI. Farming Systems, Production-Consumption Economics and Socio-Cultural Factors

Farming systems. The farming systems approach in this CRSP refers to a procedure to understand, in an efficient and timely manner, biophysical (natural, environmental, technical) and socio-economic conditions of farms and farmers and their characterization for purposes of orienting development research. It includes on-farm testing for purposes of evaluation by both researchers and farmers. Work of these kinds of farming systems is becoming an important element of development research and extension efforts throughout the world. A limited number of the projects have direct farming systems components, but virtually all are benefiting from clearer identification of farmers' problems and/or on-farm research in the Host Countries where they are active.

Perhaps the most complete farming systems effort in the CRSP is in the Ecuador/Cornell project where a team of social and biological scientists, both US and HC, have combined efforts to characterize farms and farmers and conduct on-farm research in two areas, one in the highlands and one in the lowlands, in which INIAP is active. These multidisciplinary studies helped determine

why closer spacing and some specific higher yielding materials were not acceptable to farmers in the two areas. In the Guatemala/Cornell project, researchers benefited from and provided additional support to the ICTA socio-economics program in its continuing farming systems activities. Well designed and appropriately analyzed and interpreted on-farm trials are an integral part of their activities. The Honduras/University of Puerto Rico project has benefited from reconnaissance surveys and on-farm research supported in part by other in-country projects. In Africa, direct farming systems components include agricultural economics in the Tanzania/WSU project and sociology in the Malawi/MSU project.

These activities can provide information critical to the biological researchers concerning periods when labor may be a constraint, relative dietary and economic importance of uses of plant parts at different stages of maturity (green leaves, green pods, green peas or beans, dry grain, dry fodder or forage, etc.), taste and color preferences, desirable plant architecture and potential limits to farm practices. Farming systems activities also include aiding in the selection of on-farm research locations, the design of on-farm research, and help in analyzing and interpreting results. As breeding and agronomic projects in this CRSP move more toward application of findings, multidisciplinary farming systems activities, including mixed cropping systems, will provide an ever more valuable contribution.

Production-consumption economics. The only project with a primary focus on economic constraints is in Tanzania. It emphasized the different "markets" for which beans are produced. When 50 percent of the bean output is produced to meet the farm family's own food needs, a very different set of considerations determine the characteristics of that part compared with the half produced for the market. Some technology may be appropriate for one and not the other.

When this dichotomy in uses of beans and cowpeas exists, increased production may create pressure to export the produce. In turn, export markets may require still another type of technology, e.g., color of bean, uniformity and attractive appearance. Suffice it to say that the economic analysis of markets is essential for the creation of appropriate technology.

Socio-cultural factors. The sociological work in Ecuador clearly indicates that bean producers should not be regarded as a homogenous mass of farmers. Because, for example, subsistence farmers are clearly different from commercial

ones producing for urban or export markets, their receptivity to new technology can be expected to be different. In fact, the technology needs are different, e.g., with respect to purchased inputs. Further, the work in Ecuador clearly demonstrated that natural science research workers must address the problems expressed by the farmers themselves rather than those which they imagine are important.

As with all crops everywhere, consumer preference is important in bean marketing. This has been documented by findings in Malawi. In fact, the work there indicates that two sets of preferences are important--those related to what is consumed immediately and those which concern what seeds are selected for planting. Further, the research documents the important role of women in both of these processes. Clearly, these factors must be considered in endeavors to improve technical methods intended to be used by farm families.

Program Evaluation: Project Ratings and Recommendations

Ratings and Recommendations Format

It is the normal business of the EEP to consider and make recommendations on the future of individual CRSP projects. On this occasion, the EEP felt this should be done with special care, since the CRSP may have to accept substantial budget reductions.

In the context of (a) contributions to reduction of constraints comprising the CRSP global plan, (b) operational mode and (c) prospective availabilities of funds, each CRSP project was reviewed and given one of the following category designations, ratings and recommendations:

Category	Rating and Recommendation
1	Highly satisfactory--continuation with no recommended changes.
1A	Highly satisfactory--major goals achieved; Board of Directors may wish to consider orderly phaseout in FY 86 or later.
2	Satisfactory--continuation with no recommended changes.
2A	Satisfactory--Board of Directors may wish to consider major adjustments in activities and/or budgets.
3	Satisfactory--Board of Directors may wish to effect an orderly change in mode of operation, perhaps by FY 87.
4	Unsatisfactory--Board of Directors may wish to consider orderly phaseout in FY 86.

CATEGORY 1

BRAZIL/UNIVERSITY OF WISCONSIN/BLISS

This project is the only one of its kind in the Bean/Cowpea CRSP, perhaps in the world, that deals primarily and exclusively with improving biological nitrogen fixation and bean plant response to nitrogen. It has a uniquely important role in the world of bean improvement (i.e. the IARCs, the CRSP, bean breeders and others) in that it is a principal source of information on the appropriate breeding methodology, analytical methods for quantifying N_2-fixation and superior plant/Rhizobia combinations, superior Rhizobium phaseoli strains and plant germplasm with potential for increased fixation. Through outstanding leadership in the US and Brazil, this project is on the threshold of what appears to be a bountiful payoff: selection for superior host plants has produced black bean lines that have been shown to fix up to 50-60 kg N/ha under field conditions. These lines fix more nitrogen and yield more grain than standard cultivars in use in Brazil. The work shows that selection for improvement of the host plant is an important factor for increasing the potential for symbiotic fixation of nitrogen. The project has also developed an improved method to enumerate Rhizobium phaseoli and potentially superior inoculant strains. Evaluation under farmer-use conditions remains. The research results of this project could have worldwide impact in increasing the supply of nitrogen for bean crops grown by small, resource-poor farmers. The project illustrates that a single project or line of research can have a substantial practical effect.

BRAZIL/BOYCE THOMPSON INSTITUTE/ROBERTS

Without question, insect pests adversely affect production and storage of cowpeas everywhere and especially in tropical environments. Through a well-designed and executed collaborative research plan, this project is making outstanding progress toward the selection and use of pathogens to be incorporated in cowpea insect control programs as supplements or alternatives to chemical insecticides. This is important because virtually no experienced insect pathologists are working on cowpea pests anywhere. Brazil is a most appropriate location for this pioneering project on cowpeas. In the northeast there

is the need and Brazil has the capacity to collaborate through a young cadre of BS and MS level plant protection workers and excellent laboratory and field research facilities. Accomplishments to date include: (1) establishment of an Insect Pathology Resource Center in Brazil, (2) establishment of laboratory colonies of fungal pathogens of cowpea insects, (3) surveys to identify and assess the prevalence and importance of cowpea insects and their pathogens in the principal cowpea-growing regions, (4) screenings of entomopathogenic fungi to identify the most promising strains, (5) biological assays of virulence, (6) completion of selected ecological and epizootiological studies, (7) formulations of entomopathogenic fungi for use in the field and (8) preliminary field and screenhouse trials of promising fungal pathogens. These sequential, systematic accomplishments have resulted in the successful, small-scale field application of Erynia radicans against Empoasca leafhoppers. Tests with Erynia radicans and Beauveria bassiana have demonstrated that fungal pathogens can be applied against cowpea pests without the use of prohibitively expensive formulation additivies or application machinery. It appears likely therefore that methods of the kind which this project is developing could be useful to limited resource, subsistence farmers wherever cowpeas are grown.

GUATEMALA/CORNELL UNIVERSITY/WALLACE

The sociological portion of this project was terminated September 30, 1985. Accomplishments include detailed descriptions and analyses of farming systems in one region of the Guatemalan highlands, including family farming patterns, agricultural zones and socio-economic and cultural characteristics of a representative group of farm families. With regard to the genetic portion of the project, research results have contributed importantly to improved understanding of how the interaction of daylength, temperature and cultivar regulate bean yield. These results could have considerable influence on agronomic and breeding improvement programs for beans and other crops in diverse environments and perhaps for other crops also.

MEXICO/MICHIGAN STATE UNIVERSITY/ADAMS

This project is another outstanding example of how a US university and a national Host Country research organization can join forces to try to

ameliorate a major crop production constraint. It has been noted by Dr. Adams that, "Among environmental limitations affecting the expression of genetic potential for and stability of grain yield in beans and cowpeas, none are more ubiquitous or adverse than limited and erratic rainfall and limited soil nitrogen and phosphorus." This collaborative project focuses on the improvement of bean production in the semiarid, temperate, non-irrigated highlands of north-central Mexico. As far as is known, there is no other project in the world where improvement of bean yields under drought and under low nutrient status jointly are major objectives. This project is clearly alone in combining a search for drought resistance with a search for adequate levels of biological nitrogen fixation where both water and nutrients are limited. The thrust of this project is to determine if there are heritable mechanisms in beans that confer adaptation, or tolerance, to dry conditions, as is the case of the tepary bean. Progress to date has been slow but promising.

SENEGAL/UNIVERSITY OF CALIFORNIA-RIVERSIDE/HALL

This cooperative project has built a substantial national capability in cowpea research and development in Senegal, including agronomy, physiology and crop protection (in which IITA cooperates). Its work in identifying and selecting short-season, drought-escaping cowpeas for use in the hot and dry areas of Senegal has been of special importance. Specifically, the work has helped Senegal to increase substantially the area and output of cowpeas in the arid northeast districts in a manner reminiscent of the imports of wheat seed that helped to start the Green Revolution in Asia in the 1960s. The Government decided to substitute a part of the cereal area with cowpeas to counter the continuing drought. The CRSP research had shown that CB5 (California Blackeye 5) was early and reasonably productive in the drier zones of Senegal. Six hundred fifty metric tons of high quality, disease-free CB5 seed were imported from California and distributed to farmers in northern Senegal together with recommendations on cultural methods that had been developed by the project. As a result, in 1985, cowpea productivity and production in Senegal, respectively, were double and quadruple the average levels obtained in the preceding fourteen years. It is estimated that one million people benefited from the food supplied by these early cowpeas during the "hungry period" of

August and September. This all came about as a result of close cooperation between the Government of Senegal, the European Economic Community, USAID, IITA and the CRSP.

Dr. Hall of UCR and his counterparts at IITA have created a network of cooperative CRSP cowpea breeding and agronomy programs involving Senegal, Botswana and the Cameroon and national programs in Sudan and Nigeria. This network ties into IITA's global network of 52 countries.

This is a model project with outstanding inputs in both the Host Country and in the United States and with strong international linkages.

TANZANIA/WASHINGTON STATE UNIVERSITY/SILBERNAGEL

Unlike most of the CRSP projects which have a sharp, narrow focus on selected objectives, this project has a wide range of interests--insects, diseases, plant response, physical environment, storage, farming systems, including consumption economics and socio-cultural factors. In short, this is a multi-purpose CRSP project which has produced impressive results, i.e., 90 percent of the project's five-year objectives have been achieved. Several very promising breeding lines (insect and disease resistant) are in the final stages of evaluation. It is expected these will go through on-farm testing to release in the next few years. Concurrently, an assessment will be made of the socio-economic impact of the new cultivars on smallholder farm families for whom baseline information was established early in the project. A small marketing study is being initiated in anticipation of the new releases, so as to better plan and promote public dissemination and acceptance of the new cultivars. This CRSP program has generated a great deal of national and international cooperation.

CATEGORY 1A

BRAZIL/UNIVERSITY OF WISCONSIN/MAXWELL

After problems in its early stages, this project is now on track and has made very creditable progress. Specifically, a procedure has been developed for screening breeding lines for multiple resistance to pathogens. In addition, the detached leaf technique has been developed to study and test the

results of multiple inoculations made in the greenhouse or in the field. Further, methods have been developed to prepare and use dry inoculum using simple laboratory procedures. These improved techniques for the breeding for multiple disease resistance should eventually be useful wherever beans are grown.

MALAWI/MICHIGAN STATE UNIVERSITY/ADAMS

The study, under the direction of Dr. Wayne Adams, a world leader in bean research, of the genetic structure of landraces in the Malawi project is the only one of its kind for beans anywhere in the world. With methods adapted from statistical and genetic disciplines, along with contributions from cultural anthropology, the Malawi project has produced unforeseen and challenging information with regard to the origin and the generation and maintenance of genetic variability in bean landraces, which is universal in its significance. The results include both basic and applied data.

Notwithstanding outstanding results, this project has operated in Malawi since February 1982 with expatriate scientists supported by Michigan State University funding; thus, this project may not be conceptually and operationally compatible with CRSP concepts.

Comment: These two projects, Brazil/Maxwell and Malawi/Adams, may be at a point of achievement where orderly phaseout can be a consideration. Further inputs may be fine tuning rather than innovative or creation of substantial advances in knowledge (except that we do not yet know enough about the part which is played by seed selection in maintaining the genetic structure of the populations in Malawi).

CATEGORY 2

NIGERIA/UNIVERSITY OF GEORGIA/McWATTERS

This project, which seeks to increase the availability of cowpeas to consumers in Nigeria by developing technologies to reduce postharvest storage losses and to simplify the preparation of cowpeas for human consumption, has had to overcome difficulties of communication between Georgia and Eastern

Nigeria. The new resolve of the PIs to do this was evident during the year and during the five-year program review when the new Nigerian Principal Investigator, Dr. D. O. Nnanyelugo, gave his unqualified support to current program plans. These plans include establishing a prototype village-scale process for mechanical removal of the seed coat from dry cowpeas and for making meal/flour suitable for use in traditional West African foods which use cowpea paste as a principal ingredient. Studies on improving conditions to prevent deterioration of cowpea meal/flour in storage, prevention of weevil infestation in storage and nutrition will continue. This project gives promise for significantly increasing the quality and quantity of cowpea foods in Nigeria and elsewhere in Africa where cowpeas are grown and consumed.

CATEGORY 2A

DOMINICAN REPUBLIC/UNIVERSITY OF NEBRASKA/COYNE

This project has made very satisfactory progress. Genetic and epidemiological information of value have been obtained and bean cultivars with resistance to bacterial and rust pathogens are available for use (secured in cooperation with the University of Puerto Rico). The information and the cultivars have been distributed to other CRSP bean programs. Close cooperation with CIAT has been arranged. In fact, this project is a fine example of collaborative research involving a US university, a developing nation, CRSP projects and an international agricultural research center.

The progress made in building an operational bean research capacity in the DR makes it possible and timely to consolidate CRSP activities in the DR. The Board of Directors may wish to consider merging this project with that of the UPR which also operates in the DR on much the same problems.

DOMINICAN REPUBLIC/UNIVERSITY OF PUERTO RICO/BEAVER

Dr. Beaver and his predecessor, Dr. Lopez-Rosa, have been largely responsible for establishing a very productive and mutually rewarding relationship with their counterpart scientists in the DR, Honduras and the University of Nebraska. The result is that improved bean cultivars with multiple disease resistance are now in place and being multiplied for release

to farmers. Should widespread adoption of these cultivars take place as expected, this project should have a significant impact on increasing the availability of beans in the DR.

Because of its favorable location to deal with problems and to exploit opportunities rapidly and because of its rapport with the DR, the CRSP Board of Directors may wish to designate the University of Puerto Rico as the lead institution in a merger of the two bean CRSP projects now operating in the DR. The resulting project should be able to make substantial contributions to bean improvement in the Caribbean basin along with CIAT and other bean programs in the region, as well as in the DR.

INCAP/WASHINGTON STATE UNIVERSITY/SWANSON

Research by INCAP and its CRSP collaborators has provided better understanding of the changes which occur in dry beans as they mature and when they are in storage, more information on the nutritional quality of dry beans and more reliable data on the ways in which beans are incorporated into the diets of rural people of Guatemala. These research results have provided the bases for preparation and dissemination of educational dietary information regarding handling/processing and cooking of beans. They indicate that complementary blends of beans and maize, methionine supplementation, milling, toasting and roasting of beans appear to improve nutritional quality and/or acceptability of dry beans. The hard-to-cook phenomenon is a matter of priority research concern. Various investigations--water imbibition, microstructural changes in beans during maturation, relation of processing quality to bean phenotype and genetic background, and other research leads--offer promise for reducing the hard-to-cook characteristic. Screening techniques have been developed to determine differences in beans for cooking time as well as for minimizing hardening in storage. This work will allow plant breeders to develop dry beans which will require less cooking time. Given the urgency of this problem as it relates to energy requirements, the Board of Directors may wish to consider limiting support under this project to this facet of the project.

CATEGORY 3

BOTSWANA/COLORADO STATE UNIVERSITY/deMOOY

This project has made creditable progress towards establishing a cowpea improvement program under difficult circumstances in a location where everything needs to be done. The valiant, persistent efforts of one individual, Dr. de Mooy of Colorado State University, have made this beginning possible. A short-season, high-yielding variety, ER7, obtained from IITA, has been tested, found to be adapted and released to farmers. An important germplasm collection, including 700 local lines, has been established. It should be useful for varietal development in Botswana and elsewhere.

The project has been operating in a direct technical assistance mode and has been doing so since it was initiated in July 1982. By the end of FY 87, it will have been operating in this manner for five years. Five years should be sufficient time to shift this project into a more desirable collaborative mode.

CAMEROON/UNIVERSITY OF GEORGIA/CHALFANT

For the lack of local collaborators in a country in which the number of professionals trained in the agricultural sciences was very limited, this project was regarded as "troubled." This is now being remedied. The project now seems likely to provide producers with reliable cowpea insect control procedures, as well as improved, insect-resistant cultivars. It may have a favorable impact on cowpea production during the next few years. The program is becoming linked to a developing network of cowpea programs associated with IITA and the University of California-Riverside. With this link and the direct support from the University of Georgia and Boyce Thompson Institute, together with the growing capacity of the Government of Cameroon to sustain a national cowpea improvement program, conditions seem favorable for continued progress.

While most of the work so far has been directed to urgent needs in the Cameroon, certain elements can and will contribute to the reduction of global constraints. For example, supporting research by the University of Georgia and Boyce Thompson Institute on roles of chemical and physical stimuli on insect egg-laying are such as to have value wherever cowpeas are grown. Also, cowpea

germplasm found in the Cameroon will be valuable accessions to world collections of cowpeas held at IITA and in other gene banks, if and when collected.

In the Cameroon, the project is directed by an employee of the University of Georgia, an expatriate scientist from Togo, who has done a fine job of getting the project established and resolving communication and operational difficulties. This situation--expatriate operational control--is being gradually developed into a less dependent mode as CRSP-trained specialists return to the Cameroon. As in the case of the Botswana project, the Board of Directors may wish to consider actions to insure transition to a fully collaborative mode in the next several years.

CATEGORY 4

ECUADOR/CORNELL UNIVERSITY/WALLACE

The EEP reviewed the plan for restructuring this project with the Ecuadorian Principal Investigator and the present and future Co-US Principal Investigators and discussed the plan in detail in executive sessions. There were widely divergent views regarding several important issues: (1) appropriateness of such a plan in a situation where there are questions as to the importance of beans and cowpeas and (2) prospects for contributions to the Bean/Cowpea CRSP Global Plan.

Given an unimpressive history and mixed views of the future, the Board of Directors may wish to consider orderly termination of this CRSP project. If the decision to terminate is made, consideration should be given to initiating a farming system element in one of the on-going CRSP projects.

HONDURAS/UNIVERSITY OF PUERTO RICO/BEAVER

This project is essentially the same as the University of Puerto Rico project in the Dominican Republic and the reported results are much the same. There has been a succession of Principal Investigators in Honduras. The present one is a Colombian who has had experience with beans as a scientist with CIAT. He has recently joined the faculty of the Escuela Agricola Panamericana, a private, regionally supported institution which conducts the

CRSP activities in Honduras for the Ministry of Agriculture. Institutionalization of bean research in a Honduran national institution is not promising under this arrangement. Further, contributions of this project to reduction of global constraints are not evident nor in prospect.

The Board of Directors may wish to consider orderly termination of this project, with some provision for Honduras to benefit from the Dominican Republic/University of Puerto Rico project.

KENYA/UNIVERSITY OF CALIFORNIA-RIVERSIDE/WAINES

USAID and CRSP officials requested the EEP Chair, Clarence Gray, to visit Kenya, review CRSP activities and prospects and make recommendations as might be appropriate. The review was conducted during the period January 6-11, 1986 and the recommendation was to effect orderly termination in FY 86. The EEP concurs with that recommendation. The Gray report is available to CRSP officials, cooperating institutions, the CRSP Board of Directors and USAID officials.

Because tepary/common bean hybrids developed by Dr. Waines and his associates show promise for improving adaptability of beans to drought, the Board of Directors may wish to include this work in one of the other CRSP projects if the decision to terminate is made.

1059C:skb:080586

BEAN/COWPEA CRSP
1985 EXTERNAL EVALUATION PANEL SCOPE OF WORK*

The EEP 1985 review for the first time will be able to turn to the substance of the CRSP contribution. As has been said by the chair of that group, "building an organizational framework to conduct collaborative research is a pre-requisite to assaulting the big picture . . . in an institutional context, this takes time." All agree now, however, that the building of that framework has been largely accomplished. Evaluation of progress can now turn to the accomplishments within the constraints identified in the global plan which is the organizational and driving force of the program's research. The basic question being asked is what has really been achieved in the biological and social sciences by the CRSP to improve the production, availability and utilization of beans and cowpeas in the poverty areas of the world.

AGENDA

I. Evaluation of State-of-the-Science Statements in Constraint Areas.

   A. Scientific knowledge, understanding and research expressed by Principal Investigators in constraint area--if completed and proposed research is appropriate to the specific situations for which it is being developed.

   B. Collaboration and integration of the research information which is presented within constraint area.

   C. Additional literature or research analyses necessary to better contribute to understanding improvement of production, availability and utilization of beans and cowpeas around the world.

II. Evaluation of the Projects That Make Up Constraint Area.

   A. Accomplishment of approved FY 85 and five-year objectives.

   B. Performance in relation to resource allocation.

   C. Adequacy of institutional support and contribution.

III. Evaluation of CRSP Contributions that Address Constraint Areas.

   A. Breakthroughs or expanded current technology, problems solved and methodologies developed.

   B. Collaboration among projects focusing on the global plan; extent of duplication of contributions among projects.

*The 1985 Five-Year Review was conducted in January 1986.

C. Complementarity of work with other professional groups outside of the CRSP.

D. Critical disciplines not included in the CRSP that would strengthen the global plan.

IV. Evaluation of the Application and Utilization of Research in Constraint Areas.

A. Contribution of applied research to traditional small farm practices, including attention to roles and concerns of women in rural and urban settings.

B. Evidence of collaboration among projects and of user participation in planning, utilization and application of research.

C. Identification of potential economic/social impacts of applied and basic research. Demonstration that constraints addressed are recognized by the Host Country as constraints and that the research will lead to applicable solutions to them.

V. Evaluation of Proposed Actions and Future Directions.

A. Appropriateness of major focus for the extension years.

B. Identification of changes needed in research program (reduced or increased emphasis).

VI. Summary and Conclusions.

Contribution and importance of research on this constraint to the global plan. Priority of the research in relation to other constraint research efforts. Lessons learned in consideration of the state of the science as well as the progress of the CRSP in the constraint area. General recommendations.

1986 EXTERNAL EVALUATION PANEL

Dr. Clarence C. Gray, III (Chair)
Professor, International Extension and International Studies
Virginia Polytechnic Institute and State University
Office: 9945 Great Oaks Way
Fairfax, VA 20030

Dr. Melvin Blase, Professor
Agricultural Economics
200 Mumford Hall
University of Missouri-Columbia
Columbia, Missouri 65201

Dr. A. Hugh Bunting, Professor
University of Reading
Q 7/8, No. 4 Earley Gate
Whiteknights Road
Reading, Berks. ENGLAND RG6 2AR

Dr. Luis H. Camacho
INTSOY Plant Breeder
Centro Internacional de Agricultura
Tropical (CIAT)
Apartado Aereo 6713
Cali, COLOMBIA

Dr. Peter E. Hildebrand, Professor
Food and Resource Economics Department
1125 McCarty Hall
Institute of Food and Ag Sciences
University of Florida
Gainesville, Florida 32611

Dr. Antonio M. Pinchinat
Tropical Agricultural Research
and Development Specialist
IICA
P. O. Box 11185
Lima 14 PERU

Dr. Charlotte E. Roderuck
Director
World Food Institute
Iowa State University
102 E. O. Building
Ames, Iowa 50011