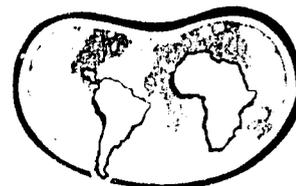


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**THE BEAN/COWPEA
COLLABORATIVE RESEARCH
SUPPORT PROGRAM (CRSP)**

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**REPORT OF
THE EXTERNAL EVALUATION PANEL OF
THE BEAN/COWPEA CRSP FOR FY 92**

February 1993

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TABLE OF ACRONYMS

A.I.D.	Agency for International Development
ALS	Angular Leaf Spot
AVRDC	Asian Vegetable Research and Development Center
BCMV	Bean Common Mosaic Virus
BGMV	Bean Golden Mosaic Virus
BOD	Board of Directors
CB	Common Blight or Common Bacterial Blight
CIAT	Centro Internacional de Agricultura Tropical (International Center of Tropical Agriculture)
CRSP	Collaborative Research Support Program
DNA	Deoxyribonucleic Acid
DR	Dominican Republic
EAP	Escuela Agrícola Panamericana (Pan-American Agricultural School)
EEP	External Evaluation Panel
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Enterprise for Agricultural Research)
FPR	Farmer Participatory Research
FY	Fiscal Year
Fe	Iron
GN	Great Northern
GOS	Government of Senegal
GTZ	Deutsche Gesellschaft fuer Technische Zusammenarbeit (German Agency for Technical Cooperation)
H	Hydrogen
HC	Host Country
IARC	International Agricultural Research Center
IBPGR	International Board of Plant Genetic Resources
IITA	International Institute of Tropical Agriculture
INCAP	Instituto de Nutrición de Centroamérica y Panamá (Institute of Nutrition of Central America and Panama)
INIAP	Instituto Nacional de Investigaciones Agropecuarias (National Institute of Agricultural Investigations)
INIFAP	Instituto Nacional de Investigaciones Forestales y Agropecuarias (National Institute of Forestry and Agricultural Investigations)
INTSORMIL	Sorghum/Millet CRSP
IPM	Integrated Pest Management
ISRA	Institut Senegalais de Recherches Agricoles (Senegalese Institute Agricultural Research)
M.S.	Masters Degree
ME	Management Entity
MNR	Ministry of Natural Resources
MO	Management Office
MSU ¹	Michigan State University
Mn	Magnesium
N	Nitrogen
P	Potassium
PCR	Polymerase Chain Reaction
PI	Principal Investigator
PR	Puerto Rico
PROFRIJOL	Research Network of Latin American and Caribbean Countries "For Beans"
PSTC	Program in Science and Technology Cooperation
RAPD	Random duplicated Polymorphic DNA
RELAF	
SADCC	Southern African Development Coordinating Committee
SAFGRAD	Semi-arid Food Grain Research and Development Project
SEA	Secretaría de Estado de Agricultura (Secretary of State for Agriculture)
SODEVA	Société de Développement et de La Vulgarisation Agricole (Agency for Agricultural Development and Extension)
SSD	Single Seed Descent
SUA	Sokoine University of Agriculture
TC	Technical Committee
U.S.	United States
UCD	University of California-Davis
UCR	University of California-Riverside
UFL	University of Florida
UGA	University of Georgia
UMN	University of Minnesota
UNL	University of Nebraska-Lincoln
UPR	University of Puerto Rico
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
UWI	University of Wisconsin
WA	Washington
WB	Web Blight
WID	Women in Development
WSU	Washington State University
Zn	Zinc

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**REPORT OF
THE EXTERNAL EVALUATION PANEL OF
THE BEAN/COWPEA COLLABORATIVE RESEARCH SUPPORT PROGRAM (CRSP)
FOR FY 92**

INTRODUCTION

The Bean/Cowpea CRSP began with funding in September 1980. The original grant came to an end in FY 86. Subsequently, there have been two three-year extensions and, during FY 92, the program was extended for an additional five years. The present review covers FY 92 activities, part of the third year of the second extension and part of the first year of the FY 92 extension.

Evaluations are based mainly on project Annual Reports, project extension documents, discussions with the CRSP MO/ME and the A.I.D. Project Officer, and perspectives gained from site visits to Host Countries and U.S. institutions.

THE FY 92 EXTERNAL EVALUATION PANEL: Originally the EEP consisted of seven members, all appointed in 1980-81. During 1986, two members (Drs. Melvin Blase and Luis Camacho) retired from the EEP, reducing the number to five. In 1987, another two of the original seven retired (Drs. Antonio M. Pinchinat and Charlotte E. Roderuck). They were replaced by Drs. Edna McBreen and Kenneth O. Rachie. Two more of the original seven (Drs. Hugh Bunting and Peter E. Hildebrand) retired in 1988. They were replaced by Drs. John S. Robins and Arthur J. Siedler in 1989. The last of the original seven, Dr. Clarence C. Gray, retired in 1990 and has not yet been replaced. The current members and their affiliations are given in Attachment D.

ORGANIZATION OF THE BEAN/COWPEA CRSP: When it was organized, the Bean/Cowpea CRSP consisted of eighteen projects in thirteen countries of Africa, Central and South America, including the Caribbean area, in collaboration with ten U.S. lead institutions. At the end of FY 91, there were thirteen projects in HCs (beans-nine; cowpeas-four). The FY 92 extension resulted in the termination of four projects and the initiation of three new ones. In addition, the Socioeconomics Component at MSU has been restructured, and some of the ongoing projects were significantly revised.

The Bean/Cowpea CRSP is funded through the Office of Agriculture, Bureau for Research and Development, Agency for International Development. The Project Officer is Dr. Harvey Hortik, Chief, Agricultural Production Division and Senior Horticulturist/Plant Pathologist.

FY 92 EEP REVIEW--SEQUENCE OF EVENTS: The following events comprised the FY 92 EEP review process.

1. Site visits were made by EEP members and/or MO staff to five U.S. universities and two HCs in late 1992.
2. Using the *Guidelines for Collaborative Research Support Programs* and inputs from the TC and BOD, the MO/ME developed a Scope of Work (see Attachment A) which was based on the outline distributed to PIs to be used as a format and guide for preparation of Annual Reports due by November 2, 1992 (see Attachment B).
3. EEP members were assigned projects for review from which discussion drafts were prepared prior to the annual EEP meeting in San Diego in February 1993.
4. Draft reviews of individual projects and special topics were discussed at the San Diego meeting. Final project and topic evaluations were made during the discussions.
5. The fiscal and administrative review was based on data/information supplied by the MO and a site visit by a member. Discussions of CRSP operations and procedures, status of activities and related matters were held with MO officials and the A.I.D. Project Officer.

6. The summary, overall evaluation of the CRSP was made on the basis of the results of individual project reviews, discussions of the progress towards amelioration of constraints, estimates of the performance of participating U.S. institutions, evaluation of fiscal and administrative operations, information acquired through conversations and discussions with CRSP officials and perspectives gained through site visits to HCs and U.S. universities.

PROGRAM EVALUATION: SUMMARY AND SPECIAL COMMENTS

SUMMARY: For the FY 92 review, twelve projects; the Women in International Development, Agricultural Economics, and Socioeconomics Components; training and the fiscal and administrative dimensions were evaluated with regard to progress, funding/fiscal management, planning, status and prospects. Eight of the projects were devoted to improvement and consumption of beans (six in Central and South America and the Caribbean and two in East Africa). The remaining four are concerned with improvement and consumption of cowpeas (all in West Africa). The final reports of three of the four terminated projects were reviewed with special attention to comprehensiveness and a subjective observation about sustainability of effort in the HC. The WID, Agricultural Economics and Socioeconomics Components are funded separately from the MO. The MO itself was evaluated on the basis of its Annual Report, a site visit and discussions with ME/MO personnel and the A.I.D. Project Officer.

The EEP again finds that the Bean/Cowpea CRSP is being managed and operated in a highly satisfactory manner in full compliance with the *Guidelines for Collaborative Research Support Programs* and the enabling grant document.

Overall Rating of the Bean/Cowpea CRSP: 1--Highly Satisfactory

SPECIAL COMMENTS: The FY 91 EEP review identified several special concerns. The Panel expresses general gratification with the response to them. We are pleased at the manner in which the social science and economics components were structured in the five-year plan. Most of the concerns seem to be adequately addressed. We again comment on some.

Inter-Project Collaboration in Host Countries: We again note several examples of intra- and inter-project collaboration and applaud efforts of the CRSP to identify opportunities. We especially note the developing cooperation among the cowpea projects but are still concerned by the lack of attention to this matter by Host Country Missions, which in some cases preclude inter-project collaboration and consequent cost-effective sharing of resources. We think that there are many opportunities for further interaction with the cross-cutting projects; i.e., biological nitrogen fixation, IPM and food science.

Baseline Data Collection: We applaud the attention given in FY 92 to the initiation of baseline data collection in some projects. We continue to encourage projects to call upon the program's social scientists and others experienced in this area to assist in these efforts.

English Language Capability: As noted in previous reviews, the EEP is concerned that the lack of English language capabilities by HC scientists is a deterrent to their full participation in a global scientific community. For example, this issue was mentioned to an EEP member during a review in Mexico. Mexico was presented as having excellent scientists working on beans or in related areas who, merely for lack of English language capability, are excluded from the international science community. We believe that provision of ongoing English language training in the Host Country; intensive English language training for students in preparation for admission to degree programs; and/or intensive English language programs in the U.S. or elsewhere for junior, mid-level, and senior HC scientists should be a CRSP priority. Those programs focusing on scientists who may have already completed degree training are/will be especially important to mature CRSP projects and will help to insure the sustainability of HC involvement in the interactive world scientific community.

Reporting: We note with satisfaction the attention to improving the Annual Report format. We think the present format is more reflective of CRSP problems and/or successes and more accurately addresses issues of impact and sustainability. We think the Training Report in FY 92 was by far the best ever and, with further attention to uniformity of reporting, can provide a highly useful data base.

Training Plans: As indicated in the report on training, we continue to be concerned at the apparent lack of definitive plans in some projects. We urge attention to this important matter.

PROGRAM EVALUATION: FISCAL AND ADMINISTRATIVE

After more than a decade of operations, the Bean/Cowpea CRSP has settled into a pattern of standard operating procedures that conform to U.S. Government grant guidelines and acceptable accounting practices and facilitate achievement of the CRSP's objectives.

The Management Office continues to exert leadership and operate in a highly satisfactory, efficient manner in FY 92. The Director, Deputy Director, Administrative Officer and support staff comprise a dedicated and highly efficient team with an excellent *esprit de corps*. Specific contributions during the past year include developing strong support from the Michigan Bean Shippers Association; orchestrating the Egypt buy-in (N₂ fixation); developing solutions for the Dominican Republic institution issue; providing leadership in development of the CRSP Council (specifically coordinating impact assessment baselines); facilitating PI transitions in the Tanzania and Malawi projects; arranging a cooperative effort between Clemson and Auburn Universities in support of the Ghana project; developing effective publications including an operational manual; strengthening the Socioeconomic Component by adding agricultural economic expertise; and last but not most important, finalizing a five-year extension proposal for continuation of this CRSP. Of particular note are the actions in phasing out and adding new projects which have resulted in twelve very strong projects. The MO also continues to encourage the development of comprehensive (production to utilization) regional programs (e.g., West African cowpeas projects involving Cameroon, Ghana, and Senegal), and the inclusion of social science components in the CRSP projects. The appointment of an agricultural economist (40 percent time) has enhanced the economic and socioeconomic inputs to the Program. Issues that the MO continues to cope with are political unrest (Cameroon and Malawi), budget uncertainties (delay in A.I.D. releasing funds, proposal cuts, etc.) and slow responses to travel and equipment requests.

With regard to fiscal matters, a budget process has been developed through trial and adjustment which works well for this CRSP (i.e., the participating U.S. and HC institutions and PIs). The process is now in place and it is routine, efficient and fair. Its notable features include (1) adjustment and accommodation to the vagaries and unpredictabilities of A.I.D. financing; (2) maximum participation of CRSP entities (i.e., TC, BOD, PIs and MO/ME); (3) timely release of funds and timely receipt of expenditure reports; (4) up-to-date monitoring of the flow of funds; and (5) flexibility to transfer unspent funds to points of need within the system.

There continues to be a strong commitment and support for the Bean/Cowpea CRSP at all levels of Michigan State University, particularly by the College of Agriculture and Natural Resources administration. This has been, and is being, reflected in MSU's staffing and administrative support for the Management Office and in the overall operation of a highly successful CRSP.

The Panel was pleased to learn of the success of the MO in gaining approval authority for equipment purchases up to \$5,000. This has been very helpful to a number of projects and will continue to be in the future.

Overall Rating: 1--Highly Satisfactory

PROGRAM EVALUATION: PROJECT SUPPORT COMPONENTS

WOMEN IN DEVELOPMENT: The Women in Development Component of the Bean/Cowpea CRSP has continued to flourish under the leadership of Dr. Anne Ferguson. Major efforts over the past year have focused on the Ghana (integrated pest management and utilization components) and Costa Rica (utilization aspects) projects. Information on WID aspects was sent to Ghana and Costa Rica PIs. Meetings with the PIs and Co-PI were concerned with gender and social science issues relating to these projects. Participatory research strategies on cowpea storage were also discussed with Cameroon project personnel.

Feedback to the Ecuador project's anthropology graduate student's project was also provided. Pertinent information was disseminated throughout the CRSP network. Compilations of literature concerned with participatory research strategies have been sent to project PIs and appropriate Co-PIs. Participation in research workshops is being planned for FY 93.

The WID Component is a collaborative effort with all CRSP projects. Activities include presentation of a paper on "Gender, Class and Ethnicity in Technology Design" to participants from various CRSPs at a University of Kentucky workshop.

The needs of small-scale farmers, women and/or other beneficiaries are the focus of WID. Almost half of the degreed individuals trained via this CRSP and 27 percent of the non-degree trainees are females. Dr. Ferguson has monitored the training of women in CRSP projects. To date, the CRSP has had a very good record. Impacts of WID programs in the CRSP projects have not been assessed. However, a review of FY 93 project workplans has been completed regarding impact assessments. Dr. Ferguson has also reviewed the FY 92 Annual Reports regarding their WID Components and suggested strategies for strengthening this component in individual projects.

Strategies for baseline determinations are being developed. Studies have been completed on various aspects of production and utilization practices in Malawi and an assessment is planned for the D.R.

A number of studies have resulted in publications concerned with WID issues in Malawi. Other publications included two papers in Volume 2 of *The Women and International Development Annual* and two accepted for publication in this journal. Two presentations were also made (University of Kentucky and Michigan State University).

The Leadership of Dr. Ferguson has resulted in increased addressing of WID Components in projects. The addition of an agricultural economist has enhanced economic/socioeconomic facets of WID goals. A developing team effort in the WID, Socioeconomics, and Agricultural Economics Components is apparent. Increased support and development of WID aspects in CRSP projects has occurred since the FY 91 EEP review.

Overall Rating: 1--Highly Satisfactory

AGRICULTURAL ECONOMICS: The Agricultural Economics Component is a resource unit serving the CRSP under the direction of Dr. Rick Bernsten. Part of this activity is concerned with socioeconomic aspects in concert with the WID Component.

Dr. Bernsten's activities in FY 92 included reviewing Annual Reports and workplans and providing inputs to PIs and TC regarding strengthening economic aspects; and assisting in the development of methodologies to address economic issues in the Cameroon/Purdue, Ghana/UGA, Costa Rica/MSU, Dominican Republic/UNL and the Egypt buy-in projects.

The training activity consisted of serving as the advisor to three M.S. candidates doing research on economic issues in the Cameroon (2) and Malawi. It is planned to utilize graduate student projects for HC assessments.

Publications and presentations in FY 92 included five presentations and one report, a satisfactory output at this early stage of the component.

This component is developing well in concert with WID and the Socioeconomic Component. Its success will depend upon PI and HC participation and support.

In support of the Tanzania project, an evaluation of consumers would be very desirable. However, limited resources are a constraint which limits economic assessments in support of all the CRSP projects.

Overall Rating: 1--Highly Satisfactory

SOCIOECONOMICS: This is a relatively new component of the CRSP. It is categorized as a support activity serving the various projects, the Technical Committee and the Management Office. The participants (Co-PIs) are Drs. Anne Ferguson and Rick Bernsten, who are working together very well in this effort.

The overall function of this component is to aid in the development of socioeconomic capabilities in the HCs parallel with the production and utilization efforts and to aid in the development of strategies for on-farm participatory research in concert with WID. This includes macroeconomic studies on production and distribution of beans and cowpeas in the HCs; socioeconomic research on technology impacts; and training in the social and economic sciences.

A major effort over the past year has been the development of a research proposal concerned with the impact of the Bean/Cowpea CRSP technologies in the Dominican Republic.

Overall Rating: Satisfactory Startup.

PROGRAM EVALUATION: TRAINING

This year's Training Report, for the first time, begins to describe the current and anticipated status of CRSP training efforts. There are still problems with plans for several of the projects--they really aren't plans or they have omitted important information. A review of each project's training plan follows.

In light of these remaining glitches in the reporting of training, it is suggested that several areas of CRSP policy regarding training should be clarified.

1. What are the training priorities of the CRSP? Essentially, the first priority group to be trained is HC students, the second is U.S. students and the third is students from other developing countries. Training of other students with CRSP funding should occur only in special circumstances and must be justified. If projects are training students from developing countries other than the HC and/or students not represented in the priority list, the annual Training Report should explain why these decisions have been made.
2. Each CRSP project should have (or develop) a simple plan for degree-level training based upon an analysis of HC needs and research priorities. Plans should: briefly describe HC needs and research priorities; present plans for degree training including numbers and/or names of trainees, fields and degree levels for training, and a timeline for implementation; a statement regarding progress made in implementing plans; and any anticipated changes in plans as well as the reason for those changes.
3. Similarly, a year-to-year plan for short-term training, based upon Host Country needs and research priorities, should be developed by each project for inclusion in the Annual Report.

4. While the new Training Activities Report Form adds much to our understanding of ongoing training and funding for that training, the form seems to have been inconsistently completed by the PIs. Some have clearly noted where CRSP funds have been spent and in what amounts, others have not even filled in the dollar amounts when they note that CRSP funding has been provided. This is important information and should be provided accurately.

In reviewing the reports of the individual projects included in the Training Report, it is clear that some of the PIs understand the need for this effort while others may need additional guidance in justifying their training expenditures. It is, by the way, important to note that these expenditures are sufficiently significant to deserve further consideration. According to the submissions of each PI on the new Training Activities Report Form, U.S. CRSP funding for training was over \$205,000 for FY 92 while HC CRSP funding totaled over \$125,000.

Cameroon/Purdue/Murdock: The plan does not anticipate additional degree training for HC or U.S. students; is there a reason for this? Have all HC degree-level training needs been met? Are there no plans for a training component for the Auburn part of the project? Is there not a need to develop HC capabilities in the social sciences?

Caribbean Basin/UWI/Maxwell: The report included no training plans but presented a historical review of training accomplishments. What are the plans for the future? What are the HC personnel needs? This is especially important for this particular project because of the need to bring HC scientists up to speed with the technology being developed through this research. We suggest that the post-doctoral appointee be left off the training report--we see this as a predominantly non-training activity.

Costa Rica/MSU/Hosfield: The plans described in the training report seem to reflect considerable analyses of HC needs and research priorities; however, the former is not really clear. Are these plans based on HC institution needs? The mention of English language training plans is particularly encouraging.

Dominican Republic/UNL/Coyne: Without solving the problems with the USAID Mission, it is difficult to consider long-term training plans. However, there appears to be some discrepancy between the statement of the training plan and the information on the Training Activities Report Form. Significant FY 92 CRSP funding (according to the Training Activities Report Form) was spent on training (\$65,000 CRSP/U.S. and \$6,000 CRSP/HC) with a considerable amount of that funding (\$65,000) being spent on non-U.S., non-HC students. We suggest that the post-doctoral employees be omitted as this is not primarily a training activity.

Ecuador/UMN/Graham: The training plans consider HC needs with both degree and non-degree plans reflective of those needs. The Training Activities Report Form has not been completely filled out, leaving several questions regarding funding amounts and sources. Additionally, several of the students listed apparently completed their training prior to FY 92.

Ghana/Clemson/Shepard: The training plans for this new project are still, legitimately, very general. During the next year it is important to work with HC counterparts to analyze HC training needs related to the project so a clear, comprehensive plan can be developed and students can be recruited.

Ghana/UGA/Phillips: The statement in the report is not a training plan. What are HC needs? What are the minimum numbers to be trained, at what levels and in what fields to meet HC needs and fulfill research priorities? This new project should have at least a tentative training plan within a year. Why is the CRSP supporting a non-U.S., non-HC, non-developing country student?

Honduras/UPR/Beaver: Although it is unclear what the content area of degree training will be, it appears that consideration has been given to HC training needs. As is the case with most of the reports, this one is a little too sparse to determine what is actually going on. There has been only one woman trained by this project--an attempt to increase the number of women trained may be an important inclusion in a training plan.

Malawi/UCD/Gepts: This is a good example of a short but comprehensive training plan. HC needs have been analyzed and are reflected in the plan. Unfortunately, there are inconsistencies between the narrative training plan, the Training Activities Report Form and the Annual Report--these three seem to address the status quo at different times (FY 92 vs. FY 93). Is there a rationale for supporting a non-U.S./non-HC student with CRSP funds? With only one Malawian woman having received degree-level training funded by the CRSP, this may be an important inclusion in a training plan.

Mexico/MSU/Kelly: It is unclear whether or not the training needs of the HC have been considered in training plans. In fact, it is also unclear what those training plans are (Who will be trained, how many people, in what fields, and at what levels?). In recent past EEP evaluations, several training issues have been brought up regarding this project. We are especially concerned about junior scientists working on the project in Mexico who are apparently ineligible for training by the Mexican government because they are 100 percent CRSP employees. Have these issues been addressed?

Senegal/UCR/Hall: It appears significant progress has been made in meeting HC training needs; however, it would be helpful to know what progress has been made during the life of the project and what still needs to be done. A HC training plan will, no doubt, be an important part of next year's Annual Report.

Tanzania/WSU/Butler: There appears to be a training plan but this really isn't clear. Similarly, it is not clear if there has been an analysis of HC needs for U.S. degree training. There are several gaps in the Training Activities Report Form which make it difficult to determine sources of funding for training and specific amounts of CRSP funds being spent on training, especially at SUA. The amount and level of training going on at SJA is especially encouraging.

WID/MSU/Ferguson: While there may not be an opportunity to offer specific degree training in WID through the CRSP, it seems that short-term training in this field is essential. Perhaps a goal of having each HC and U.S. research team have at least one person who has received short-term training in WID would be an acceptable goal.

Agricultural Economist/MSU/Bernsten: The training plans in the report represent an excellent use of minimal training funds to expand the quality of CRSP research through the generation of greater understanding of economic analysis and the economic impacts of research efforts.

Socioeconomics/MSU/Bernsten and Ferguson: The socioeconomics training proposal is excellent and would clearly move the CRSP a long way toward meeting its goals in this area. Both the degree training and the short-term training should be a priority for CRSP funding.

In reviewing the Training Report and the Annual Reports from the various CRSP projects, it is clear that training has had a significant institutional impact on the HCs and on other developing countries. The EEP believes information regarding this impact, for each project, is an important part of the Annual Report. We would like to see a summary (qualitative and quantitative) of returned trainees as well as those trained by the CRSP working in non-HCs and their impact on bean/cowpea research. We would like to see, in the FY 93 Annual Report, a retrospective review of degree-level trainees for each project. We are interested in who the graduates are, their fields and degrees of training, what they are currently doing, and their contributions to bean/cowpea research.

Over the last several years, the EEP has raised the issue of the need for English language training for HC scientists. Clearly long-term training sponsored by the CRSP has assisted young scientists from around the world in gaining research expertise as well as English language competency. Both are essential for access to the world scientific community. However, the CRSP has not yet addressed the issue of English language training to assist collaborating scientists who do not participate in long-term training to become more involved in the scientific community. Each PI as well as the CRSP as a whole should consider strategies to address this issue. There are excellent examples of inexpensive but effective programs to assist the scientists at HC institutions in gaining language competency-- especially when departments of foreign languages and their graduate students are brought into the plan. Until this issue is addressed, there will continue to be a significant barrier keeping HC counterparts from achieving their potential as scientists.

PROGRAM EVALUATION: PROJECT RATINGS

Bases for Evaluation--Rating Categories/Format: Using *Guidelines for Collaborative Research Support Programs* provided by A.I.D., a Scope of Work was prepared which provided for evaluation of progress, funding, plans and status/prospects for each CRSP project (Attachment A). These criteria were assessed on the basis of reports submitted by the projects' Principal Investigators, site visits to selected HC institutions and U.S. universities, data provided by the MO, and discussions with MO and A.I.D. officials. Numerical and adjective ratings are based on assessment of the criteria against the plans spelled out for FY 92.

The Panel judged that it was too early to rate the new projects/components, i.e., Ghana/Clemson, Ghana/UGA, Costa Rica/MSU and Socioeconomics. We do believe that each has made a satisfactory start-up.

Category	Rating
1	Highly Satisfactory
2a	Satisfactory Plus
2b	Satisfactory
3	Unsatisfactory
	Satisfactory Start-up

Summary of Ratings:

Category 1: Highly Satisfactory Bean/Cowpea CRSP Economics Fiscal and Administrative Women in Development Cameroon/Purdue Caribbean Basin/UWI Dominican Republic/UNL Ecuador/UMN Honduras/UPR Senegal/UCR Tanzania/WSU	Category 2b: Satisfactory Mexico/MSU Category 3: Unsatisfactory None Satisfactory Start-up Socioeconomics Costa Rica/MSU Ghana/Clemson Ghana/UGA
Category 2a: Satisfactory Plus Malawi/UCD	

THE FIVE-YEAR EXTENSION PROPOSAL

The Panel commented at some length in the FY 90 and FY 91 reports on the five-year extension proposal as it had evolved up to that time. Our views on the then proposed extension have not changed materially as we examine the extension as implemented. We applaud the manner in which the social science and economics are structured, and we note with satisfaction the outcome of negotiations on the integrated pest management project.

FY 92 EXTERNAL EVALUATION PANEL SCOPE OF WORK

Use the outline below to write report. Discuss every item listed based on the information presented in the corresponding section of the project's Annual Report and/or your site visit. If an item does not apply to a particular project, please do not omit but indicate "Not Applicable."

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. New research results from FY 92 disseminated and currently in use in HC and U.S.
 - a. Improved cultivars, inoculants, tests, methods and systems
 - b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally
 - c. Evidence of project impact on production/consumption of beans/cowpeas
 - d. How research findings address needs of small-scale farmers, women and/or other beneficiaries
 - e. Impact(s) results have had on the developing and developed world
2. Changes in national production/consumption of beans/cowpeas in HC

B. Institutional Development and Training

1. Institutional personnel changes since FY 91
2. A.I.D.-funded long- and short-term training

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. U.S. research activities and progress achieved
2. HC research objectives and progress achieved
3. Length of time project has been engaged in lines of research addressing these objectives
 - a. Progress in relation to schedule in log frame
 - b. Reasons for delay, if any
4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere
5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints

D. Evidence of Biological/Social Sciences Integration

1. Identification of and attention to relevant WID issues
2. Identification of and attention to other social and/or economic issues

E. Baseline Data

F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. U.S.
2. HC

B. Adequacy of Current Management, Policies and Procedures

C. Activity Towards buy-ins and/or Other Funding

D. Responsiveness to 50/50 Split Policy

III. STATUS IN FY 92

A. Appropriateness of Activities to Goals of the Global Plan

B. Impact of Training Program on Project

C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives

D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel

E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives

F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy

G. Evidence of Institutionalization in HC and U.S.

1. Faculty (researcher) recognition for international activities and awards
2. Integration of domestic program with CRSP project
3. Internal support for project management and institutional management
4. Opportunities for/frequency of student/professor interactions

H. Other Comments

IV. WORK PLAN CHANGES

A. Changes/Additions/Deletions in FY 92 Work Plan

B. Reasons for Changes

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. Publications

1. Refereed journals
2. Non-refereed journals

B. Presentations

VI. OVERALL RATING

A. General Strengths

B. General Weaknesses

C. Recommendations

FY 92 ANNUAL REPORT FORMAT
Due November 2, 1992

(Report is to be single-spaced in at least 12-pitch type.)

EXECUTIVE SUMMARY--A one-page synopsis of the year's research activities, written in non-technical language for use in CRSP publications. The first paragraph should be a general summary of the overall objectives and strategies of the project. Middle paragraphs should summarize activities/achievements/impacts during FY 92. The last paragraph should address the project's training activities.

TECHNICAL SUMMARY (the only limitation on length is that Section I.C. may not exceed ten pages, not including appendixes). Do not omit items. Those which do not apply should be answered "not applicable."

I. PROGRESS DURING FY 92 (October 1, 1991-September 30, 1992)

A. Specific research contributions in FY 92.

1. New research results from FY 92 disseminated and currently in use in HC and U.S. (list only A.I.D.-funded FY 92 activities).
 - a. List and describe improved cultivars, inoculants, tests, methods and systems.
 - b. List and describe accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally.
 - c. Provide evidence of project impact on production and consumption of beans and cowpeas (e.g., on-farm trial results and/or changes in production statistics on development and adoption of new products or processes).
 - d. Discuss specifically how the research findings address the needs of small-scale farmers and women or other beneficiaries (indicate).
 - e. Discuss impact(s) your results have had on the developing and developed world.
2. Changes in national production (or consumption using appropriate indicators) of beans and cowpeas in HC: Hectares planted/yields per hectare/total production.

B. Institutional development and training, i.e., strengthening HC bean and/or cowpea research and improvement systems.

1. Cite any institutional personnel changes since FY 91.
2. Update attached training form. Include all A.I.D.-funded long- and short-term training.

C. Progress achieved in relation to the objectives stated in your FY 92 work plan (attached).

1. List each U.S. research activity and then describe the progress made in that activity. Indicate whether each objective is a primary or secondary project objective.
Example: 1. Identify and determine the inheritance of additional sources of resistance to web blight and bean golden mosaic (primary objective).
2. List each HC research objective and describe the progress made towards each. Indicate whether the objective is a primary or secondary project objective.
3. Indicate how long your CRSP project has been engaged in lines of research addressing these objectives. How does the progress relate to the log frame? Is the research on schedule? If not, give reasons for the delay.
4. Discuss how your project research relates to other research being conducted in the HC, IARCs and elsewhere. Is it complementary, duplicative, unique, etc.?
5. Provide an update on the likely contribution of research to the HC, the U.S. and to the amelioration of global constraints.

D. Evidence of biological/social sciences integration.

1. Identification of and attention to relevant WID issues. Describe critical issues and your project's efforts to address them.

2. Identification of and attention to other social and/or economic issues. Describe the critical issues and how your project is addressing them.

E. Baseline data, i.e., does your project have baseline data adequate to evaluate the impact of your project? Please describe. If not, what do you plan to do to obtain this baseline data?

F. Collaboration with other Bean/Cowpea CRSP projects, linkages with other CRSPs and other external groups not included in C.4. above.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems regarding funding, budgeting, release of funds, procurement and other--in U.S. and HC.

B. Adequacy of current management, policies and procedures (especially regarding follow-up on use of funds and use of equipment).

C. Activity towards buy-ins and/or other funding.

D. Responsiveness to 50/50 split policy (and plan to rectify any imbalance).

III. STATUS IN FY 92

A. Appropriateness of activities to goals of the Global Plan.

B. Impact of the training program on your project. Indicate any changes in your five-year (92-97) training plan.

C. Balance between domestic vs. overseas activities with respect to program objectives.

D. Collaboration/cooperation between U.S. and HC institutions and personnel. Describe process for research planning, budget development, training and publications/presentations.

E. Contributions of collaborating institutions and individuals towards accomplishment of objectives. Report other funding over and above that by A.I.U. and participating U.S. and HC institutions, with comments as to the uses and impact of this additional funding.

F. Interest, involvement and support of USAID Mission and/or U.S. Embassy. Discuss contacts made and the prospects of Mission support for your project.

G. Evidence of institutionalization in HC and U.S.

1. Faculty (researcher) recognition for international activities and awards.

2. Integration of your domestic program with the CRSP project(s).

3. Internal support for project management and institutional management.

4. Opportunities for and frequency of student/professor interactions.

H. Other comments.

IV. WORK PLAN CHANGES

Describe changes/additions/deletions in the FY 92 work plan (submitted to the TC in May 1991) regarding funding, personnel, research activities, commodities, etc. Give reasons for such changes (e.g., availability of funds, successes, failures, marginal activities, inadequate performance, unrealistic plans, etc.).

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. List publications in two categories: refereed and non-refereed journals.

B. List presentations (including poster sessions, seminars, workshops, etc. and also in this section, list proceedings of meetings).

VI. ROSTER

A. U.S.

B. HC.

CAMEROON • PURDUE UNIVERSITY • MURDOCK

Preservation of Post-Harvest Cowpeas by Low-Resource Farmers

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. New research results from FY 92 disseminated and currently in use in HC and U.S.

- a. Improved cultivars, inoculants, tests, methods and systems:** Bulletins explaining the use of research results (solar heater, improved ash storage and triple bagging) have been disseminated in Cameroon. Training in the use and development of these technologies has also been provided to change agents.
- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** None during FY 92.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** It is probably too soon for wide impact; however, recent acceptance of developed technologies by important change agent organizations in Cameroon bodes well for broad dissemination and a resultant positive impact on consumption.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** The storage technology developed by the project is especially aimed at small-scale, low-income farmers, many of whom are women. It is hoped that the recent focus on biotechnology research will also ultimately assist this same group of farmers in that the technology developed through this effort will produce insect resistance within the plant itself.
- e. Impact(s) results have had on the developing and developed world:** No major impact to date.

2. Changes in national production/consumption of beans/cowpeas in HC: Not available.

B. Institutional Development and Training

- 1. Institutional personnel changes since FY 91:** There has been a change in HC PI, the former having been transferred to another station. The new Maroua Station Director is Mr. Samuel Nzietchueng. Progress is being made in training previously identified students. A major change in the project involved the addition of an integrated pest management component from Auburn University. Auburn scientists, Dr. Tim Mack (entomologist), Dr. William Moar (entomologist), Dr. Oyette Chambliss (cowpea breeder) and Dr. Narendra Singh (molecular biologist) add considerable additional expertise to the project.
- 2. A.I.D.-funded long- and short-term training:** Progress is clearly being made in implementing the existing training plan developed collaboratively with HC counterparts at the beginning of this project. The project has also assisted in the training of technicians at the Maroua station, an excellent expenditure of training funds.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. U.S. research activities and progress achieved
2. HC research objectives and progress achieved

a. Storage science and technology

- (1) **Solar disinfestation technology:** Technology is being developed and tested at Purdue for heating cowpeas on sheets of corrugated galvanized tin roofing in order to kill pests; this technology will be further tested in Cameroon. Use of plastic bags to provide a solar disinfestation seed-treatment method for use on small quantities of seeds by breeders when refrigeration is unavailable is being tested; use of black plastic sheeting as solar heaters is also being considered. Each of these approaches is seen as providing additional treatment options to protect seeds against infestation.
- (2) **Pod storage:** Progress is being made toward the further development and improvement of a model of cowpea weevil population growth (Auburn and Purdue researchers working together); the breeding program to isolate sources of pod resistance continues in Cameroon, at Purdue and at Auburn.
- (3) **Triple bagging:** Triple bagging has been proven to be more effective in preventing the build up of bruchids than double bagging.
- (4) **Applied ecology of bruchids:** Because of travel restrictions in Cameroon, work there on this issue has been postponed until FY 93. Some progress has been made in studies at Auburn, especially in developing methodologies and working hypotheses for use in Cameroon.
- (5) ***Bruchidius* studies:** No progress has been made on this objective which is to be implemented in Niamey, Niger. Plans are for Dr. Murdock to visit Niamey this spring with hopes of beginning the development of a colony of *Bruchidius atrolineatus* for use in testing effectiveness of technologies against this pest.

b. Farmer participation network

- (1) **Collaborate with the Maroua Testing and Liaison Unit of the NCRE project:** Training sessions have been conducted with change agencies to disseminate research results.
- (2) **Continue farmer participation activities:** Not yet begun.
- (3) **Conduct demonstration-tests of the solar heater technology:** Demonstration tests were successfully conducted in five villages. The techniques tested worked well and have the potential to be widely adopted.
- (4) **Sampling frame:** No major results in FY 92.

c. Cowpea breeding

- (1) **Hybridization and generation increase:** Progress was made during FY 92 in breeding to produce plants with resistance to the prevailing strain of cowpea aphid-borne mosaic virus, large white seeds, retention of leaves after pod ripening and harvest, semi-determinate plant type with good foliage characteristics, pod presentation primarily over the plant canopy for easy harvesting, and seed and pod resistance to bruchids.
- (2) **Cowpea trials:** Preliminary, regional and advanced yield trials are being conducted.
- (3) **Inheritance study:** Progress has been made in an inheritance study of pod resistance, no final results available to date.
- (4) **Breeding methodology study:** Progress is being made in comparing the relative merits of single seed descent breeding method and pedigree method. No final results available to date.
- (5) **Screening of cowpea lines from Cameroon, IITA and other CRSP projects:** This effort to identify pod and seed resistance to bruchids is newly implemented at Auburn University.

- d. **Bases for genetic engineering of cowpea and common bean for insect resistance**
 - (1) **Genes for bruchid resistance:** Preliminary efforts are ongoing. No specific results to report.
 - (2) **Bioassay *Bacillus thuringiensis* protoxins for effectiveness against cowpea pod borer:** Efforts should result in better understanding of potential uses of *Bacillus thuringiensis* protoxins in controlling cowpea pod borer, cowpea weevil and hairy caterpillar. Progress is being made but there are no final results to date.
 - (3) **Biosafety issues:** No progress to date but a serious, important goal.
 - (4) **Chimeric genes for insect resistance:** No progress to date.
- e. **Regionalization of research efforts**
 - (1) **Formalize the relationship with Niger and USAID/Niamey Mission:** Contacts have been made and interest determined. Further efforts are expected in FY 93.
 - (2) **Visit to additional potential Host Country site:** Planned for FY 93.
 - (3) **Assist as needed other CRSP projects:** Information has been shared with other cowpea projects and with the Ecuador/UMN project.
 - (4) **Plan for cowpea conference to be held in West Africa:** Postponed for possible implementation in FY 94.
 - (5) **Continue attempts to develop a working relationship with the SAFGRAD cowpea network:** No progress to date. Correspondence was initiated in FY 92 but no response was received from SAFGRAD.

- 3. **Length of time project has been engaged in lines of research addressing these objectives:** This was not reported separately in the Annual Report. Information is included in descriptions of some objectives.
- 4. **Relationship of project research to other research being conducted in the HC, IARCs and elsewhere:** See notations on progress achieved above.
- 5. **Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints:** Not reported separately in Annual Report. However, it is clear that this project has the potential to assist the HC in providing a higher quality of cowpeas to the consumer through the control of pests during storage.

D. Evidence of Biological/Social Sciences Integration

- 1. **Identification of and attention to relevant WID issues:** No reported progress in this area in FY 92, but there is a continued recognition of the importance of the issue and ongoing encouragement of the participation of women in demonstration tests.
- 2. **Identification of and attention to other social and/or economic issues:** FY 92 efforts included an assessment of the losses associated with cowpea storage as currently practiced. No results reported as yet.

- E. **Baseline Data:** The project has qualitative baseline data about cowpea growing and storage practices, and social science issues. Efforts are underway to determine the economic importance of cowpeas in Cameroon and to analyze the economic losses due to storage pests as well as the potential economic impact of project-developed technology.
- F. **Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above:** Strong collaboration with other CRSP projects, especially the other cowpea projects but also the Ecuador/UMN and Caribbean Basin/UWI projects. In Cameroon, cooperation with the A.I.D.-funded NCRE project has been good.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

- A. Problems:** Past problems with transfer of project funds and reimbursements in Cameroon have been solved. The Government of Cameroon, however is experiencing ongoing, severe financial difficulties which result in difficulties for its employees.
- B. Adequacy of Current Management, Policies and Procedures:** Appear to be adequate.
- C. Activity Towards Buy-ins and/or Other Funding:** No particular progress.
- D. Responsiveness to 50/50 Split Policy:** Funding has been greater for Host Country activities.

III. STATUS IN FY 92

- A. Appropriateness of Activities to Goals of the Global Plan:** Goals are appropriate.
- B. Impact of Training Program on Project:** There seems to have been a very positive impact of training on the project. Of special interest is the clear development of and adherence to the existing training plan and the training of technicians in the HC.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** The addition of the Auburn team has helped to balance the project as will the hoped-for results from the biotechnology research.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Excellent.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** Both institutions seem to have contributed considerably to the accomplishment of objectives. There remains a concern that the U.S. partner in projects which include basic research focus in that area, with the HC partner only participating in applied research. It is not clear whether or not this has been the case in this project since the training of HC counterparts in the U.S. may have included involvement in the project's basic research elements.
- F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** The relationship with the A.I.D. Mission has apparently been good.
- G. Evidence of Institutionalization in HC and U.S.**
 - 1. Faculty (researcher) recognition for international activities and awards:** None.
 - 2. Integration of domestic program with CRSP project:** This appears to be excellent leading to greater successes in both the domestic and CRSP activities.
 - 3. Internal support for project management and institutional management:** Excellent at Purdue at the university, college and business management levels.
 - 4. Opportunities for/frequency of student/professor interactions:** Appear to be excellent.
- H. Other Comments:** None.

IV. WORK PLAN CHANGES: None.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. Publications

1. **Refereed journals:** 4
2. **Non-refereed journals:** 0

B. Presentations: 3

A reasonable level of productivity for this project.

VI. OVERALL RATING: 1--Highly Satisfactory

- A. General Strengths:** This project has been extremely well planned and well implemented. The incorporation of the social sciences into the project has been excellent as has progress toward the accomplishment of other research goals. The level of collaboration with the HC is impressive as are the research elements that have led to the adoption of new technology by the intended audience.
- B. General Weaknesses:** None identified.
- C. Recommendations:** The training plan for the project should be re-examined in light of two major issues: first, the addition of the Auburn University component and its opportunities for training of HC scientists; second, the need to provide the HC with social science expertise--there has not been a HC person trained in this area although social science has been an important part of the total project.

CARIBBEAN BASIN • UNIVERSITY OF WISCONSIN • MAXWELL

Molecular Approaches for the Control of Bean-Infecting Geminiviruses and Other Viruses

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. New research results from FY 92 disseminated and currently in use in HC and U.S.

a. Improved cultivars, inoculants, tests, methods and systems

- (1) **Production of monoclonal antibodies:** Infectious full-length clones of BGMV Type I (Brazil) and Type II (Guatemala) were used to produce virions by inoculation of beans at CIAT with the gene gun. Purified virions were sent to Dr. E. Hiebert at the University of Florida to make antibodies.
- (2) **Diagnostic methods:** Polymerase chain reaction methods were developed which involved the design and testing of general primers for whitefly-transmitted geminiviruses and are now widely used.
- (3) **Geminivirus diagnostic service:** Both the PCR and squash blot hybridization method were developed by this project and were used to evaluate more than 1,000 samples for geminiviruses from all over the world.
- (4) **Geminivirus sequences deposited in GenBank:** The complete nucleotide sequences of four bean-infecting geminiviruses were deposited with the international library for sequences, GenBank. These can be accessed by anyone with electronic mail.
- (5) **Function of geminiviral genome:** Scientists at Northern California State University are using the infectious clones of BGMV-Georgia from UWI to study the mechanisms of host specificity between tomato golden mosaic virus and BGMV-Georgia to determine sequences essential for viral replication.

b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally: Not applicable.

c. Evidence of project impact on production/consumption of beans/cowpeas: Not applicable.

d. How research findings address needs of small-scale farmers, women and/or other beneficiaries: This project is mainly supportive to bean research around the world. Accurate diagnostic methods will accelerate applied breeding efforts, and development of transformed bean plants could lead to the permanent solution of BGMV.

The project also provides training opportunities for many women from foreign countries (7) and from the U.S. (6).

e. Impact(s) results have had on the developing and developed world: The most immediate result has been in training--at the "cutting edge" of plant science--thirteen women and four men in 1992, including three M.S. degrees earned during the year.

One of the diagnostic tools with enormous potential is PCR. PCR primers are currently being transferred to the University of California-Davis and institutions in Costa Rica, Jamaica, South Africa, Taiwan (AVRDC), Egypt and Colombia (CIAT). The PCR primers being distributed allow scientists around the world to amplify geminiviral DNA from beans, other crops and weeds to accurately characterize the virus and determine their reservoirs.

2. Changes in national production/consumption of beans/cowpeas in HC: Not applicable.

B. Institutional Development and Training

- 1. Institutional personnel changes since FY 91:** The restructuring of this project in the five-year extension to encompass a regional, multi-institutional program in the Caribbean resulted in formalizing a major expansion in HC collaborators. This includes personnel at CIAT, University of Costa Rica, University of West Indies and EMBRAPA/Brazil in addition to former formal links in the Dominican Republic.
- 2. A.I.D. funded long- and short-term training:** Only two changes--Ms. R. Teresa Martinez was funded on Bean/Cowpea CRSP support (tuition) for one semester after the PSTC/USAID grant was exhausted, and Ms. Maria R. Rojas joined the group at the Universidad de Costa Rica for four months after completing training at University of Wisconsin. Three graduate students and one post doctorate continued under A.I.D. funding at Wisconsin.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. U.S. research activities and progress achieved:

- a. Molecular characterization of bean geminiviruses:** After extensive sequence alignments of geminiviruses, general primers for DNA-A and DNA-B of whitefly-transmitted viruses were designed and reported in FY 91. This year, these general primers were much more extensively evaluated from several sources and the thirteen most useful were selected. More than fifteen undescribed geminiviruses were sequenced to obtain signature sequences. Several weedy and wild species were characterized by PCR.

Of the fifteen geminiviruses evaluated, four distinct families and eight "subspecies" were detected: five affect beans (three BGMV types plus dwarf and calico mosaics), two are on tomatoes and one is squash leaf curl. The four main branches are distinct from African geminiviruses on cassava and tomato.
- b. Development of DNA probes:** Studies on the extent and importance of bean calico mosaic in Mexico were planned but have not yet materialized.
- c. Virus-derived resistance scheme for transgenic plants:** Considerable effort has been devoted to studying the role of the coat protein in movement and symptom expression. Three mutants in the AR1 ORF (virus coat protein) have been discovered that are infectious, but none were sap transmissible and did not accumulate coat protein.
- d. Evaluation of transgenic plants:** The first transgenic plants engineered by Agracetus in 1991 produced eleven R₂(second seed population) transgenic families of the navy bean Seafarer, and two lines which were crosses between transformed Seafarer and Carioca. All but two carry the GUS (blue bean-indicator) and Ignite (herbicide) resistance gene and coat protein (ORF) of BGMV-Georgia. In addition, two new lines were made available in September 1992.

All lines carrying the three alien genes were sap inoculated with BGMV and symptoms were measured fourteen days later. Infectivity ranged from 0 percent to 80 percent and coat protein was easily detected in the infected plants but not in uninoculated controls. Lines 46-18 and 42-18 showed only 0 percent and 7 percent infectivity. However, both lines were susceptible to whitefly transmission in Puerto Rico. In further screening tests in PR, the lines KW42-18 and KWA-23 showed delayed symptoms (15 to 35 days) after inoculation.

- e. **Evaluation of germplasm for resistance to BGMV:** This activity has been deferred due to other more urgent activities.

2. HC research objectives and progress achieved:

a. Molecular characterization/variability of geminiviruses

- (1) **Variability of BGMV:** PCR-amplified fragments of beans from Georgia and the Caribbean Basin proved to be BGMV Type II. Samples from Brazil were Type I. **NOTE:** Host resistance response is also different.
- (2) **Evaluation of weeds as BGMV reservoirs:** Several crops and weeds were assayed for BGMV. Only positive squash-blot hybridization signals were obtained with a *Rhynchosia* species and a malva weed.

- b. **DNA probes for detection of geminivirus:** A non-radioactive probe method was evaluated in Costa Rica on BGMV-Costa Rica and a virus-infected weed. Only the PCR-amplified viral-DNA was detected with dot blotting or a nylon membrane.

- c. **Evaluation of virus-derived resistance in transgenic beans:** Only one of nine lines tested (with whiteflies) in Puerto Rico showed delayed symptom development in 25 percent of the plants. All others were susceptible.

- d. **Germplasm evaluation for BGMV resistance:** *Phaseolus* germplasm was screened for BGMV in Puerto Rico using infected whiteflies. Many previously reported BGMV-resistant lines were found susceptible. Two *P. coccineus* genotypes were resistant and should be used for interspecific crossing.

- e. **Establishment of whitefly colonies in Nicaragua:** Present facilities for rearing whiteflies need to be upgraded before "pure" colonies can be successfully maintained.

- f. **Whitefly transmission of cloned geminiviruses:** Beans were inoculated with cloned DNAs of BGMV using the gene gun at CIAT. Whiteflies were fed on the infected plants and successfully transmitted the virus to other healthy plants.

3. Length of time project has been engaged in lines of research addressing these objectives

- a. **Progress in relation to schedule in log frame:** Intensive research activities on BGMV were initiated in January 1987. Progress has been steady and ahead of schedule on all objectives.

- b. **Reasons for delay, if any:** Not applicable.

4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere: The project has helped to build and sustain a global network for geminivirus research. Exceptionally close working relationships have been established with the Dominican Republic/UNL, Honduras/UPR and Malawi/UCD CRSP projects and with Agracetus, Inc., CIAT (Morales), UFL (Hiebert), EMBRAPA (Faria and Ribeiro) and researchers in AVRDC, Egypt, South Africa, the United Kingdom and India.

Very few, if any, research projects have such a wide coterie of active participants working together on a comparatively narrowly defined problem area. The real cost of this effort has to be several times the modest CRSP support provided. In other words, the project is highly leveraged by other support.

5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints: BGMV is likely to be the number one problem of bean production on a global basis. Therefore, the exceptional progress made in identifying and characterizing the

pathogen, and in developing transgenic resistant beans, will greatly accelerate genetic improvement efforts. The poorest and disadvantaged segments of society are likely to benefit most from the critical advances being made. Moreover, the new research methods and techniques developed will become models for further efforts on beans and other primary subsistence crops.

D. Evidence of Biological/Social Sciences Integration

1. **Identification of and attention to relevant WID issues:** A special effort has been made to provide training for women in plant biotechnology. In 1992 fourteen women were trained at various levels in University of Wisconsin laboratories.
2. **Identification of and attention to other social and/or economic issues:** The project is aware of the implications of the release of transgenic plants in the developing world. Current strategy is to follow all safety procedures outlined for genetically engineered organisms in the U.S. and elsewhere in obtaining U.S. and Animal and Plant Health Inspection Service approvals. The proposed program involves a first screening at Puerto Rico, followed by evaluations at CIAT and in Jamaica and, finally, a release to national programs.

E. Baseline Data: The project relies on baseline data collected by other CRSP projects in the DR and Honduras. The project is neither equipped nor funded to carry out this activity except in identifying and characterizing BGMV.

F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above: New linkages include frequent communications with Jerusalem University (Israel); organization of workshops on PCR at AVRDC and UWI in 1993; with IITA (training-Dr. G. Thottapilly); with CIAT on PCR primers for cassava; and University of Hawaii-Manoa for PCR primers.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. **U.S.:** The delay in signing a subcontract with the University of Costa Rica and the ordering of equipment for the University of Wisconsin and the University of Costa Rica resulted from the slow approval of the CRSP extension.
2. **HC:** The Caribbean Basin/University of Wisconsin project is inadequately funded to carry current support for the DR, Costa Rica and Jamaica despite their importance and contributions made to the project.

B. Adequacy of Current Management, Policies and Procedures: Continuation of the project in the DR under the Secretaria de Estado de Agricultura is a serious concern of USAID and is delaying operations there. Hopefully this issue will be resolved soon. Other policy areas which require attention are the availability of bean transformation technology to other scientists; the issue of transgenic bean ownership; the depositing of transgenic seeds in the national seed bank; and biosafety and political implications of transferring transgenic germplasm to developing countries. These issues will be addressed at various levels beginning in FY 93.

C. Activity Towards Buy-ins and/or Other Funding: The project is highly leveraged by funding from other sources (about 2:1), but there is only limited support for training. Other sources of funding include: State of Wisconsin, Hatch Act, PSTC/USAID (trainee from DR), USDA grant, USAID Mission in Costa Rica (training), Foundation-Costa Rica, Graduate School-University of

Wisconsin, Riker Fellowship, Taylor Undergraduate Research Award, EMBRAPA-Brazil and Agracetus. Geminivirus research on tomatoes (\$110,000) directly complements BGMV studies. Altogether, support totals \$301,000 (including \$110,000 for tomatoes).

- D. Responsiveness to 50/50 Split Policy:** The project research is focused on a major problem in the host region; but, owing to the highly complex nature of biotechnology, many basic aspects must, at this stage, be carried out at the University of Wisconsin. If project funding were increased, more support could go to efforts in Jamaica and Costa Rica.

III. STATUS IN FY 92

- A. Appropriateness of Activities to Goals of the Global Plan:** The project is highly appropriate to the CRSP Global Plan in that it specifically addresses BGMV, the number one constraint to bean production in Latin America. The poor and disadvantaged in bean-growing regions will benefit directly from advances being made.
- B. Impact of Training Program on Project:** There is limited support for training in this project; however, the PI has attracted several other sources of support for training. The project would not have advanced so rapidly without the trainee input and collaboration both during training and afterward.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** The highly complex and technical nature of this project necessitates that it be heavily concentrated in the United States. However, activities are now increasing at selected institutions in Puerto Rico, Costa Rica, DR and Jamaica where some of the technical equipment and trained researchers are available.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Collaboration has been excellent. However, close and frequent communication between collaborators has had to be done long distance by phone, fax and E-mail. This is why the BGMV Workshop in Guatemala on November 9-13, 1992 was so useful and timely. Perhaps more frequent such meetings would be justified.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** The rapid progress made to date would not have been possible without the contributions of collaborators, especially Agracetus with the gene gun; screening of transgenic beans in Puerto Rico; transmitting virus particles with the gene gun at CIAT; preparation of probe materials and monoclonal antibodies at UFL; collection of samples from several locations in the United States and abroad; and increasing roles in research in Costa Rica and Jamaica.
- F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** The project has to date received considerable interest and encouragement from USAID Missions, but no funding for HC activities. The USAID Mission in the DR is dissatisfied with current national management. Therefore, the University of Nebraska-Lincoln and the University of Wisconsin projects are looking for an alternative institutional umbrella.
- G. Evidence of Institutionalization in HC and U.S.**
- 1. Faculty (researcher) recognition for international activities and awards:** The U.S. PI is widely recognized for his contributions and leadership in virus research and, more recently, in biotechnology. He serves on the University of Wisconsin International Agriculture Program Committee, assisted in developing an undergraduate degree program in international agriculture, and helped prepare a grant for international plant biotechnology.

2. **Integration of domestic program with CRSP project:** The U.S. PI's activities are primarily related to international agriculture. However, the studies on geminiviruses are attracting increasing attention in the United States because of their growing importance in both tropical and temperate ecologies.
 3. **Internal support for project management and institutional management:** Excellent support has been obtained from the Institutional Representative, who is the Director of International Agriculture Programs, e.g., providing office staff to assist with USAID (international) graduate student formalities. He has also helped promote political support for the project at the local, state and national levels.
 4. **Opportunities for/frequency of student/professor interactions:** The geminivirus team has a weekly laboratory meeting and the PI has daily or weekly contact with members of the group, including seven graduate and five undergraduate students, five visiting scientists and one post-doctoral fellow.
- H. **Other Comments:** An urgent need is for support to Agracetus to continue genetic transformation with the gene gun. The PI proposes an additional \$30,000 per year to provide a technical support person for this purpose.

Success of the project is attributable to the hard work and dedication of each member of the team and to the brilliant, inspired leadership of the U.S. PI.

IV. WORK PLAN CHANGES

- A. **Changes/Additions/Deletions in FY 92 Work Plan:** Two activities were not initiated: (1) an evaluation of bean geminiviruses in Northern Mexico and (2) studies on the inheritance of BGMV.
- B. **Reasons for Changes:** Lack of budget and urgency of other objectives (e.g., developing the PCR).

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. Publications

1. **Refereed journals:** 5
2. **Non-refereed journals:** 7
3. **Book chapters:** 1

B. Presentations: 12

VI. OVERALL RATING: 1--Highly Satisfactory

- A. **General Strengths:** The general strengths of the project include the large number of highly trained and dedicated personnel; wide base of institutional support and public interest in biotechnology; large coterie of collaborators; brilliant, inspired leadership; and generally adequate funding and facilities.
- B. **General Weaknesses:** The primary weakness is the low and unstable CRSP funding. Other weaknesses include lack of CRSP training component and over-extension of activities.
- C. **Recommendations:** There are two recommendations: (1) Add a training plan and (2) increase the research budget, primarily to provide access to a gene gun.

COSTA RICA • MICHIGAN STATE UNIVERSITY • HOSFIELD

*Improvement of Digestibility and Nutritional Quality of Common Bean (Phaseolus vulgaris L.)
Through Traditional Breeding, Molecular Biology, Genetics and Food Technology***I. PROGRESS DURING FY 92****A. Specific Research Contributions in FY 92****1. New research results from FY 92 disseminated and currently in use in HC and U.S.**

- a. Improved cultivars, inoculants, tests, methods and systems:** This is a new project which was funded in September 1992. Activities in the HC are being developed. Research on digestibility has been initiated at Purdue (protein) and MSU (carbohydrate). The approaches will involve traditional breeding and molecular biology to improve digestibility. The utilization of beans particularly as a weaning food is constrained by the presence of non-digestible complex sugars and other undesirable factors.

At MSU, drum drying is being investigated as a process for the development of bean-based weaning foods for use in the HC and other bean-consuming developing countries as well as developed countries, including the U.S. Processing parameters for drum drying and chemical analyses of drum-dried prototype products are being evaluated. Physical and functional properties and color were included in these evaluations. Acceptable drum-dried products having a bland flavor and neutral color were obtained.

Different extraction procedures (steam or hot water) to remove undesirable constituents (primarily oligosaccharides), prior to drum drying, did not result in changes in the product regarding protein content, but hot water extracted more mineral components. Fat was low in both extracted preparations.

Genetic transformation techniques are being developed to improve the protein quality of beans. The approach involves development of transformed beans containing a Brazil nut gene which when expressed would increase the limited sulfur amino acid content of the bean protein. The Brazil nut gene construct was obtained from Pioneer Corporation. These studies are primarily being done at Purdue.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** Fourteen bean stocks have been obtained from the University of Costa Rica which are resistant to web blight and anthracnose. These are being multiplied at MSU. Three accessions selected for high yield and adaptation to Midwest growing conditions were sent to Purdue for transformation experiments.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** None, as this project has just been initiated.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** This research will address the need to develop a nutritious, low-cost, bean-based weaning food for developing countries in which beans are a major source of protein. This development will impact women and children and offer an additional utilization aspect for beans.

- e. **Impact(s) results have had on the developing and developed world:** Development of high-quality protein in beans will impact all bean-consuming areas of the developing world. Non-animal-based weaning foods also are of significant interest to developed countries as evidenced by Gerber Products Company's collaboration with this project.

2. **Changes in national production/consumption of beans/cowpeas in HC:** None as of yet.

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** This is a new project, therefore, no changes have occurred as of yet.
2. **A.I.D.-funded long- and short-term training:** This is just being developed. One individual has started a training program at Purdue and one short-term trainee was partially funded.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. **U.S. research activities and progress achieved:** Since this project has recently been started, progress has been limited to the initiation of research on water extraction and subsequent drum drying of beans and the development of transformation techniques for modifying bean protein-quality characteristics to enhance digestibility.
2. **HC research objectives and progress achieved:** Planning is being done for initiation of the HC research program.
3. **Length of time project has been engaged in lines of research addressing these objectives**
 - a. **Progress in relation to schedule in log frame:** Initiated in September 1992.
 - b. **Reasons for delay, if any:** None.
4. **Relationship of project research to other research being conducted in the HC, IARCs and elsewhere:** Although development of weaning foods from non-animal sources is being pursued by various groups, none are attempting to use beans. The approach of using breeding and molecular biology techniques to develop beans with improved digestibility is a relatively unique approach. This "marriage" of plant breeding and utilization is an important concept.
5. **Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints:** Successful research accomplishments of this project will enhance the nutritional status of infants in the HC. The collaboration of Gerber Products Company is ample evidence of U.S. vested interest. Pioneer Corporation has also collaborated by supplying a gene construct. Development of a bean with high quality protein and a process for maximizing its protein digestibility will impact developing and developed countries and eliminate some global restraints regarding bean utilization. The problem of carbohydrate digestibility is a constraint to infant formulation and elimination or modification of these components would significantly enhance overall utilization of beans.

D. Evidence of Biological/Social Sciences Integration

1. **Identification of and attention to relevant WID issues:** WID issues are central to this project as it is focused on development of weaning foods. This project has planned to collect baseline data in its workplan on malnutrition in Costa Rican children and current weaning food and weaning practices. An anthropologist is part of the core research team (Dr. Sue Kenyon) and collaboration is planned with Ms. Leda Munoz, a nutritionist at the University of Costa Rica.

2. Identification of and attention to other social and/or economic issues: Drs. Anne Ferguson and Rick Bernsten, CRSP WID Specialist and Agricultural Economist respectively, have been involved with the planning of this project to insure attention to these issues.

E. Baseline Data: These are a part of the workplan of this project.

F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above: Although recently initiated, effort is underway to establish linkages with other CRSP utilization projects. Particular efforts are involved with establishing collaboration with the Tanzania/WSU cookability and digestibility evaluations and the Ghana/UGA cowpea utilization project to ascertain whether technologies are interchangeable.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. U.S.: None.

2. HC: Release of funding to HC awaits appropriate HC documents.

B. Adequacy of Current Management, Policies and Procedures: Satisfactory.

C. Activity Towards Buy-ins and/or Other Funding: None as of yet, but buy-ins are being pursued.

D. Responsiveness to 50/50 Split Policy: Not established as of yet.

III. STATUS IN FY 92

A. Appropriateness of Activities to Goals of the Global Plan: Although this activity has just been initiated, the project is very appropriate to goals and global plan.

B. Impact of Training Program on Project: None as of yet.

C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives: Not applicable.

D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel: Two meetings have been held between all the participants (U.S. and Costa Rica). Strong collaboration ties are being developed on this project between all personnel involved. Gerber Products Company also has a Costa Rican subsidiary.

E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives: Cooperative stances of all participants point to an excellent potential towards accomplishing goals.

F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy: The Mission has been very supportive and a Memorandum of Understanding has been signed. Support is being pursued.

G. Evidence of Institutionalization in HC and U.S.

1. Faculty (researcher) recognition for international activities and awards: Not applicable.

2. **Integration of domestic program with CRSP project:** Highly integrated with programs at MSU.
3. **Internal support for project management and institutional management:** Highly satisfactory.
4. **Opportunities for/frequency of student/professor interactions:** Excellent rapport between students and faculty is occurring in the graduate program.

H. **Other Comments:** None.

IV. **WORK PLAN CHANGES**

A. **Changes/Additions/Deletions in FY 92 Work Plan:** Work has just started.

B. **Reasons for Changes:** None.

V. **PUBLICATIONS AND PRESENTATIONS IN FY 92**

A. **Publications:** None as of yet since project has just started.

B. **Presentations:** None as of yet since project has just started.

VI. **OVERALL RATING: Satisfactory Start-up**

A. **General Strengths:** Enthusiasm of personnel involved and excellent leadership of Professor Hosfield.

B. **General Weaknesses:** None apparent.

C. **Recommendations:** Although recently initiated, satisfactory progress is being made.

DOMINICAN REPUBLIC • UNIVERSITY OF NEBRASKA • COYNE

*Disease Management Strategies and Adaptation of Dry Beans, with Emphasis on Lowland Tropics***I. PROGRESS DURING FY 92****A. Specific Research Contributions in FY 92****1. New research results from FY 92 disseminated and currently in use in HC and U.S.**

- a. Improved cultivars, inoculants, tests, methods and systems:** A new white bean Anacaona (L-86-020), developed in PR, was released in the DR in 1992. It has a higher level of rust resistance and yield potential than Arroyo Loro.

In Nebraska certified seed of Starlight was produced; and a new high-yielding Pinto line, WM2-89-5, with combined resistance to common blight, halo blight, brown spot, rust and white mold (partial) was developed and should be released in 1993. New Great Northern and Pinto lines with combined resistance to bacterial, fungal and viral diseases were also developed in NE.

New methods to improve regeneration of beans from callus through organogenesis and embryogenesis have been developed. Also, an improved rooting technique for detached bean leaves is facilitating testing pathogens on the same genotype; and a method for testing the heritability of seed infection with *X. cp* was devised.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** Germplasm development rather than collection/evaluation *per se* is a primary activity of this project. In 1992, 55 new selections from the Pompadour landrace were evaluated in PR for growth habit, leaf pubescence, rust and common blight.

CB resistance from NE is used worldwide; and NE germplasm has been used widely in bean breeding in the United States and elsewhere for improving GN (Starlight) and Pinto (Pinto 89-5) types.

- c. Evidence of project impact on production/consumption of beans/cowpeas:** Socioeconomic studies indicate that the new PC-50 cultivar represents more than 60 percent of production in the DR. The introduction of a fall fallow period to reduce pathogen inoculum and whiteflies increased yields by 29-59 percent in the main bean production area of San Juan de la Maguana.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Project technology development helps small farmers and their families through reduction of production costs, increased incomes and a more reliable source of food. Reduction of pesticide use helps eliminate pollution and worker exposure. A plentiful supply of beans will improve usage, diet and nutrition of poor farm families.
- e. Impact(s) results have had on the developing and developed world:** The adoption of PC-50 and a fall fallow period have improved bean yields in the DR. The development of new cultivars in the United States (Starlight and Pinto 89-5) will increase total bean production and crop profitability in NE and adjoining states. NE elite germplasm

(e.g., CB resistant) is used by bean breeders throughout the world. Similarly, the identification of non-specific rust resistance (pubescence) and BGMV resistance in Pompadour types in the DR, and heat tolerance (in PR) is of major importance to bean programs elsewhere.

2. **Changes in national production/consumption of beans/cowpeas in HC:** Official statistics do not yet reflect the impact of new technology in the DR.

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** The HC PI, Ing. Agron. Freddy Saladin, accepted the position as Director of PROFRIJOL effective January 1, 1993; Dr. Eladio Arnaud-Santana earned the Ph.D. at UNL in May 1992 and returned to the DR as a bean breeder; Dr. Graciela Godoy, a plant pathologist, was named Co-PI of the project in the DR; Dr. Margaret Mmbaga completed her research on bean rust at UNL and became the legume pathologist at International Center for Agricultural Research in Dry Areas, Syria; Dr. Mohamed Mohamed completed his studies on bean regeneration at UNL and will return to Egypt in early 1993; Mr. Matthew Blair completed an M.S. on BGMV at UPR; and Mr. Cristobal Adames (PROFRIJOL grant) will carry out his M.S. thesis research on transgenic beans at UPR in 1993.
2. **A.I.D.-funded, long- and short-term training:** Ms. Tania Polanco (DR) initiated studies for the M.S. degree at UPR (on web blight) in 1992; Mr. Maximo Halpay (DR) initiated studies for the M.S. at UPR (on rust resistant genes) in 1992; Mr. James Boskosi (Malawi) continued his Ph.D. program in plant breeding at UNL; and Mr. Mohammed Meskine (Morocco) continued his Ph.D. program in plant pathology at UNL.
3. **Other funding support for bean research training:** Mr. Geun Hwa Jung (Korea) continued his Ph.D. program in molecular gene mapping at UNL and Ms. Yen Yoo Sung (Taiwan) continued her M.S. program in plant architecture in beans at UNL.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. **U.S. research activities and progress achieved:**
 - a. **Race non-specific rust resistance:** The presence of pubescence confers a type of general resistance to rust; but selection for susceptibility at the seedling stage (before pubescence is fully developed) could eliminate some adult resistance. Although abaxial long (1-2 mm) leaf hairs are associated with non-specific resistance, they are not the only factor involved in adult plant resistance. Data are being analyzed and studied.
 - b. **Radioactive probe for *X. campestris* pv. *phaseoli* in bean seed:** In all cases the probe assays agreed with greenhouse results.
 - c. **Breeding for multiple disease resistance in red mottled GN and Pinto beans:** The best method for selecting BGMV resistance is in F₄ replicated trials. However, whiteflies preferred pubescent types over glabrous ones.

A reliable greenhouse inoculation technique for WB was found; and two PR isolates proved to belong to the AG-2 group.

Several new advanced GN and Pinto lines with combined resistance to rust, BCMV, brown spot, halo blight and avoidance of white mold have been developed. Pinto 89-5 also performed well and may be released.

Interspecific crossing *P. vulgaris* x *P. acutifolius* progressed; and studies were continued on plant architecture. More erect, upright types (Starlight) had better disease avoidance characteristics and are easier to harvest.

- d. **Stability of plant architecture:** Crosses between prostrate and erect types showed instability of architecture when grown in different environments. High temperature regimes (28/20c) increased branching and prostrateness, except in the stable line A-55 (CIAT).
 - e. **Regeneration and genetic transformation:** These studies produced advances in somatic embryogenesis of callus tissue derived from seedlings grown on forchlorfenuron-containing medium. If successful, this will lead to much easier genetic transformation.
 - f. **Red-mottled beans with heat tolerance:** A red-mottled bean line, 9180-25, showed useful levels of heat tolerance and resistance to rust and CB. Several genotypes of snap beans (Geneva, NY) showed good heat tolerance but susceptibility to CB.
 - g. **BGMV epidemiology and management strategies:** BGMV spread much more slowly in fields of DOR 364 than other lines, and particularly when wide spacings (40 x 40 cm) were used. Studies also showed that the atypical Pompadour resistance to BGMV could be selected for.
2. **HC research objectives and progress achieved:**
- a. **Inheritance of resistance to CB and WB:** Heritabilities (H) of seed transmission and leaf and pod reactions to CB and WB were studied. H values of .34-.46 for leaf reaction, .12-.27 for pod reaction and .26-.53 for seed transmission of CB were estimated on F₆ lines using SSD. A low correlation (+.22) was found between WB and plant type.
 - b. **Evaluate bean lines with Type I and II growth habits:** Indeterminate plant types were significantly superior in yield (+35 percent), more stable over all environments, but may be more susceptible to BGMV compared with determinate varieties in similar genetic backgrounds.
 - c. **The pathogen (*Xanthomonas campestris* pv. *phaseoli*) causing common bacterial blight:** Pathogenic *X. cp* were more numerous than non-pathogenic types. *X. cp* survived only up to 60 days on leaves of some perennial weeds indicating low probability of survival to the next bean planting in five months.
 - d. **Web blight studies:** Widespread basidio-spore infection was detected in the Cibao Valley. Unblemished seeds from infected plant of P. Checo, H270 and L-86020 were devoid of WB pathogen. White and black seeded types had lower levels of seed blemish than red types. Best was the white seeded Anacaona (L-86020).
 - e. **Impact of the new release, PC-50:** A new socioeconomic study on the impact of PC-50 release and adoption in the DR is being carried out as a cooperative project between the DR PI (Saladin) and MSU (Bernsten, Ferguson and Heikes). The field work was begun on June 1, 1992 and analysis/write-up will be done during the first semester 1993.
3. **Length of time project has been engaged in lines of research addressing these objectives:** Extensive work on CB and rust began with the project's inception in 1981. Studies on race non-specific resistance to rust (pubescence) began in 1987; and investigations on newly emerging diseases BGMV and WB began with the merger of the UPR and UNL

projects in 1987. Regeneration of bean plants from callus and studies on plant architecture were started in 1989.

- a. **Progress in relation to schedule in log frame:** Proposed research is on schedule.
 - b. **Reasons for delay, if any:** Not applicable.
4. **Relationship of project research to other research being conducted in the HC, IARCs and elsewhere:** The project is particularly complementary and supportive of work on improved seed production, control of bacterial diseases and seed transmission of web blight being conducted jointly with PROFRIJOL. The project also collaborates with the national bean program in conducting on-farm trials, technology transfer and basic seed increase of breeding lines.
 5. **Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints:** The new technology (PC-50 and fallow period in the fall) has already been widely adopted in the DR and is contributing to increased bean production there. Other new technologies like the white seeded Anacaona and other cultivars in the pipeline will contribute similarly in the future to, and beyond, the DR.

New information on pathogen epidemiology, sources of resistance, pathogen variation and genetics of resistance to various bean diseases will be very useful to bean breeders everywhere.

D. Evidence of Biological/Social Sciences Integration

1. **Identification of and attention to relevant WID issues:** A socioeconomic survey on the impact of the project's new technology in the DR is being carried out. Dr. Anne Ferguson, CRSP WID Specialist, and Dr. Rick Bernsten, CRSP Agricultural Economist, both at MSU, are directly involved in this study which will be analyzed and written up in 1993. Information has also been gathered on women's roles in bean production, harvesting and sale.
2. **Identification of and attention to other social and/or economic issues:** Not applicable.

E. **Baseline Data:** Major focus was given to assessing yield losses due to diseases. The new technologies (PC-50 and fall fallow period) have been widely adopted (60 percent) and increase yields by 26-59 percent.

F. **Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above:** There is a very close collaboration between the partners in this project, especially with UPR (Beaver); UNL (Steadman) in Jamaica, Malawi and Tanzania; UWI (Maxwell); USDA (Stanley-Beltsville and Silbernagel-WSU); University of Idaho (Myers); dry bean nursery (Grafton); and CIAT.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. **U.S.:** None.
2. **HC:** Transportation will be solved in 1993.

B. **Adequacy of Current Management, Policies and Procedures:** Administrative and accounting procedures are working smoothly. The new grant procedures are now in place and ensure that only HC scientists with approved projects are funded by the CRSP project. Modified

equipment procurement procedures whereby the MO can approve expenditures up to \$5,000 will greatly facilitate HC operations. However, current "level" funding over years does not allow for increased costs due to inflation.

- C. **Activity Towards Buy-ins and/or Other Funding:** The USAID Mission has declined to consider any buy-ins at this time; however, other sources are available (See I.C.4. and I.F.).
- D. **Responsiveness to 50/50 Split Policy:** The project is already close to a 50/50 split.

III. STATUS IN FY 92

- A. **Appropriateness of Activities to Goals of the Global Plan:** The DR program is primarily focused on low elevation problems of beans (under 1,000 M) where CB, BGMV and WB can be severely limiting. The purpose is to increase production in tropical coastal regions (in the cool season) and reduce pressures on the fragile hillsides. The technologies being developed are, therefore, highly relevant to bean-growing areas in the Caribbean Basin and other similar regions of the world. Moreover, resistance strategies (such as, race non-specific rust resistance, CB and BGMV resistance sources, general disease management strategies and improved germplasm) will also prove useful to the bean improvement community everywhere.
- B. **Impact of Training Program on Project:** The project could not achieve its goals and objectives without the participation of recently trained HC scientists, particularly Dr. Godoy (plant pathology-1990) and Dr. Arnaud-Santana (plant breeding-1992). At present Mr. Adames and Ms. Polanco are pursuing M.S. programs at UNL and are expected to return to the DR project. Four M.S. degree holders trained by the project have already returned to the DR.
- C. **Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** Previously, most basic research was done in the U.S. and the applied work was carried out in the DR. However, the return of two recently trained Ph.D.s plus two M.S. in 1993-94 will shift an increasing amount of basic research to the DR.
- D. **Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Research planning and budget development for FY 92 was done jointly in July 1992 with colleagues and participants from UNL, DR, Honduras, Jamaica, UWI, UPR and CIAT. Prior to any travelling, plans are made to maximize contacts with UNL, UPR, DR, UWI and CIAT representatives. Joint authorship on numerous publications provides further evidence of close collaboration between DR, UPR and UNL.
- E. **Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** Estimated budgetary requirements have been about \$210,000 almost equally split between the U.S. and HC. In addition, the HC derives some support from PROFRIJOL (\$9,000), CIAT, SEA and other internal and private sources. The UNL obtains other funding mainly from institutional sources, USDA Regional Research W-150 (\$22,000) and Nebraska Dry Bean Commission (\$14,400). Actual budgets are derived mainly from salaries, benefits and overhead applied to the actual time devoted to the project. Other contributions (e.g., laboratory supplies, secretarial assistance, greenhouse and field expenses, and labor) are not as easily documented.
- F. **Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** The USAID Mission is interested but gives only token support to the project for various reasons, mainly, lack of confidence in the DR Ministry of Agriculture (SEA). Until a new administrative shelter is found for the project, it will continue to be handicapped by weak Mission support and delays in travel requests and purchases.

G. Evidence of Institutionalization in HC and U.S.

1. **Faculty (researcher) recognition for international activities and awards:** Eight project researchers received special recognition and awards for contributions to bean improvement: Ing. Agron. Freddy Saladin, Dr. Mohamed Mohamed, Dr. Paul Read, Dr. Dermot Coyne, Dr. Eladio Arnaud-Santana, Mr. Rohini Deshpande, Dr. Graciela Godoy and Dr. James Steadman.
2. **Integration of domestic program with CRSP project:** The UNL, UPR and UWI bean programs are closely integrated. In addition, there is cooperation with the USDA, WSU, UCD and MSU. Among these programs there is integration in research strategies and approaches, and disease management strategies have been formulated from both U.S., HC and other experience. Training grad students also serves as a powerful incentive for continuing collaboration.
3. **Internal support for project management and institutional management:** Administrative support at the UPR and UNL has been excellent. Grants and contract officers have given time and expertise to the project. Administrative support in the DR has also been good, considering current budgetary limitations.
4. **Opportunities for/frequency of student/professor interactions:** Contacts between researchers and students have been good even after the return of students to their HC duties. For example, Drs. Godoy and Arnaud-Santana returned to UNL to work with Drs. Steadman and Coyne on a collaborative research project in July 1992.

H. **Other Comments:** The project urgently needs an early solution to the dilemma on an administrative base in the DR.

IV. WORK PLAN CHANGES

- A. **Changes/Additions/Deletions in FY 92 Work Plan:** None.
- B. **Reasons for Changes:** Not applicable.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

- A. **Publications**
 1. **Refereed journals:** 10 plus 6 refereed abstracts.
 2. **Non-refereed journals:** 21
- B. **Presentations:** 20

VI. OVERALL RATING: 1--Highly Satisfactory

- A. **General Strengths:** Major strengths are the excellence and productivity of the research staff at the basic and applied levels in both the U.S. and HC and the wide base of close and effective collaboration on bean problems between individuals and institutions. The project resolved a prior concern on socioeconomic activities by mounting a major study on socioeconomic and WID issues in collaboration with MSU.
- B. **General Weaknesses:** The major weakness is the inability to resolve the HC institution in the DR. This delay affects support, travel, procurement and inter-institutional relationships.
- C. **Recommendations:** Resolve the DR Host Country institution issue, as soon as possible.

ECUADOR • UNIVERSITY OF MINNESOTA • GRAHAM

*Improving the Symbiotic Nitrogen Fixation of Cultivars of
Phaseolus vulgaris Under Low Resource Conditions***I. PROGRESS DURING FY 92****A. Specific Research Contributions in FY 92****1. New research results from FY 92 disseminated and currently in use in HC and U.S.**

- a. Improved cultivars, inoculants, tests, methods and systems:** Evaluation of Ecuadorian peat sources as inoculant carriers was completed in 1992. Samples were drawn from twenty-one sites in six provinces ranging from 4.0 to 5.5 in pH and 5.95 to 39.3 percent in organic carbon contents. Nineteen peat sources were judged satisfactory for use in maintaining at least 100 million viable rhizobial cells/cm³ after eight months of storage. One of the best and most convenient sources at Pichincha was selected for manufacturing inoculants.

Soil surveys extended to four additional provinces confirm earlier results on deficiencies of nitrogen, zinc, manganese and iron. Greenhouse and field studies show a particularly strong response to zinc application and indicate the need for commercial applications of Zn in bean-growing regions, either as dry soil applications or as foliage sprays.

Superior bean lines from previous tests and giving good performance in 1992 have been selected by PROFRIZA (CIAT-coordinated regional testing program) for large-scale testing and seed multiplication.

Studies were continued on the genetic basis for differences in nitrogen fixation and on methods of early generation testing at the University of Minnesota.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** INIAP has maintained a large collection of germplasm for many years but many have been lost because of poor storage conditions. Project funds have been used to grow out and characterize the remaining accessions in 1991 and 1992.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** Not applicable. The project was only activated in 1989.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Both medium- and long-range objectives favor small-scale farmers and women.
- e. Impact(s) results have had on the developing and developed world:** Not applicable. Project is too new.

- 2. Changes in national production/consumption of beans/cowpeas in HC:** Not applicable at this stage.

- B. Institutional Development and Training:** INIAP was granted autonomy from the Ministry of Agriculture in 1992 and is currently recruiting a new Director General and senior

administrators. INIAP is planning ambitious structural, staffing, training and research changes. Therefore, there should be good opportunities for younger, newly trained staff including the six *egresados* whose thesis activities received project support.

1. **Institutional personnel changes since FY 91:** Collaborative research studies were continued with the Universities of Loja and Chimborazo.

Ing. Consuelo Estevez completed her M.S. at the University of Minnesota in 1991 and was named Head of the Plant Pathology Department at Santa Catalina. She is also the HC PI and the HC representative on the Bean/Cowpea CRSP Technical Committee.

2. **A.I.D.-funded long- and short-term training:** Six *egresados* are receiving project support for their thesis work in Ecuador. Two staff scientists are doing graduate training at the University of Minnesota.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. **U.S. research activities and progress achieved**
2. **HC research objectives and progress achieved**

Eleven work plan objectives are included in the FY 92 program activities. These may be grouped as follows: (1-3) breeding beans for improved adaptation, yield and N-fixation; (4-6) studies of interactions between bean genotypes and rhizobial nodulation, soil pH and low soil *P*; (7) importance and nature of root diseases on bean production and N-fixation; (8) biodiversity of Ecuadorian bean *Rhizobium*; (9) micro-nutrient deficiencies in Ecuadorian soils; (10) WID issues in bean production; and (11) weevil damage to stored bean seeds.

The studies and experiments carried out were done jointly by HC and U.S. researchers. Most of the field trials and tests were done in Ecuador, while laboratory and greenhouse activities were done in both the HC and the U.S. The University of Minnesota often "backed up" lab work in Ecuador.

In general, highly satisfactory progress has been made for all eleven objectives in FY 92. The most significant highlights include:

- a. Developing and testing ten high-performing (yield, adaptation and N-fixation) red (7) and black (3) seeded lines for low and high elevation conditions (see above).
- b. New crosses made between high N-fixers (Puebla 152 and RIZ21) and Ecuadorian lines (Paragachi and INIAP404-2).
- c. Identifying good N-fixers under zero nitrogen conditions: AFR550, SUG71, SUG91, AND904.
- d. Additional crosses on Puebla 152 and RIZ21 with RAB39, BAT271 and MXA238. F₂ and F₃ seeds from these and (b) above will be available for growing out in late 1992.
- e. Large seeded Andean bean gene pools nodulated better than the Mesoamerican (Mexico) sources with local rhizobial strains.
- f. Bean host specificity for rhizobial strains was demonstrated by testing 300 bean accessions on UMR1116 (ineffective *Rhizobium*) and UMR1899 (effective *Rhizobium*).
- g. Root diseases (*Fusarium oxysporum*, *F. solani* and *Rhizoctonia solani*) were recovered from a high proportion of root and plant samples collected (44.5 percent, 8.0 percent and 2.5 percent) and demonstrate the importance of root disease in Ecuador.

- h. Root disease resistance was found in RH5-250, BAT477, Negro Angel and WIS21-58. All of these were previously identified as good N-fixers.
- i. Soil sample analysis (146) from the provinces of Chimborazo, Guyas, Canar and Azuay showed unacceptably low levels of N, P, Zn, Fe and Mn (63 percent, 33 percent, 56 percent, 41 percent and 77 percent respectively). Field and laboratory studies confirm plant responses, especially to zinc, among the micronutrients.
- j. The role of women in bean production in Ecuador will be studied by Ms. Voight in the thesis research portion of her Ph.D. in anthropology.
- k. Studies on weevil damage in beans will be continued using solar disinfestation (but less intense than previously) and the use of insect deterrents like ash, cooking oil and black pepper.

3. Length of time project has been engaged in lines of research addressing these objectives

- a. **Progress in relation to schedule in log frame:** The project was started in 1989 (only three years). However, objectives 9, 10 and 11 are in response to new problems identified as part of baseline data gathering. In general, research activities are ahead of schedule in both the U.S. and HC.
- b. **Reasons for delay, if any:** Not applicable.

4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere: This project is unique to the Bean/Cowpea CRSP with major emphasis on N-fixation in large seeded bean types. CIAT has an input in N-fixation but the present program leader, Dr. Kipe-Nolt, has left and has not yet been replaced.

5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints: Biological nitrogen fixation is an excellent and inexpensive means of providing nitrogen for plant growth. It also allows better regulation of nitrogen and water fluxes in the groundwater (thereby reducing N-pollution).

D. Evidence of Biological/Social Sciences Integration

- 1. **Identification of and attention to relevant WID issues:** The project has given major attention to WID issues. The HC PI, one of the U.S. Co-PIs and four of the six graduate students involved in the project are women. Ms. Voight will carry out a study of the WID issues in Ecuador for her doctorate thesis in anthropology while Ms. Draeger will participate in a rapid assessment of sociological implications of rapid biological change in Ecuador.
- 2. **Identification of and attention to other social and/or economic issues:** Not applicable.

E. Baseline Data: A major strength of the project is the collection of baseline data including considerable information from the Cornell project. In addition, much data has been collected on Ecuadorian soils--their fertility status and *Rhizobium* populations--and farm surveys have been carried out on disease and fertilizer practices.

F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above: The project has benefitted from advances of other CRSP programs: solar disinfestation method from Cameroon/Purdue, bean root rot differentials identified at WSU and many other genetic materials developed or identified by several programs. The U.S. PI also collaborates with Mexico--the bean group at Chapingo and the molecular genetics group at Cuernavaca--and with faculty at the UFL and the Grain Legume Research Center in Perth, Australia.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. **U.S.:** The limited budget tends to constrain activities. Elevated fringe benefits for graduate students (at University of Minnesota) in 1993 will impact on training.
2. **HC:** Current financial reports from Ecuador are delayed, followed by a delayed turnaround at UMN. This situation is partly alleviated by operational advances to the HC PI.

B. Adequacy of Current Management, Policies and Procedures: Not a problem.

C. Activity Towards Buy-ins and/or Other Funding: To date, the USAID Mission has not responded to proposals for buy-ins but has expressed interest in low-input systems for high-elevation "paramo" locations. A bean research buy-in from Egypt has been initiated and has important implications for Ecuador because of similarity of soils. Responsibilities could be divided so that Egypt works on iron problems and Ecuador on manganese and zinc.

Funding was also obtained from the Consejo Nacional in Ecuador for the evaluation and testing of peat. This could lead to the development of a legume inoculant industry.

D. Responsiveness to 50/50 Split Policy: The correct split is being maintained.

III. STATUS IN FY 92

A. Appropriateness of Activities to Goals of the Global Plan: Project activities are all directly related to specific constraints identified in the Global Plan. Major problem areas for bean production in Ecuador, Latin America and U.S.--as well as bean/rhizobial issues in other regions of the world--are being addressed. The project has also maintained a germplasm conservation focus for both bean and *Rhizobium* collections with special emphasis on regional needs.

B. Impact of Training Program on Project: Most of the research in both the U.S. and HC is done through graduate students (*egresados*). Since nearly half the budget is utilized for training costs, training activities are the project. The newly trained Ecuadorians will be well situated to step into key positions in the newly reorganized INIAP.

C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives: The return of Ing. Consuelo Estevez with her M.S. (Plant Pathology) has helped shift more of the activities relating to Ecuador to INIAP. In addition to the research of the *egresados*, studies are being expanded with Peace Corps Volunteers and with staff members at Loja and Chimborazo.

D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel: Collaboration and cooperation between the U.S. and Ecuadorian institutions is excellent, thanks in part to Ing. Consuelo Estevez and E-mail links between the two institutions.

E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives: Contributions of collaborators appear fully consistent with their capabilities. Moreover, several collaborators are tapping outside funding; e.g., work study, MacArthur Fellowship, University of Minnesota Experiment Station, Egyptian buy-in and Consejo Nacional (Ecuador).

F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy: USAID/Quito has taken an interest in the project and has helped instigate collaboration with the Peace Corps.

G. Evidence of Institutionalization in HC and U.S.

- 1. Faculty (researcher) recognition for international activities and awards:** The U.S. PI is widely recognized as a leader in legume/*Rhizobium* microbiology. He is one of the few scientists to fully bridge the gap between bean improvement and plant interaction with microbes and to attempt genetic manipulation of both organisms. His international experience and capabilities--particularly in Latin America--are unsurpassed.

The HC PI, Ing. Consuelo Estevez, is a superb collaborator. Her research capabilities and success in attracting and working with cooperators is well recognized. This is certainly one reason she was recently named Head of the Plant Pathology Department at Santa Catalina. She is also recognized by being named as the Bean/Cowpea CRSP HC representative to the Technical Committee.

- 2. Integration of domestic program with CRSP project:** Fully integrated.
- 3. Internal support for project management and institutional management:** Support is excellent in both the U.S. and HC.
- 4. Opportunities for/frequency of student/professor interactions:** Excellent--as evidenced by the large number of graduate students (and *egresados*) attached to the program. Their enthusiasm and capabilities were clearly evident from contacts and discussions in Ecuador.

H. Other Comments: None.

IV. WORK PLAN CHANGES

- A. Changes/Additions/Deletions in FY 92 Work Plan:** Work plans have not been significantly altered although flexibility has been necessary to address new problem areas, especially in collecting baseline data.
- B. Reasons for Changes:** Not applicable.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92**A. Publications**

- 1. Refereed journals:** 2
- 2. Non-refereed journals:** 1
- 3. Book chapters:** 1

B. Presentations: 7

The number of publications attests to the many activities underway and documents progress made.

VI. OVERALL RATING: 1--Highly Satisfactory

- A. General Strengths:** Major strengths of the project are the outstanding, capable personnel attracted to the program including the two PIs and their many collaborators and associates. Institutional support is excellent; and the reorganization of INIAP will, in due course, become a major advance in implementing program activities.
- B. General Weaknesses:** None observed.
- C. Recommendations:** None.

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Integrated Pest Management for Cowpea in Sub-Saharan West Africa

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. **New research results from FY 92 disseminated and currently in use in HC and U.S.:** Since funding for this project only began in May (with actual funding notification in late June), the funding period for FY 92 was only five months, not sufficient time to allow for research contributions.
2. **Changes in national production/consumption of beans/cowpeas in HC:** Not applicable (see above notation).

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** Not applicable.
2. **A.I.D.-funded long- and short-term training:** Not applicable.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. U.S. research activities and progress achieved

- a. **Conduct ethnographic studies of cowpea in South Carolina:** From the seven possible distinct landraces of cowpea found in South Carolina, three have been planted at Charleston for seed advancement. These landraces are not only a fascinating resource for the breeding program, they also represent a historical resource with four of the landraces still being cultivated after having been passed down through generations of the same families for up to 100 years. Of interest to breeding plans, it appears that attack by insects on these varieties may be less than on improved varieties.
- b. **Conduct systematic surveys of pests and biological control agents:** One planting and analysis of pests and biological control agents has been completed. These studies will result in a better understanding of the insects that feed on cowpeas and their level of damage as well as potential biological controls. Preliminary information identified sucking bugs as the most economically important with additional research needed to determine economically important population densities.
- c. **Identify and evaluate pest-resistant germplasm:** Field testing of six cowpea genotypes was conducted at Charleston to determine possible resistance to insect pests. Tests of PI-293557, Carolina Cream, Floricream, FLA 68F-137, CR-22-2-21 and CR-17-1-13 generally revealed few significant differences in numbers of insects and spiders and in resistance to the major pest species such as the sucking bug complex (southern green stink bugs and leaf-footed bugs). Pests that did vary from genotype to genotype were those that are generally considered to be of minor importance.
- d. **Determine crop losses and action thresholds:** In field tests, losses from damage caused by the sucking bug complex surpassed economically important levels. Further experiments will provide better explanations of the relationships between yield losses and insect population densities.

- e. **Develop simplified crop surveillance methods:** Three different sampling methods have been compared for consistency of estimating population levels of major insect pests and predators. Evaluation of sweep net, plant shake and pitfall sampling methods revealed differences in yields and variation for different insect types.
- f. **Evaluate pilot IPM programs:** Not scheduled for implementation until later in the program.

2. HC research objectives and progress achieved

- a. **Conduct ethnographic and economic studies of farming practices in Ghana:** Key contacts have been established to begin work in this area, meetings with the CRSP social science team from MSU and a planned visit to Ghana, both scheduled for February 1993, will mark the beginning of research planning and implementation in these areas.
- b. **Conduct systematic surveys of pest and biological control agents:** Planning for these surveys began with the U.S. team's first visit to Ghana. Progress was made at that time and follow-up activities will be initiated with the scheduled February visit.
- c. **Identify and evaluate pest resistant germplasm:** Plans for this work were developed during the U.S. team's visit to Ghana. Activities will include exchange of materials between the U.S. and Ghana as well as between breeders at the research stations in Kumasi and Tamale.
- d. **Determine crop losses and action thresholds:** Work is planned to be conducted at Kumasi to determine damage caused by thrips, sucking bugs and Maruca pod borers.
- e. **Develop simplified crop surveillance methods:** Plans for attaining this objective include addressing the issues as a part of HC Objective a. activities. Major work in this area will be conducted in the U.S. with hopes of bringing a HC scientist to Charleston for a period of time to work directly with U.S. scientists.
- f. **Evaluate pilot IPM programs:** Activities under this objective will be implemented later in the project.

3. Length of time project has been engaged in lines of research addressing these objectives: The project has been in existence for less than one year, it is still in its start-up phase.

- a. **Progress in relation to schedule in log frame:** Not applicable.
- b. **Reasons for delay, if any:** Not applicable.

4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere: Apparently research in the HC has concentrated primarily on screening of germplasm from IITA. Planned activities under the CRSP program will be an important addition to those activities and will expand country capacity so that the cowpea program is more responsive to the need to consider the framework of the farm family in Ghana, responses to insect problems other than insecticides, and an integrated approach that includes an understanding of the damage inflicted by insects as well as alternative ways of dealing with the problem.

5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints: Because of the very short lifespan of the project, this is difficult to project. However, there are several elements of this particular effort that could yield progress in greater understanding of the problems of insects on cowpeas, the various approaches that can be used to solve those problems, and the application of research in this area to the

family farm in Ghana. The dependence upon insecticides in dealing with pest problems is not only expensive and dangerous in many cases, it has resulted in very limited knowledge of the pests themselves and their impact on production and consumption.

- D. Evidence of Biological/Social Sciences Integration:** As the plans have been developed for implementation of this particular research activity, it has the potential of being a model for the integration of the biological and social sciences. All of the U.S. scientists involved seem to have a sincere interest in this integration, with excellent leadership being provided by the PI.
- 1. Identification of and attention to relevant WID issues:** Research plans include these issues both in terms of accessing baseline data and in incorporating them into research plans.
 - 2. Identification of and attention to other social and/or economic issues:** The social sciences are well represented and well integrated into research plans with social science fields represented on the research team and already beginning to access the expertise of the CRSP social science experts.
- E. Baseline Data:** Existing baseline data are inadequate. The project's plans include extensive surveys to gather baseline data.
- F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above:** Plans are in place to link this activity with the Ghana/UGA cowpea utilization project although they are still rather informal. The PIs of both projects stated an interest in developing more concrete linkage plans--something that could be very profitable and could, if well planned and implemented, serve as a model for other such linkages in the future. Ghana, with both a production and a utilization project, provides an excellent opportunity to develop unique linkages. During the EEP campus visit, discussion also included possibilities of significant linkages with the other CRSP projects in West Africa. This seems to be an especially appropriate idea given the network of cowpea activities funded by the CRSP in that part of the world. In addition to CRSP linkages, there is potential for cooperation with the Global 2000 program and the Deutsche Gesellschaft fuer Technische Zusammenarbeit (German Agency for Technical Cooperation) programs in northern Ghana.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

- 1. U.S.:** Approval of funding was considerably delayed by Congress this year. This proved to be a special limitation for the projects that were to be started with this funding cycle. Funding delays resulted in delays in setting up the project and beginning project activities.
- 2. HC:** HC collaborators had not yet established a bank account into which funds could be transferred at the time of writing of the Annual Report.

B. Adequacy of Current Management, Policies and Procedures: Because of the short life of the project to date, it is too soon to tell whether current policies and procedures are adequate.

C. Activity Towards Buy-ins and/or Other Funding: None to date.

D. Responsiveness to 50/50 Split Policy: During FY 92, the HC received slightly more funding than the U.S. institution. It is expected that this imbalance will be remedied in such a way that the life-of-project figures will be equal.

III. STATUS IN FY 92

- A. Appropriateness of Activities to Goals of the Global Plan:** The CRSP has long lacked an integrated and appropriate project to consider the impact of pests on cowpea production and utilization. This project will be very important in filling that void. Plans will particularly aim efforts at marginal farmers, allowing them alternatives to the use of expensive (and potentially dangerous) pesticides. The project's planned incorporation of social science elements throughout the life of the project as well as integration with the utilization project in Ghana also have the potential to serve as a model for application in other areas.
- B. Impact of Training Program on Project:** None to date.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** Plans imply that there will be an acceptable balance, but it is too soon to evaluate project implementation.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Plans and accounts of the U.S. researchers' visit to Ghana bode well for collaboration. However, there is a very serious communications problem with Ghana. It is crucial that project activities, especially travel in either direction, be carefully planned to take care of a variety of communications and sharing needs. It would be helpful if the two Ghana projects could especially cooperate in this area. This is probably the greatest single administrative/management constraint to the potential success of the project.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** Because of the newness of this project, contributions have been in the planning efforts. In this case, both institutions appear to have been contributing. In both cases, these institutions have a focus on cowpeas and/or integrated pest management as a part of their ongoing research efforts. Therefore, both institutions will be providing considerable resources to the overall research program. The result should be a far greater level of progress than could be achieved with CRSP funding alone.
- F. Interest, Involvement, and Support of USAID Mission and/or U.S. Embassy:** The Mission appears to have been supportive of the project, however additional Mission involvement is not anticipated at this time.
- G. Evidence of Institutionalization in HC and U.S.**
- 1. Faculty (researcher) recognition for international activities and awards:** None.
 - 2. Integration of domestic program with CRSP project:** There seems to be a great deal of potential for integration. Ongoing research on IPM applied to vegetables provides the basic framework for the cowpea program.
 - 3. Internal support for project management and institutional management:** There seems to be support at least at the level of rhetoric. It is probably too soon to determine exact levels of support however.
 - 4. Opportunities for/frequency of student/professor interactions:** Not applicable.
- H. Other Comments:** None.

IV. WORK PLAN CHANGES: None.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92: None.

VI. OVERALL RATING: Satisfactory Start-up

- A. General Strengths:** This project has strong leadership, a cohesive group of U.S. scientists involved, a clear commitment to the content and to the integration of social sciences into the research program, strong plans for collaboration with counterparts in Ghana, and what appears to be a sincere desire to coordinate with other CRSP projects and other research activities in the U.S. and Ghana. The project has real potential to serve as a model project to which would be applied what has been learned over the life of the Bean/Cowpea and other CRSPs.
- B. General Weaknesses:** The problem of communications between Ghana and the U.S. has the potential of severely limiting the success of this project. Researchers are planning special efforts to function without good communication channels until phone lines are functional.
- C. Recommendations:** The EEP commends the PI and his research team for their efforts to date. They are encouraged to proceed as quickly as possible to develop a training plan based on HC needs and research priorities. They are also encouraged to further formalize plans for cooperation with the UGA utilization project both technically and in relation to management and communication issues; to cooperate with the other cowpea projects in the CRSP; and to proceed as planned in terms of their work with the social science experts in the CRSP.

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*Research Strategies to Increase the Utilization of Cowpea***I. PROGRESS DURING FY 92****A. Specific Research Contributions in FY 92**

1. **New research results from FY 92 disseminated and currently in use in HC and U.S.:** The project has only been in effect for one year, limiting research results somewhat. Considering the challenge of setting up a new project, considerable progress has been made.
 - a. **Improved cultivars, inoculants, tests, methods, and systems:** None to date.
 - b. **Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** Not applicable.
 - c. **Evidence of project impact on production/consumption of beans/cowpeas:** None to date.
 - d. **How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Improved nutrition for Ghanaians is a primary goal of the project, to be attained by increasing the use of cowpea in the diet. Efforts are directly aimed at women and children and the poor.
 - e. **Impact(s) results have had on the developing and developed world:** None to date.
2. **Changes in national production/consumption of beans/cowpeas in HC:** None to date.

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** Not applicable.
2. **A.I.D.-funded long- and short-term training:** This project is in need of a plan for degree-level and short-term training based upon HC needs and research priorities. Because such a plan does not exist, it is impossible to determine the appropriateness of ongoing training. It is suggested that over the next year, the U.S. research team work with the HC team to develop such a plan.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. **U.S. research activities and progress achieved**
 - a. **Socioeconomic factors involved in cowpea utilization:** A Rapid Appraisal Subsector Analysis of the cowpea subsector has been conducted in collaboration with Dr. Rick Bernstein and members of the Clemson Integrated Pest Management research team. Although results are not yet available, they will assist researchers in understanding the subsector and in developing appropriate research priorities.
 - b. **Modified cowpea milling technology:** Appropriate milling techniques for cowpeas are seen as a possible way to overcome the hard-to-cook defect in some cowpeas. Some progress is being made in developing the means to produce a cowpea flour or meal that is acceptable to consumers in Ghana using cowpeas that have this defect.

- c. **Mechanism of hard-to-cook defect in cowpea:** Research has, for the first time, determined an intracellular contribution to the hard-to-cook defect. There appears to be no difference between protein from control and hard-to-cook seeds, but changes in solubility and stability are largely due to a decrease in seed pH during storage. Gelatinization temperature of starch was unaffected by storage. Therefore, the hypothesis is that protein insolubilized by pH drop and denatured by heating in the first stages of cooking formed a rigid matrix which prevented starch gelatinization and seed softening.
- d. **Composite flours:** Progress in attaining this objective is still at a level of developing greater understanding of food products in Ghana and the impact of the addition of cowpea flour on flavor and acceptability in those and other products.
- e. **Nutritional evaluation of cowpea proteins:** Research in this area is just beginning, with pigs being raised for the study.
- f. **Improved medium for enumerating xerophilic molds in cowpeas and cowpea products:** Analysis of use of various solutes to control spreading of colonies of *Eurotium* species resulted in a suggested medium for use in the laboratory.
- g. **Market potential for akara:** Results of studies of American teenagers' acceptance of akara as a fast food product imply that the product has considerable potential for extending the use of cowpeas in the U.S.

2. HC research objectives and progress achieved

- a. **Socioeconomic studies:** Host Country progress in this area has primarily involved making contacts for the identification of farming communities involved in cowpea cultivation, and additional groups for collaboration.
- b. **Cowpea variety selection and evaluation:** Evaluation of four varieties of cowpeas: Asontem, Bengpla, Ayiyi and Soronko were supplied to the project by the Ghana Grains and Legumes Development Board. These varieties are being evaluated using the following analyses:
 - (1) **Chemical composition:** Studies included dry matter, protein, fat, and ash composition, and mineral analysis. Results showed very high concentrations of calcium and iron in the hulls but otherwise only characteristic chemical composition.
 - (2) **Functional properties:** The characteristics of raw seeds and flour as well as steam-treated samples were tested.
 - (3) **Brabender viscoamylograph:** The cooked paste characteristics of 12 percent dehulled flour suspension were evaluated.
 - (4) **Cowpea fortification of a traditional food--steamed abolloo:** Comparison of products made from the different varieties and the impact of the inclusion of cowpea flour in the project led to a conclusion that each potential variety must be evaluated for inclusion in traditional food products because of the variation in acceptability of different varieties.
- c. **Literature review of cowpea flour processing research:** Review of literature and interview data related to cowpea production in Ghana revealed that there is currently no commercial production of cowpea flour in the country. In-country research and publication has focused on laboratory-scale studies on the production of cowpea flour. However, cowpeas are traditionally processed into flour/paste for processing into traditional foods, thus forming a significant part of the diet.

- d. **Weaning foods:** Progress in this area has been limited to making contacts for future collaboration.
 - e. **Steam treatment to enhance storage:** Preliminary research results indicate that steam treatment of cowpeas followed by drying may be effective in preventing the attack of cowpeas by *Callosobruchus maculatus*.
- 3. Length of time project has been engaged in lines of research addressing these objectives**
- a. **Progress in relation to schedule in log frame:** Even though the project has been ongoing for only a year, some progress has been made in attaining project objectives as noted above. Not all log frame segments have been addressed in the first year of the project.
 - b. **Reasons for delay, if any:** There has actually been no delay in accomplishing objectives; however, there is concern regarding problems of communication between the U.S. and Ghana and the potential impact of those problems on project activities.
- 4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere:** Researchers on this project clearly see their work as relating to each of the other CRSP-funded cowpea projects. The existence of this project in the same region as the other production-oriented projects gives the CRSP what may be a unique opportunity for linking production and utilization research. This project has begun to develop important relationships with other entities in Ghana as well as those in the U.S.
- 5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints:** This project's major focus on increasing the nutritional well-being of HC populations implies a likely contribution to the HC and an impact on the amelioration of global constraints through a focus on production and consumption economics; improved storage, food preparation, nutrition and health; and increased HC research capability through education and training.
- D. Evidence of Biological/Social Sciences Integration**
- 1. **Identification of and attention to relevant WID issues:** The focus of this research implies a direct, positive impact on women. Women in Ghana are the primary actors in the informal food processing sector--a primary focus of the research on steamed *abalo*. Any improvement in traditional foods and their preparation will have a direct impact upon women. Hopefully the social sciences analyses already being conducted in Ghana will lend greater understanding of the roles of women in the cowpea subsector, giving researchers greater insight into positive and negative impacts of their research efforts on women.
 - 2. **Identification of and attention to other social and/or economic issues:** The implementation of a Rapid Appraisal Subsector Analysis at the very beginning of this project will assist researchers in being aware of and responding to a variety of socioeconomic issues.
- E. Baseline Data:** Some baseline data on traditional foods and cowpea varieties were already available in Ghana. The Rapid Appraisal Subsector Analysis will provide additional baseline data.
- F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not included in C.4. Above:** This project has done an especially good job of linking with related groups and organizations. Internal to the Bean/Cowpea CRSP, the linkage with the Ghana/Clemson IPM project is particularly promising both in terms of content focus

and to overcome potential communication barriers with Ghana. Linkages with the other cowpea projects are also promising. In the Host Country, a similar level of potential cooperation seems to be developing. Finally, this project has been successful in linking to businesses in the U.S. regarding the adoption of certain cowpea products.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

- A. Problems:** Problems appear to be primarily a function of extremely poor communication between the U.S. and Ghana. Communication problems resulted in delays in the transfer of funds. The communication problems with Ghana will require specific planning by U.S. and HC scientists both in relation to fiscal issues and to maintain a high level of scientific collaboration.
- B. Adequacy of Current Management, Policies and Procedures:** These appear to be adequate.
- C. Activity Towards Buy-ins and/or Other Funding:** Researchers are considering the possibility of developing a proposal for possible funding under the A.I.D. University Linkages Program, which would also include Tuskegee University. The possibility of a Mission buy-in has not been explored.
- D. Responsiveness to 50/50 Split Policy:** The FY 92 budget included a 50/50 split of direct costs.

III. STATUS IN FY 92

- A. Appropriateness of Activities to Goals of the Global Plan:** The activities are appropriate and potentially will have a positive impact on the alleviation of hunger through the improved efficiency of cowpea use.
- B. Impact of Training Program on Project:** Some progress has been made in determining HC training needs and developing a training plan to address those needs. However, it is not clear that the plan currently exists nor is it clear that HC students have a priority for training. It is important that the project move quickly to develop a plan that will focus on HC and U.S. students. In discussions with the U.S. PI, the possibility of a special recruitment effort aimed at African-American students was raised. Such a program would be a very exciting addition to training efforts of the CRSP and would undoubtedly attract additional external funding as well as U.S. university funding.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** Research appears to be well balanced.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** It seems that a collegial, collaborative relationship is developing. This will be particularly difficult given communication problems between the U.S. and Ghana. Researchers appear to be aware of the problem and are encouraged to continue to work to overcome it.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** In both the U.S. and the HC, CRSP research activities are complementary to ongoing research activities, allowing CRSP funds to accomplish more than would be possible in isolation.
- F. Interest, Involvement, and Support of USAID Mission and/or U.S. Embassy:** The Mission has been extremely supportive even though CRSP activities are not within the primary emphases of the strategic plan. A Mission buy-in has not been discussed.

G. Evidence of Institutionalization in HC and U.S.

1. **Faculty (researcher) recognition for international activities and awards:** Ms. Kay McWatters, U.S. Co-PI, received the 1992 D.W. Brooks Faculty Award for Excellent in International Agriculture.
2. **Integration of domestic program with CRSP project:** As noted earlier, both HC and U.S. research efforts are well integrated into ongoing research programs.
3. **Internal support for project management and institutional management:** Administrative support for the CRSP continues to be high at the University of Georgia.
4. **Opportunities for/frequency of student/professor interactions:** It appears that student/professor interactions are excellent, making it all the more important to begin a conscious effort to meet HC training needs through the development of a concrete training plan. The quality of student/professor interaction and the opportunities available to students in this project make the suggestion noted earlier regarding the recruitment of African-American students an especially good idea.

H. **Other Comments:** None.

IV. **WORK PLAN CHANGES:** None.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. **Publications (Refereed and Non-refereed):** 18

B. **Presentations:** 10

This U.S. research team is especially adept at insuring that research results are published and presented. The publication list is quite impressive for such a new project.

VI. OVERALL RATING: Satisfactory Start-up

- A. **General Strengths:** The enthusiasm that seems to exist for collaboration between and among U.S. and HC researchers is an important strength as is interest in collaboration with other CRSP projects. The presence of both a production and a utilization project in Ghana offers special opportunities for collaboration, with researchers on both projects enthusiastic about the prospect.
- B. **General Weaknesses:** The problem of communication between the U.S. and Ghana has the potential of being a confounding factor in this project. Researchers must carefully plan techniques to overcome this barrier.
- C. **Recommendations:** The EEP encourages the development of a training plan based on HC needs and research priorities. We also compliment the researchers on their efforts to cooperate with other cowpea projects in the CRSP and especially encourage further development of the linkage with the Clemson project in Ghana--both in terms of the research focus and to assist one another in overcoming communication barriers between the two countries.

HONDURAS • UNIVERSITY OF PUERTO RICO • BEAVER

Strategies for Breeding Beans with Enhanced Disease Resistance and Greater Tolerance to Heat and Drought Stress

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. New research results from FY 92 disseminated and currently in use in HC and U.S.

- a. Improved cultivars, inoculants, tests, methods and systems:** The first new red seeded variety with BGMV resistance, Dorado (DOR 364), was released in 1991 and is being actively disseminated in the country. About 18,000 pounds of seed of Dorado and 10,000 pounds of seed of DOR 483 (not yet released) were produced at the Escuela Agricola Panamericana. Concurrently with the distribution of seeds, integrated management practices like early planting of resistant varieties, use of crop barriers and the roguing of diseased plants are advocated to reduce BGMV.

Early-generation evaluation for CB resistance was found effective, whereas, late-generation screening in replicated nurseries was more effective for breeding for BGMV resistance.

High-yielding small red beans with rust resistance and carrying the "I"-type resistance to BCMV have been developed. Populations have also been developed to study the inheritance of web blight resistance and identify the specific genes resistant to races of rust. The Honduran rust races were found to be highly virulent compared with rust races from other areas.

Breeding lines of small red beans have been developed at EAP with pyramided resistance to up to three of five diseases: BCMV, BGMV, CB, rust and anthracnose.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** A total of 325 accessions of Honduran small red bean landraces have been collected and evaluated for disease resistance and agronomic traits. After evaluation is completed, they will be added to the 600+ bean accessions maintained at EAP. These collections are also deposited with CIAT and USDA.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** The use of the BGMV-resistant variety, Dorado, has resulted in an estimated 15-20 percent increase in production in the El Paraiso area. The artisan seed production program has increased seed availability in the provinces El Paraiso, Olancho and Francisco Moran. In June 1992, 100 kg of DOR 483 was supplied to this seed program.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Most of the bean production in Honduras is on small farms. Therefore, higher-yielding, disease-resistant varieties directly benefit these farmers and their families. The new cultivars also reduce the need for pesticides. Small-scale farmers will continue to benefit from new varietal releases disseminated through the artisan seed producers.
- e. Impact(s) results have had on the developing and developed world:** The importance of small red beans on global production of beans is yet to be determined. However, the collection and evaluation of germplasm will most definitely contribute to genetic improvement everywhere, as will the pyramiding of disease-resistant genes and new methodologies in obtaining multiple disease resistance.

2. **Changes in national production/consumption of beans/cowpeas in HC:** Official statistics show little change in national production over the past eight years (1984-1991): 37,501 tons from 65,147 ha (576 kg/ha). However, recent studies showed an average yield of 914 kg/ha on farms planting the new Dorado variety in the Danli area.

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** Mr. Roberto Young began studies on a Ph.D. in plant breeding at MSU (with J. Kelly); Dr. Jairo Castano joined EAP recently to strengthen the bean rust research; Mr. Oswaldo Varela will soon complete an M.S. degree at UPR and return to the HC project; and there continues to be close collaboration with Dr. Federico Rodriguez and Ing. Agron. Danilo Escoto of the Ministry of Natural Resources.
2. **A.I.D.-funded long- and short-term training:** The project contributed directly or indirectly to long-term training of the following eleven HC and U.S. researchers: Mr. Oswaldo Varela, 1992 M.S. at UPR, genetics of CB resistance; Mr. Oswaldo Diaz, 1992 M.S. at UPR, testing transgenic beans; Mr. Roberto Young, 1992-95 Ph.D. at MSU, anthracnose resistance; Mr. David Erazo, 1992 M.S. at Universidad Nacional Autonoma de Honduras, (SS) technology transfer; Mr. Alfredo Robleto, 1993-94 M.S. at UNL, plant pathology; Ms. Ana Bohorquez, 1992 Ing. Agron. at EAP, cultural control of BGMV; Mr. Elvis Ortega, 1992 Ing. Agron. at EAP, embryo rescue; Mr. Gerardo Torres, 1993 Ing. Agron. at EAP, technology transfer; Mr. Jose Velez, 1993 Ing. Agron. at EAP, biocontrol of whiteflies; and Mr. Mohammed Meskine, 1994 Ph.D at UNL, bean rust.

The EEP notes with some wonderment that only one female has been trained by this project.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. **U.S. research activities and progress achieved:** Progress on U.S. research objectives for both UPR and UNL has been excellent. Screening of materials resistant to BGMV has shown some previously reported resistant lines (e.g. DOR 364) to be susceptible when exposed to infected whiteflies, whereas new sources of resistance are more stable and include DOR 483, two accessions of *Phaseolus coccineus* and two curly top (virus) resistant lines of snap beans from Los Mochis, Mexico.

Studies on web blight using the Tania Polanco inoculation technique showed significant differences in resistance among small red bean lines. Meanwhile, good progress is being made on pyramiding multiple disease resistance in small reds to five diseases. Studies are also underway at UNL to identify specific genes for rust resistance.

Several small red breeding lines combining CB resistance and heat tolerance (from Desarrural I) have been identified having seed yields greater than 2,000 kg/ha. Maintaining a modicum of heterogeneity in lines shows promise of more stable (higher) yields and better disease resistance.

Evaluation of rust races for virulence on 19 standard bean differentials showed that a high proportion of Honduran rust races (68 percent) were highly virulent compared with other sources and that tropical rust races are more virulent than temperate sources. Good resistant bean lines included Ecuador 299, Mexico 235, Mexico 309, Early Gallitin, Olathe and C. Negro Chimaltenango.

2. **HC research objectives and progress achieved:** Promising new small red beans carrying multiple disease resistance, good agronomic traits and satisfactory seed yields have been developed. Some lines combine resistance to BCMV, BGMV, CB and anthracnose. The best of these are included in field trials carried out by the Ministry of Natural Resources/ Bean Research Program. The project has also spearheaded the effort to release DOR 483.

New lines are screened at EAP for yield, agronomic traits and resistance to CB, rust and BGMV and in regional trials for resistance to web blight in Costa Rica and for BGMV reaction in Guatemala and the DR.

The interspecific crosses between small reds and tepary beans (made at UMN) are screened for drought tolerance and CB resistance at EAP.

Evaluation of breeding lines on small-scale farms shows that in the absence of BGMV several lines (EAP 10-88, EAP 12-88 and HND 43-40) out-yielded Dorado and DOR 483. These lines also have higher levels of resistance to CB and anthracnose than the BGMV-resistant genotypes.

3. Length of time project has been engaged in lines of research addressing these objectives

a. Progress in relation to schedule in log frame: Very satisfactory progress has been made toward the objectives of the log frame. The project has developed small red breeding lines with greater yield potential, heat tolerance and higher levels of resistance to several important diseases. Complementary, but longer term, activities are underway in other departments on bruchid resistance, enhanced biological N-fixation and drought resistance. Moreover, cultural practices are being developed to reduce BGMV and CB infections. Rapid strides on heat tolerance will have an important impact on production and the areas where beans are currently grown.

b. Reasons for delay, if any: Not applicable.

4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere: EAP has clearly demonstrated the ability to breed superior, multiple disease resistant small red beans and is making progress on heat tolerance. All of these activities and types of beans are of direct interest to CIAT, PROFRIJOL and Honduras' neighbors. Also, much has been learned on virulence patterns of rust and in the use of both race-specific and non-specific resistance (to rust) in bean improvement--also of regional interest.

5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints: Small red beans are consumed in many Central American countries and elsewhere. Multiple disease resistance in beans is a concern worldwide and can be readily transferred to other types (white, black, Mexican reds, etc.) from the small red background. Also, strategies for more durable rust resistance based on both specific and non-specific sources can be utilized in many other regions. Likewise, the enhanced heat tolerance obtained from interspecific crosses to tepary beans could have major global impact.

D. Evidence of Biological/Social Sciences Integration

1. Identification of and attention to relevant WID issues: The project has made every effort to identify opportunities to interact with social scientists. Support was provided to the thesis studies of Mr. David Erazo for the adoption of technology by small-scale farmers using a bean/maize intercropping system. Thesis research at EAP by Mr. Gerardo Torres focuses on economic factors affecting the adoption of varieties and technology. On-farm research on hills in 15 locations provide feedback from farmers, merchants and consumers on new beans and production practices. PROFRIJOL social scientists conducted studies in Honduras on acceptance of Dorado. There is also a possibility of working with the CRSP socioeconomics team on assessing the impact of the new technology.

2. Identification of and attention to other social and/or economic issues: Not applicable.

- E. **Baseline Data:** Information on small-scale farmers; yield losses from BGMV, anthracnose and CB; and importance of management practices in controlling BGMV have been obtained. On-farm testing has also produced much useful information on diseases, yield and other data.
- F. **Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above:** The project has collaborated extensively with other CRSP projects. The DR/UNL project screens small reds for BGMV resistance; Mexico/MSU provided the bc_3 gene for BCMV resistance; and Tanzania/WSU helped screen for BCMV resistance. Dr. Peter Ascher did the interspecific crossing (with tepary beans), and several U.S. bean researchers use the winter nursery at Mayagüez. Both EAP and UPR actively participate in PROFRIJOL. Red bean nurseries are also evaluated in several countries.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

- A. **Problems:** Planning was more difficult because of uncertainty about the funding level. Also, on-farm testing was curtailed owing to the delay in purchasing a vehicle.
- B. **Adequacy of Current Management, Policies and Procedures:** Funding is adequate and smooth financial procedures have been developed in both the HC and U.S. In the future (FY 94), EAP may need to readjust the budget to cover indirect costs.
- C. **Activity Towards Buy-ins and/or Other Funding:** The project has been highly successful in obtaining funding from several donors including PROFRIJOL, CIAT, USDA, NSF, IBPGR, NifTAL and others with whom the project collaborates on a continuing basis. Other sources of support include PROFRIJOL, a PSTC proposal with UMN (interspecific crossing) a second PSTC proposal with UFL (on BGMV) and a Caribbean Basin Agricultural Group/Cooperative State Research Service grant to develop BGMV-resistant snap beans (with UPR).
- D. **Responsiveness to 50/50 Split Policy:** The project already adheres to a 50/50 split in funding. Collaboration among project personnel is excellent. Researchers from the U.S. and HC meet frequently. The well-trained staff and good facilities at EAP greatly facilitate close collaboration.

III. STATUS IN FY 92

- A. **Appropriateness of Activities to Goals of the Global Plan:** Highly appropriate.
- B. **Impact of Training Program on Project:** Training has been a major factor in the success of the project.
- C. **Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** Balance is about right to achieve success in collaborative HC/U.S. efforts.
- D. **Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Excellent.
- E. **Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** The HC in-kind contributions are considerable including salaries, land, laboratories, equipment, other facilities and supplies.
- F. **Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** The current CRSP Liaison Officer, Mr. Craig Anderson, and Technical Advisor, Mr. Wesley Kline, have elicited considerable interest in supporting the project.

G. Evidence of Institutionalization in HC and U.S.

- 1. Faculty (researcher) recognition for international activities and awards:** The bean research programs at EAP and UPR have gained considerable stature and recognition for the success of their activities. This is borne out by numerous grants by several agencies. The PI at UPR is also widely recognized and respected both in the region and in the United States.
- 2. Integration of domestic program with CRSP project:** The U.S. PI is virtually full-time on bean improvement. The bean problems in Puerto Rico are more or less similar to those of the Caribbean Basin and Honduras. The same situation holds for Honduras.
- 3. Internal support for project management and institutional management:** There is excellent support for the project in both Honduras and Puerto Rico. Facilities, laboratories, equipment, machinery and experiment station lands are more than adequate for carrying out the program. EAP administrators have given strong support to the program.
- 4. Opportunities for/frequency of student/professor interactions:** The PIs interact with students on a continuing basis in the field, laboratories and meeting rooms. Whenever possible, regular meetings are held to discuss problems, map out strategies and other purposes.

H. Other Comments: This project has impressed this reviewer as one of the most effectively organized and functioning programs in the Bean/Cowpea CRSP.

IV. WORK PLAN CHANGES

- A. Changes/Additions/Deletions in FY 92 Work Plan:** The project followed activities outlined in the FY 92 work plan except for some increased emphasis on rust research in Honduras.
- B. Reasons for Changes:** Rust is a major problem of beans in Honduras and is difficult to work with because of the many virulent races.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. Publications

- 1. Refereed journals:** 6
- 2. Non-refereed journals:** 8

B. Presentations: 10

VI. OVERALL RATING: 1--Highly Satisfactory

- A. General Strengths:** Excellent leadership by both PIs (Drs. Rosas and Beaver); sustained efforts by highly capable researchers over several years; excellent support and facilities; and the wide base of collaboration.
- B. General Weaknesses:** None.
- C. Recommendations:** The PIs and Host Country institutions should assess the reason(s) for lack of females for training and take appropriate actions.

MALAWI • UNIVERSITY OF CALIFORNIA-DAVIS • GEPTS

*Bean Improvement, Genetic Diversity and Host/Pathogen Co-Adaptation***I. PROGRESS DURING FY 92****A. Specific Research Contributions in FY 92****1. New research results from FY 92 disseminated and currently in use in HC and U.S.**

- a. Improved cultivars, inoculants, tests, methods and systems:** A major effort was development of a comprehensive plan for a bean breeding program focusing on five cultivar types with resistance to angular leaf spot and bean common mosaic virus.

On-farm trials were conducted using five varieties being considered for release or already released. These on-farm trials were unsuccessful owing to a major drought. A strategy for on-station participating research was planned. A number of accessions (seven) were tested for drought resistance in a split plot test. All varieties showing tolerance were small seeded.

Based on Malawian farmer input, five seed types were identified for improvement purposes in future efforts.

The data from socioeconomic surveys of bean production in three major bean-producing regions were presented to participants at Bunda.

Cooking time and other bean-quality characteristics were determined on thirteen landraces (six released and seven under evaluation). Cooking time was found to be the major factor in acceptance, with flavor, color and broth thickness being other important attributes.

BCMV-free seeds from selected lines were multiplied and distributed to the Malawian National Program for their research. Enzyme linked immunoabsorbant assays are being developed to screen Malawian bean lines for BCMV prior to U.S. field studies. Sequencing of the BCMV coat protein has continued as an approach to BCMV detection.

Extensive collections were made of bean tissue infected with ALS fungus and corresponding bean seeds. A total of 43 ALS isolates were recovered and subjected to RAPD analysis, which indicated a preponderance of Andean gene pool characteristics. This information will be used in breeding strategies for ALS resistance. Two bean isolates have shown good resistance to both Andean and Mesoamerican ALS fungus isolates.

Efforts continue to identify and overcome the reproductive isolation mechanisms separating Andean and Mesoamerican genotypes.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** This project is reported to have the largest collection of bean accessions in Africa. Of the latest collection, 1,035 were grown and evaluated for various traits (descriptors).
- c. Evidence of project impact on production/consumption of beans/cowpeas:** Presently released varieties are too new to impact production/consumption.

- d. **How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Beans are the single most important source of protein in Malawi. Development of ALS- and BCMV-resistant varieties with desirable consumer traits will result in increased production and utilization of beans by farmers in Malawi. Women have a significant role in bean production and utilization.
 - e. **Impact(s) results have had on the developing and developed world:** Some new varieties have only recently been released and this project is still developing strategies which are in the early stages of implementation. Therefore, impacts on developing and developed countries are minimal. However, development of ALS- and BCMV-resistant varieties in this project will increase total bean production in the South African region. The new approaches being developed for breeding strategies, including mapping of the bean genome, will have broad application for incorporating traits in beans which are desired by developing or developed countries.
2. **Changes in national production/consumption of beans/cowpeas in HC:** None are apparent at this early stage of variety releases.

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** The Malawian breeder (Mr. James Bokosi) has left to pursue a Ph.D. and his duties will be assumed by Dr. R. Chirwa. The soil microbiologist (Dr. Newton Lupwayi) has joined ICCA in Ethiopia. Dr. Vas Aggarwal (SADCC/CIAT) joined the bean program at Bunda and will be available for advice. Dr. Richard Mkandawire (Co-PI) has left and was replaced by Dr. Stanley Khaila, a rural sociologist trained at MSU. Two technically trained students have also been added to assist in the research at UCD.
2. **A.I.D.-funded long- and short-term training:** Mr. William Johnson has joined UCD as a Ph.D. candidate working on CRSP research.

One student has completed the M.S. at Bunda and has enrolled for further graduate work in ag economics at MSU.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. **U.S. research activities and progress achieved:** Random duplicated polymorphic DNA analysis techniques were developed and bean tissue infected with ALS fungus was analyzed. This information is being used for ALS resistance breeding strategies. Two bean isolates have been found to have good resistance to both Andean and Mesoamerican ALS fungus isolates. Enzyme linked immunoabsorbant assay methodology was developed to screen for BCMV infection of germplasm. Sequence of the protein coat of the virus was also done to enable BCMV detection.
2. **HC research objectives and progress achieved:** Studies on the resistance of Malawian germplasm against six isolates of the ALS causal organism *P. griseola* indicated that a number of Malawian beans have resistance characteristics.

A split-plot experiment was designed to assess drought resistance of varieties of Sapelekedewa (released check), 6-5, 16-6, 13-3 (Malawi), BAT 125 and 477 (CIAT), Nuweveld and Kamberg (South Africa). BAT 477, as expected, exhibited a strong tolerance to drought followed by BAT 125 and 6-5.

Multi-location varietal evaluations have been done at six sites using dwarf- and bush-type beans. Yield differences were noted that appeared to be related to location, but several exhibited higher yields across locations. Similar results were obtained using materials released elsewhere. Several varieties were selected for further evaluation.

In the National Bean Variety Trial, twelve entries were evaluated across six sites using the released Nasaka as the check. Five genotypes gave higher yields and are being presented for release (21-5, A286, A344, 25-2X8-7 and PVA692).

In on-farm trials using "quasi" farmer management, Dedza A344 outperformed all others. A286 and PVA692 had higher yields than the check, Nasaka (the most preferred release). Some farmer-owned varieties also had higher yields than Nasaka or PVA692, but not higher than A286 or A344.

Cooking times are being determined on beans released or being considered for release.

Drought resistance of seven varieties was evaluated in a single split plot test as part of the selection criteria.

BCMV-free seeds from selected lines were multiplied and distributed to the Malawian National Bean Program for their research.

3. Length of time project has been engaged in lines of research addressing these objectives

a. Progress in relation to schedule in log frame: This project has been pursuing the objectives cited for approximately two years and is on schedule. Breeding research has been accentuated in the HC.

b. Reasons for delay, if any: Not applicable.

4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere: There is coordination of the project with CIAT activities both in breeding and utilization (CIAT and SADCC), the Legume Research Program (Rockefeller Foundation) and the national program at Bunda. Close association with the Tanzania/WSU CRSP project continues in both the biological and social sciences.

The BCMV investigators maintain contacts with other groups involved with BCMV.

5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints: New cultivars addressing constraints in Malawi are approaching release. Overall, research is addressing constraints in HC, other developing countries and the U.S. The concept of determining co-evolution of ALS fungus and the bean host will have applicability to other breeding strategies.

The development of breeding techniques which maintain genetic diversity in mixed bean plantings and eliminate constraints will be a useful model for areas where mixed bean plantings are practiced.

Bean genome mapping will have worldwide usage for bean genetics.

Finally, detection-method development for BCMV is important to worldwide bean production and inter-country accessions.

D. Evidence of Biological/Social Sciences Integration

1. Identification of and attention to relevant WID issues: This project has had a WID/social sciences component since its inception. Women have a major role in bean production/ utilization in Malawi.

2. Identification of and attention to other social and/or economic issues: Cooking time was found to be important to rural farmers and early maturity has economic benefits by making pod beans available at a time when food is relatively scarce. The breeding program is addressing this issue.

E. Baseline Data: This project has established extensive baseline information.

F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above: No additional collaboration was cited.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. **U.S.:** No major problems are indicated.

2. **HC:** A problem with release of funds to the HC occurred owing to late release of funds to UCD and delay of subsequent processing by UCD. The U.S. PI is pursuing a plan to minimize this type of problem, but general financial management may need improvement.

B. Adequacy of Current Management, Policies and Procedures: The PI has indicated his concerns with the form of the Annual Report (length and redundancy). However, the PI needs to conform to the format request, which would eliminate these concerns.

C. Activity Towards Buy-ins and/or Other Funding: The Mission is supportive but has no interest in a buy-in. A proposal to the Rockefeller Foundation is being developed in support of seed multiplication in Malawi and the South African Region.

D. Responsiveness to 50/50 Split Policy: The split between U.S. and HC appears adequate.

III. STATUS IN FY 92

A. Appropriateness of Activities to Goals of the Global Plan: This project is concerned with elimination of constraints that have global impacts, particularly regarding maintaining diversity while relieving constraints. Cooking time is also a global constraint. The development of screening/breeding strategies using co-evolution of pathogens and beans, RAPD techniques and BCMV detection have potential for global impacts.

B. Impact of Training Program on Project: The training program has resulted in three Ph.D.s (one food technology/science, one plant physiology, one plant pathology) and two M.S. degrees (plant breeding and agronomy) being granted to Malawians. One Malawian is currently a graduate student in ag economics in the U.S. and one in plant pathology at Bunda. Mr. Bokosi will also be returning to Bunda following his graduate work at Nebraska. These individuals will constitute an excellent bean research capability at Bunda. UCD also has two graduate students working in bean research. More attention to including women in their graduate program may be appropriate.

C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives: Adequate.

D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel: Adequate.

E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives: Bean research has also been supported by funding from the California Crop Improvement Association (BCMV research), International Board for Plant Genetic Resources and AID/PSTC.

F. Interest, Involvement, and Support of USAID Mission and/or U.S. Embassy: See II.C.

G. Evidence of Institutionalization in HC and U.S.

- 1. Faculty (researcher) recognition for international activities and awards:** None reported but the PI has a strong research capability.
- 2. Integration of domestic program with CRSP project:** Based on general information, UCD is strongly supportive of bean research since beans are an important crop in California.
- 3. Internal support for project management and institutional management:** The U.S. institution is very supportive of the CRSP. However, note comments in II.A.2.
- 4. Opportunities for/frequency of student/professor interactions:** Adequate, weekly group meetings are held.

H. Other Comments: None.

IV. WORK PLAN CHANGES

A. Changes/Additions/Deletions in FY 92 Work Plan: No significant changes are apparent.

B. Reasons for Changes: Not applicable.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92

A. Publications

- 1. Refereed journals:** 2
- 2. Non-refereed journals:** 3
- 3. Book chapters:** 3

B. Presentations: 8 by HC personnel and 9 by U.S. personnel.

The output is acceptable.

VI. OVERALL RATING: 2a--Satisfactory Plus

A. General Strengths: Research on ALS resistance and BCMV detection; strong WID/social sciences component via Dr. Ferguson's activities in Malawi; development of human resource base at Bunda.

B. General Weaknesses: No major weaknesses; the breeding research has received more emphasis.

C. Recommendations: It is recommended that the PI adhere to the format requested on Annual Reports. Particular effort is needed in the organization of information requested.

MEXICO • MICHIGAN STATE UNIVERSITY • KELLY

Breeding Beans for Yield and Adaptation under Drought

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. New research results from FY 92 disseminated and currently in use in HC and U.S.

- a. Improved cultivars, inoculants, tests, methods and systems:** Seed multiplication was initiated for newly released Pinto Villa, Bayo Victoria and Negro Durango. Yields from 6,000 hectares were distributed to newly formed seed growers associations for further multiplication, promotion and distribution of these cultivars. These newly released varieties exhibited significantly higher yields (60 percent) than the check varieties during a two-season study (1990, 1991). Grower preferences were for Negro Durango but recently are shifting to Pinto Villa because of better yields and earlier maturity.

Row-width studies have indicated that narrower row width (than traditional practices) increases yields (up to 25.5 percent for Pinto Villa) and tillage data have indicated that plowing every other year does not hinder yield (in some instances it may increase) resulting in considerable labor/cost savings to producers.

A significant observation has been the apparent "plasticity" of Pinto Villa for maturation (66-105 days). This unique trait has potential for introduction into U.S. varieties, resulting in better varieties for northern U.S. growing areas.

A new breeding line from Flor de Mayo has been developed which has the desirable traits of Flor de Mayo but appears to have higher yields, with less environmental susceptibility. This may be ready to release within the next year.

Cooking time for beans is an important factor for HC utilization. Water uptake by seeds is proportional to shorter cooking times. This method is being used to screen for hard seed coats which reflect hard-to-cook characteristics.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** Accessions from CIAT were tested for root rot tolerance and 28 wild accessions from Mexico and Peru were evaluated for flowering adaptation and resistance to pod borers.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** The apparent acceptance of the three new releases, particularly Pinto Villa, by seed growing associations should result in increased production. The new line of Flor de Mayo, which has Flor de Mayo's desirable traits but higher yield potential, should result in increased productivity following its release and seed availability. National production figures are being monitored to enable impact assessment as this project continues.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Development of varieties which increase bean yields under unfavorable environmental conditions will benefit small farmers. This project will be assessing farmer adoption of new varieties utilizing Mexican graduate student research in Rural Development. A study to determine bean traits that influence rural housewives' consumer decisions is being developed.

e. Impact(s) results have had on the developing and developed world: Development of drought-resistant bean varieties will significantly impact a number of developing countries which have rainfall deficits.

2. Changes in national production/consumption of beans/cowpeas in HC: No definitive studies have been made. However, production data is being compiled for later evaluation of changes in production/consumption.

B. Institutional Development and Training

1. Institutional personnel changes since FY 91: No changes in the U.S. or HC PI or Co-PI personnel were reported.

In Mexico, two members of the CRSP project were promoted to managers of bean research stations. Two recent Ph.D.s are at Mexican institutions working on bean research and three graduate students are being supported by Mexican sources while doing bean research (two in the U.S. and one in Mexico).

2. A.I.D.-funded long- and short-term training: One Ph.D. candidate is being trained in the area of plant physiology. Three other graduate students on non-A.I.D. funds are also involved with plant breeding research.

C. Progress Achieved in Relation to Objectives in FY 92 Work Plan

1. U.S. research activities and progress achieved: Efforts have been initiated to develop molecular markers for selection of drought resistance. RAPD methodology has been developed and is being used to select polymorphic strains of inbred lines with drought-resistant characteristics. Screening of high-yielding drought-resistant lines is being conducted using MSU facilities; and these populations are currently being evaluated in Mexico.

Investigations of physiological traits (leaf water, root growth, carbon isotope discrimination and N partitioning) related to drought adaptation have been continued. Correlations are being evaluated.

2. HC research objectives and progress achieved: Selection of drought resistant varieties continues. A number of varieties and variety families have been screened using Mexican, U.S. and tropical germplasm. Regional testing of advanced breeding lines was conducted throughout the Altiplano of Mexico in order to select candidates for release. Germplasms tolerant to root rot (selected via CIAT) are being evaluated and several lines were found to have enhanced tolerance.

Twenty-eight wild *Phaseolus vulgaris* accessions from Mexico and Peru were screened for resistance to various challenges. These selections will broaden the genetic capability for desirable characteristics.

In field studies, phenological and yield responses were evaluated for six varieties undergoing drought stress. Similar studies were conducted on drought stress and biological nitrogen fixation.

Determinations of cooking time required for different varieties indicated that there is a relatively high incidence of impermeable seed coats. The role of location on cooking time was also assessed as well as sensory evaluations of cooked beans.

3. Length of time project has been engaged in lines of research addressing these objectives

a. Progress in relation to schedule in log frame: Progress appears to be on or ahead of schedule.

b. Reasons for delay, if any: No delays were apparent.

4. Relationship of project research to other research being conducted in the HC, IARCs and elsewhere: This project has close collaboration with INIFAP stations in Mexico and CIAT scientists.

5. Likely contribution of research to the HC, the U.S. and to the amelioration of global constraints: Drought is a major problem in many bean production areas of the world. Resistance to drought and other environmental challenges being evaluated in this project, therefore, has importance throughout developing countries; and plasticity (phenological adjustment) to growing seasons has application in U.S. production areas.

D. Evidence of Biological/Social Sciences Integration

1. Identification of and attention to relevant WID issues: A survey is currently planned to determine bean traits important to rural consumers (housewives). Information was collected on the integration of new varieties and technologies in the current farming system, but more baseline information is needed.

The PIs are more aware of WID issues and are planning to strengthen this aspect.

2. Identification of and attention to other social and/or economic issues: The PIs are aware of the need to enhance this area, and plans have been developed. The EEP is looking forward to their implementation.

E. Baseline Data: National bean production was and is being compiled to establish baseline information. The Mexican government is very supportive because of interest in enhancing production.

F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above: Cross-CRSP efforts include sending BGMV-infected tissue to the Caribbean Basin/UWI project. Germplasm has been sent to the Honduras/UPR project for studies.

I. FUNDING/FISCAL MANAGEMENT IN FY 92

A. Problems

1. U.S.: Research on drought resistance needing the rain shelter at MSU has created additional labor expenses, and isotope costs have stressed the budget.

2. HC: An apparent problem regarding the advance of funds to the HC has been resolved but did inhibit spending in FY 92. Difficulties still are encountered in hiring research staff due to budget cuts imposed by INIFAP and on how research funds are expended due to interference on the part of INIFAP. There is a concern about further decreases in Mexico's contribution to this important commodity.

B. Adequacy of Current Management, Policies and Procedures: No problems were indicated.

C. Activity Towards Buy-ins and/or Other Funding: None.

D. Responsiveness to 50/50 Split Policy: For FY 92, the split of resources was satisfactory.

III. STATUS IN FY 92

- A. Appropriateness of Activities to Goals of the Global Plan:** Very appropriate.
- B. Impact of Training Program on Project:** Appears satisfactory, but the Panel suggests that a plan be formulated.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** Satisfactory.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Satisfactory, communication is very good.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** Satisfactory, but downsizing of INIFAP may affect contribution by Mexico.
- F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** Not applicable for Mission buy-in; Embassy contacts are maintained.
- G. Evidence of Institutionalization in HC and U.S.**
 - 1. Faculty (researcher) recognition for international activities and awards:** Two HC researchers were promoted to regional research stations in Mexico. The U.S. PI is a noted researcher and was invited to present research results at a CIAT workshop and was Keynote Speaker at the XIV Annual Congress of Plant Genetics in Chiapas, Mexico.
 - 2. Integration of domestic program with CRSP project:** The CRSP project is an integral part of the MSU bean breeding research program.
 - 3. Internal support for project management and institutional management:** Very satisfactory.
 - 4. Opportunities for/frequency of student/professor interactions:** Very satisfactory.
- H. Other Comments:** None.

IV. WORK PLAN CHANGES

- A. Changes/Additions/Deletions in FY 92 Work Plan:** A new and more efficient approach using RAPD screening techniques has been adopted. Work in phenological plasticity was expanded in Mexico.
- B. Reasons for Changes:** RAPD techniques will make selection for traits more efficient. Plasticity of phenologic response has potential impacts on HC, U.S. and global bean production.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92**A. Publications**

- 1. Refereed journals:** 10 published or in press, 2 submitted and 1 in preparation. 2 theses were also deposited.
- 2. Non-refereed journals:** 6

- B. Presentations:** Excellent, a large number of presentations were given in FY 92.

Output level is excellent.

VI. OVERALL RATING: 2b--Satisfactory

- A. General Strengths:** Strong research and development program.
- B. General Weaknesses:** Needs to continue to enhance WID/socioeconomics components beyond planning. The PI also should address the concerns of the EEP as cited below. There is also a concern regarding potential downsizing of the Mexican program.
- C. Recommendations:** The EEP was pleased that a start was made on studying the root rot disease of the bean-growing areas of central Mexico. As these investigations proceed, it may be necessary to broaden the scope and activities in this area. However, there was little evidence that other fundamental soil problems have been addressed. The reader is referred to EEP recommendations made in 1990:
1. "The project--both HC and U.S. investigators--should give immediate attention to fundamental soil problems mentioned above and to separating adaptive factors from drought response."
 2. "The U.S. institution should establish a strong and well-defined role in supporting studies on the more intractable problem of bean production in Central Mexico during the first semester 1991."

SENEGAL • UNIVERSITY OF CALIFORNIA-RIVERSIDE • HALL

*Development of Improved Cowpea Varieties, Management Methods and Storage Practices for Semiarid Regions***I. PROGRESS DURING FY 92****A. Specific Research Contributions in FY 92****1. New research results from FY 92 disseminated and currently in use in HC and U.S.**

- a. Improved cultivars, inoculants, tests, methods and systems:** The cowpea cultivar Mouride was released in Senegal in FY 92. It has resistance to the parasitic weed, *Striga gesnerioides*, cowpea aphid-borne mosaic, bacterial blight and cowpea weevil and is broadly adapted giving consistently high yields in the northern and center-north zones of Senegal.

The project has confirmed the discovery reported last year and confirmed by Hampton, et al. (1992) that cowpea severe mosaic virus is present in Senegal. Previously, it was thought that this virus was not present in Africa. In addition, two "new" potyviruses of cowpea were discovered and antisera developed against them. Cowpea accessions with resistance to these new potyviruses and to 20 isolates of blackeye cowpea mosaic virus from the U.S. have been described as well as accessions with resistance to the aggressive California biotype of cowpea aphid.

The first cowpea bulletin for Senegal was produced, *Guide de la Production du Niebe*, which contains useful information for scientists and for extension and development agencies, and should be published in 1993.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** During the year, 1,201 accessions were obtained from Ghana, IITA, Senegal and USDA. Cowpea seed of 602 accessions and 34 breeding lines were provided to CRSP projects at Auburn University, the University of Minnesota and Purdue University, and to other scientists at the University of Minnesota, at Lincoln University and in Perugia, Italy.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** As a consequence of on-farm experiments over four years and demonstration exercises over three years, the new cultivars Mouride and Melekh have been introduced to many farmers. Substantial amounts of seed are available in villages, and several tons of foundation seed is being produced during the dry season of 1992-93 with irrigation at Centre National de Recherches Agronomiques, Bambey. On-farm experiments indicate that the new cultivars, higher plant densities and improved weed control achieved with animal-drawn seeders and cultivators could increase grain yield/acre by about 100 percent and grain yield/unit of labor input by more than 100 percent compared with typical present-day practices. The new cowpea varieties can help farm families recover from the famine of 1992, and a massive seed production and distribution campaign has been planned in cooperation with Senegal Government seed agencies and World Vision International.
- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** Virtually all cowpea farmers in Senegal, including those involved in on-farm experiments, are small scale based upon the monetary value of farm production, even compared with farmers in Latin America and Asia. In the past, women were not directly participating in the management of Mini-Kit experiments,

even though they substantially contributed to harvesting, threshing and winnowing. During 1991 and 1992, Mini-Kit experiments were managed by groups of women in two villages. It is still too early to judge the success of this approach, and it can only be described as a small step in the complex process needed to increase the emancipation of African women.

- e. **Impact(s) results have had on the developing and developed world:** The strategy in assisting developing countries used by this project is to put first priority on developing improved technology for Senegal and training Senegalese scientists. Diffusion of the technologies is then achieved by training scientists from other developing countries, providing germplasm to scientists, providing improved methodologies through publishing papers and giving talks, and interacting with networks such as SAFGRAD operating in developing countries. Substantial progress has been made in all of these areas.

The strategy in assisting the developed countries is more indirect in that resources are not used directly for this purpose. However, there are some similarities in the objectives of the cowpea breeding program for Senegal and California; consequently, research designed for Senegal has value for California. Advanced cowpea lines have now been developed that have sufficient yield potential, heat tolerance and resistance to root knot nematodes that they are being considered for release as cultivars in California. A cowpea accession (IT84S-2049) was discovered that has resistance to many isolates of blackeye cowpea mosaic virus. This is useful information for breeders in the southeastern U.S. where this is a major disease of cowpea. The more basic research of this project is establishing principles that are useful to cowpea scientists throughout the world.

- 2. **Changes in national production/consumption of beans/cowpeas in HC:** Data from the Ministry of Rural Development in Senegal does not appear to be reliable, thus are not cited here. Severe drought in 1990 and 1991 complicate the picture, but project staff believe there has been an increase in hectareage planted and harvested in the Northern zone.

B. Institutional Development and Training

- 1. **Institutional personnel changes since FY 91:** The Senegalese project coordinator left the project to pursue a Ph.D. at Purdue University and has been replaced on an interim basis. The Senegalese project leader left the project in July 1992 and also has been replaced. The plant breeder at UCR who retired in July has been replaced with a well-qualified scientist. A replacement for the Senegalese social scientist is being sought.
- 2. **A.I.D.-funded long- and short-term training:** Four candidates completed their Ph.D.s in the Department of Botany and Plant Genetics at UCR in FY 92. Three Senegalese staff members attended short courses, and training sessions for World Vision International technicians were held in the HC.

- C. **Progress Achieved in Relation to Objectives in FY 92 Work Plan:** As noted in the FY 91 EEP Report, it is clear that the objectives have been aggressively pursued and that a very great deal has been accomplished, both in the U.S. and in Senegal. As noted in I.A., a number of significant findings have emerged. Unfortunately, the departures of the project leader and the social scientist have left voids in the soil management and social science areas. Hopefully, these areas can be covered soon.

As in any agricultural commodity research program, progress in understanding opportunities and constraints is slow and difficult and only comes incrementally over time. This project is a very good example of how a total objective can be addressed by partitioning into discrete increments and assigning them as to potential impact and technical feasibility.

- D. Evidence of Biological/Social Sciences Integration:** As a result of surveys by the social scientist, there has emerged a better appreciation of gender roles and attitudes among team members and a clear willingness to accommodate participation by women in both production (Mini-kit) and storage, marketing, and consumption aspects of the total cowpea program. As noted earlier, the absence of the social scientist has resulted in some slippage.

The ISRA team continues to engage in collaboration with World Vision International in seed production, storage and marketing with World Vision International and the Food Technology Institute in Dakar in research and education efforts on utilization of cowpea in cereal-based diets.

- E. Baseline Data:** The many years of on-farm research has provided the ISRA cowpea team with a comprehensive understanding of cowpea production systems in Senegal. The baseline data available on cowpea production may be adequate for detecting major increases in national production and productivity that are being attempted but, as was discussed earlier, recent data from the Ministry of Rural Development for the Louga and St. Louis regions is very soft.
- F. Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above:** As indicated earlier, seeds have been supplied to three other CRSP projects and to two other universities and one Italian lab. Collaboration has occurred with the University of Georgia and with the INTSORMIL team at Purdue. The project continues to maintain close liaison, and exchanges information and materials, with the cowpea team at IITA. The collaboration with Oregon State University has begun to bear fruit with identification of a previously undetected virus in material from Senegal. It is also an important training resource. The recently initiated collaboration with World Vision International is most promising and, hopefully, can be continued in future years. Finally, the strength and effectiveness of this program is further documented by its designation by SAFGRAD as lead center for cowpea breeding in Africa.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

- A. Problems:** The budget shortfalls by the GOS and the California Agricultural Experiment Station continue to be a problem. In Senegal, the reduced value of the U.S. dollar against the HC currency has further exacerbated the situation.
- B. Adequacy of Current Management, Policies and Procedures:** The project leader has done an admirable job of managing resources to maximize research and training activities under difficult circumstances. The delegation of authority for some equipment purchases to the MO has been helpful.
- C. Activity Towards Buy-ins and/or Other Funding:** A grant was obtained to propagate, multiply and characterize cowpea germplasm involving a cooperative agreement between USDA and UCR. The project assisted the MO in preparing a proposal for CRSP cowpea activities with Egypt but this proposal was not funded. World Vision International has developed a proposal in collaboration with the ISRA cowpea team to conduct extension of cowpea technology and utilization. The proposal has been submitted to the USAID Mission in Senegal.
- D. Responsiveness to 50/50 Split Policy:** No data available.

III. STATUS IN FY 92

- A. Appropriateness of Activities to Goals of the Global Plan:** As indicated in past EEP Reports, we believe the range of scientific activities related to cowpea production encompassed in this project (breeding, physiology, agronomy, pathology and entomology) are clearly appropriate. Similarly, those activities and collaborative efforts related to conservation and utilization (storage, nutritional qualities and consumption) relate directly to goals of the Global Plan.

- B. Impact of Training Program on Project:** As noted elsewhere, the return of trainees has permitted the project coordinator to go for his Ph.D. It would be hoped that more qualified students from Senegal could be approved for training. This would help in building a Senegalese capacity and reduce the likelihood of damaging personnel attrition in the cowpea program.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** The EEP feels the balance over the past three to five years has been appropriate. Concern over budgetary problems of the GOS, along with loss of the social scientist and the soil scientist from the ISRA team, raises at least short-term concern for the ISRA component of the total program.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Collaboration in this project has been exemplary. It has encompassed the full spectrum of activities and has extended to inter-CRSP and other institutional collaboration.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives:** As indicated elsewhere, this is a fully "shared" program with well-conceived division of labor. Although funding has not always been optimally divided, the research collaboration has been exemplary.
- F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** The interest and support of the USAID Mission has always been good and is very much appreciated.
- G. Evidence of Institutionalization in HC and U.S.**
- 1. Faculty (researcher) recognition for international activities and awards:** Largely as a consequence of the CRSP research, the U.S. Principal Investigator has become an authority on cowpea breeding for hot, dry conditions. During the period January to August, 1992, he was invited to speak and participated in the organization of international symposia in Taiwan and at UCR. In addition, he was invited to speak to an international workshop in Rome, Italy, and at the First International Crop Science Congress in Ames, Iowa. He is a Technical Editor for *Crop Science* and is on the editorial boards of *Field Crops Research* and *Irrigation Science*.
 - 2. Integration of domestic program with CRSP project:** This project continues to be integrated with the PI's projects supported by the Agricultural Experiment Station and the cowpea farmers of California.
 - 3. Internal support for project management and institutional management:** The Dean's Office, College of Agricultural and Natural Sciences at UCR, has actively supported this project. When Dr. Prabodh N. Patel resigned and Dr. Jeffrey D. Ehlers was hired, it was necessary to have an overlapping period of four months. During this period, the Dean's Office funded the salary of Dr. Ehlers, even though College resources had been limited by state-wide budget cuts.
 - 4. Opportunities for/frequency of student/professor interactions:** The support to this project from professors at UCR in Botany and Plant Sciences, Entomology and Soil and Environmental Sciences has been outstanding. The support given by Dr. Richard O. Hampton to Mr. Mbaye Ndiaye, and by Dr. Gebisa Ejeta and his colleagues to Mr. Ndiaga Cisse is greatly appreciated.
- H. Other Comments:** None.

IV. WORK PLAN CHANGES**A. Changes/Additions/Deletions in FY 92 Work Plan**

U.S.: Drs. Mubarak Abdalla and Abdel Ismail completed their Ph.D.s earlier than anticipated. Dr. Ismail will stay at UCR through March 1993 to complete an important experiment on the carbon isotope discrimination of parents and hybrids.

Senegal: Varietal intercrop trials include two station trials as well as the on-farm trials. Tests of dry sowing and seed dressing treatment for control of hairy caterpillar include Granox seed treatment and three more sites in addition to Louga.

New Activities: Publish bulletin for cowpea production in Senegal and prepare an English version. Produce several tons of foundation seed of the new varieties, Mouride and Melekh, during the dry season at Centre National de Recherches Agronomiques, Bambey, using irrigation, and conduct a collaborative project with World Vision International and SODEVA to demonstrate them to thousands of farmers.

B. Reasons for Changes: The changes made were basically to capture opportunities at a nominal cost.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92**A. Publications**

1. Refereed journals: 11

2. Non-refereed journals: 4

B. Presentations: 8

FY 92 was a banner year for the project's publication record. There were also 4 Ph.D. dissertations in print.

VI. OVERALL RATING: 1--Highly Satisfactory

A. General Strengths: Comprehensiveness, both in planning and execution, and collaboration, both internal and external to the project.

B. General Weaknesses: Insecurity of funding and personnel availability by the GOS is a continuing problem.

C. Recommendations: Replace the social scientist as soon as possible.

TANZANIA • WASHINGTON STATE UNIVERSITY • BUTLER

A Participatory Research Approach to Breeding and Evaluating High-Yielding Disease and Insect-Resistant Beans for Low-Input, Sustainable Farming Systems in Which Women are Major Contributors

I. PROGRESS DURING FY 92

A. Specific Research Contributions in FY 92

1. New research results from FY 92 disseminated and currently in use in HC and U.S.

- a. Improved cultivars, inoculants, tests, methods and systems:** Bean Variety SUA 90, released in 1990, is now being multiplied in Foundation Seed Farms.

Bean Line EP 4-4 is an outstanding candidate for release. One more year of on-farm trial data is needed before submitting a request for its release. It is a red-seeded, determinate bush type, with resistance to various diseases. It was rated highly by farmers in farmer participatory research.

Other breeding lines which include hybrids between SUA 90, high protein lines and other lines are being evaluated.

Regional exchange of germplasm is continuing with collaborators at CIAT-Colombia and in other SADCC countries. This includes the recent acquisition of arcelin-containing lines to develop resistance to bruchids.

- b. Accessions collected/acquired/in storage, and kinds and amounts distributed domestically/internationally:** Collection of bean landraces used by farmers was initiated and will continue in 1993. These landraces will be screened for resistance to halo blight and other bean diseases.
- c. Evidence of project impact on production/consumption of beans/cowpeas:** The released variety SUA 90 has been performing well in farmers' fields in Dumila, Mgeta and on the commercial farm of the horticulture unit of the University. It has been praised also for the good taste of its immature seeds. The rate of seed multiplication at Msimba Foundation Seed Farm is not encouraging so arrangements are being made to contract commercial farmers and seed companies to multiply seeds. Until there is sufficient seed available for distribution, it is not possible to estimate impact.

There have been requests for SUA 90 seed from several people and agencies in the country, including His Excellency the President of Tanzania who wants to grow it on his farm in Dodoma.

- d. How research findings address needs of small-scale farmers, women and/or other beneficiaries:** From the onset, this project has been geared to minimizing production constraints of small-scale farmers through developing high-yielding varieties that are resistant to pests and diseases and are drought tolerant. Fast-cooking beans have been a high priority in order to save women's time and the burden of fetching fuelwood and water. When the FPR component was added in 1990, careful attention was directed to ensuring that women farmers were strongly represented on research evaluation teams (goal is 50 percent women).

On-farm trials and FPR have been major tools developed for addressing small-scale farmers' needs. These mechanisms help scientists understand farmers' needs and preferences and bring scientists and farmers together for more joint problem-solving.

The first two years of FPR have concentrated on identifying farmer preference criteria for accepting or rejecting bean varieties. Preliminary data taken from the 1992 Ilonga evaluation of eleven lines indicate the importance that farmers place on the number of pods, number of seeds per pod, size of seeds per pod, seed color and the capacity of the plant to continue producing pods.

- e. **Impact(s) results have had on the developing and developed world:** The first two years of FPR and attempts to identify farmers' preferred seed and plant characteristics have been well received in Tanzania by SUA and other national bean researchers. At the Uyole Participating Workshop (May 1992), national bean researchers in other regions were beginning to look to SUA for guidance in applying this methodology, and early findings have also generated interest among WSU faculty and graduate students. As a result of a seminar where the project's FPR video was shown, a WSU environmental sciences graduate student has been researching participatory research strategies for more effective involvement of U.S. farmers and other agricultural constituencies in applied research planning, implementation and evaluation.
2. **Changes in national production/consumption of beans/cowpeas in HC:** Tanzania's bean production showed a significant and positive growth rate (3.5 percent) between 1970-1989. Between 1986-89 there was an estimated 472,667 hectares under production, yielding an output of 230,000 tons or 620 kg/ha. Annual increases in production are estimated to be 9,458 tons/annum. When growth in area and yield are examined, the increase is attributed primarily to a 1.1 percent increase in productivity, not to area expansion.

B. Institutional Development and Training

1. **Institutional personnel changes since FY 91:** U.S. PI responsibilities shifted from Dr. Matt J. Silbernagel, WSU-Prosser, to Dr. Lorna Michael Butler, WSU-Puyallup. Dr. Silbernagel continues to collaborate on biological and serological detection and identification of strains of bean common mosaic virus in U.S. commercial bean seed production. The Program Coordinator's position has been moved to WSU-Puyallup; Ms. Kathy Poole assumed these responsibilities in August in place of Ms. Linda Marquis.

Dr. James Teri, SUA, has stepped down as HC PI in order to take a sabbatical leave, and Dr. Robert Mabagala has been appointed Interim HC PI.

2. **A.I.D.-funded long- and short-term training:** NOTE: Participants are Tanzanian unless otherwise noted. Mr. Flavianus Magayane, Ph.D. student (rural sociology/minor in anthropology), is at SUA doing his research; Mr. Cornel Rweyemamu, Ph.D. student (agronomy), is at MSU completing his course work and will return to SUA in early 1993 to do his research; Mr. Robert Misangu, Ph.D. student (breeding), is continuing with his studies at SUA in bean breeding (bruchid resistance); Ms. Zubeda Mduruma (breeding), Ms. Fina Opio (Uganda--pathology), Ms. Theresa Sengooba (Uganda--pathology), and Mr. A. Ijani (pathology) are all Ph.D. students at SUA working on various bean production problems; Mr. Paul Njau will begin his M.S. program in virology at WSU in 1993; eight field assistants and technicians received five days' training on various aspects of bean production; Dr. Susan Nchimbi-Msolla (breeder) went to CIAT, Cali, Colombia, March 17-April 10, 1992 to visit Dr. Cardona's laboratory to learn techniques of screening for bruchid resistances (trip funded by CIAT); Ms. Mduruma went to CIAT, Cali, Colombia, March-May 1992, for a training workshop on bean breeding (trip funded by CIAT); Dr. Nchimbi-Msolla and Dr. Naftali Mollel (Extension) took part in the SADCC/CIAT Participative Planning Workshop on Bean Research in Tanzania, May 18-22, 1992 at Uyole, Tanzania (Goal: to increase the efficiency and impact of bean research in Tanzania through collaborative strategic planning); Mr. Amos Madalla (Ph.D. candidate--communications) collaborated with Dr. Scott Fedale (U.S.-communications) in the second

phase of the FPR video production and practical video production training and, in cooperation with SADCC/CIAT, filmed and interviewed farmers, scientists and others in Lushoto, Arusha and Babati. Mr. Madalla submitted his Ph.D. research proposal in 1992.

- C. Progress Achieved in Relation to Objectives in FY 92 Work Plan:** It is clearly evident from perusal of the FY 92 Annual Report that the objectives of both the U.S. and HC research elements of the project have been aggressively approached and that very substantial progress has been made. The majority of the research is on schedule although there has been some lag in the entomological work. The change in project leadership has, not surprisingly, resulted in some slippage in data analysis.

The CRSP team collaborates with other national bean researchers, including CIAT, on strategies to respond to national constraints. Farmer evaluation is done in cooperation with the Ilonga Farming Systems Research Team. The FPR video production has collaborated with CIAT's FPR in Lushoto and Babati. CIAT and SUA personnel worked together to document farmers' preferences, local seed multiplication systems and variety evaluation strategies, which helped refine SUA's FPR methodologies. The project has had an excellent collaborative relationship with SADCC/CIAT. The leadership and training resources provided by the bean improvement team, particularly through the expertise of Drs. David Allen and Todo Edje, has had a noticeable effect on the project and other regional bean research programs.

Through their CRSP work, Drs. Gaylord Mink and Matt Silbernagel monitor and intercept seedborne BCMV new strain introduction into U.S. production systems, as well as curtail the spread of existing strains. Detecting contaminated bean lots and diverting their use as seed help reduce the introduction and spread of new and potentially dangerous strains of BCMV into the U.S. seed production system.

D. Evidence of Biological/Social Sciences Integration

- 1. Identification of and attention to relevant WID issues:** This project has had a very strong biological/social science integration from its start. The involvement of women researchers, students, extension agents and women farmers in FPR has strengthened the total program and its capacity to meet the needs of women farmers. In the bean-growing regions of Tanzania, women choose the bean seeds for planting, and they contribute 59 percent of total labor on beans. For this reason the project makes a continuing effort to design methodologies for understanding women's preferences, roles and responsibilities, perceived constraints, etc. Women constitute approximately half of the farmer evaluators, and they are testing varieties at home. HC women scientists, students and extensionists are active in the program.
- 2. Identification of and attention to other social and/or economic issues:** From the onset, the project paid attention to issues of acceptability of newly developed technologies and the utilization of beans. Because of the apparent importance farmers and consumers place on taste, cookability, storage and home use, consumer preference evaluation is to be incorporated into the FPR model. Attention is being given to screening high-yielding beans for increased protein content, reduced anti-nutritional factors, cookability and quality of cooked product.

Bean straw is becoming increasingly important as livestock feed in areas which practice zero grazing or stall feeding. The Department of Animal Science has been analyzing the nutritive value of straw from various bean lines. Attention in the future may be paid to straw yield in addition to seed yield.

Storage of beans after harvest is a major problem for farmers. The Department of Engineering is researching improved, lower-cost storage technologies. This will lead to further collaboration with the Department of Food Science in assessing bean quality after storage in alternative containers.

- E. **Baseline Data:** The project has accumulated an extensive amount of baseline data through the work of Dr. Jean Due and collaborators.
- F. **Collaboration with Other Bean/Cowpea CRSP Projects, Linkages with Other CRSPs and Other External Groups Not Included in C.4. Above:** Drs. Gaylord Mink and Jim Myers are collaborating with the Malawi/UCD CRSP project on BCMV work, and Drs. Anne Ferguson and Lorna Butler are collaborating on FPR. A Malawi/Tanzania CRSP/CIAT collaborative FPR workshop was planned for Malawi in March 1992. However, this was postponed when funding became uncertain. Researchers from SADCC/CIAT, the National Program and Uyole Research Center participated in the CRSP workshop in September.

II. FUNDING/FISCAL MANAGEMENT IN FY 92

- A. **Problems:** With the change of U.S. project location, coordinator, PIs, etc., this is the ideal time to computerize the budget process. The same system could be used in the HC as in the Puyallup office. The FY 93 goal, following delivery of new computers, is to organize in a similar way so that both offices are better able to track and manage expenditures.

The U.S. PI had travel money to visit SUA once in FY 92, with other funds going to support Dr. Fedale's travel for the video production. The situation will be the same in 1993. She feels that it would be desirable, because of the change in PI, that additional funds be identified for a second visit by her to SUA. In her opinion, funds for basic management operations, in addition to maintaining the research program, are far from adequate.

The cost of the annual Bean Workshop, including publication of the proceedings, has increased to the point where there are not adequate funds to pay for it in its entirety. This event is extremely valuable in strengthening national and regional collaboration and in ensuring continued researcher motivation. With the pending termination of the SADCC/CIAT bean improvement program, the role of the workshop becomes even more vital. Without SADCC/CIAT resources, CRSP resources will be stretched to their maximum.

- B. **Adequacy of Current Management, Policies and Procedures:** It has taken new management personnel additional time to understand budgeting, purchasing and reporting procedures. All appreciate the assistance and support received in this process. There is need for the U.S. coordinator to communicate more directly with the HC PI and office support personnel to improve methods of organizing/tracking budget expenditures, purchases received, etc. The best way to do this is in person; however, funds are not now available to do this. The coordinator's position is 0.55 Full Time Equivalent. Current responsibilities are consuming more than this amount of time.
- C. **Activity Towards Buy-ins and/or Other Funding:** USAID priorities in Tanzania are not directed to agriculture so buy-in activity has not been possible.
- D. **Responsiveness to 50/50 Split Policy:** To date, the CRSP budget has been split according to this policy with a slightly higher amount going to the HC (49 percent/51 percent).

III. STATUS IN FY 92

- A. **Appropriateness of Activities to Goals of the Global Plan:** The emphasis on developing high-yielding varieties resistant to pests and diseases for smallholder farm families has been a very appropriate emphasis. The addition of more farmer participation to the breeding process reinforces this. Adding a consumer-preference evaluation activity (smallholder family preferences regarding taste, cookability, use, home storage) will strengthen the program.

- B. Impact of Training Program on Project:** HC training participants are now providing strong research program leadership in the HC, which was an overriding objective of the project.
- C. Balance between Domestic vs. Overseas Activities with Respect to Program Objectives:** Responsibilities for the breeding program now lie primarily with the HC. Other HC team members provide support in pathology, extension/rural sociology, agronomy, food technology, entomology and engineering. WSU-Prosser and the University of Idaho-Kimberly support this program by monitoring and intercepting seedborne BCMV new strain introduction and developing near isogenic BCMV differentials. Initial crosses and screening for the differential work are made at Prosser. The U.S. breeding and serology work would be difficult to carry out in the HC given the limitations of facilities and resources. FPR is carried out primarily by the HC team with methodological and training support from the anthropologist. Data analysis and reporting is a shared activity. The program activities are therefore well balanced.
- D. Collaboration/Cooperation between U.S. and HC Institutions and Personnel:** Collaboration is excellent at this time. Cooperation between U.S. and HC team members has been reinforced by joint field work, data analysis, reporting, program discussions, workshop participation and video production. Collaborative research planning took place this year at a joint team meeting in August at WSU-Prosser. An effort is made to ensure that one or more of the HC team visits the U.S. annually in conjunction with a professional meeting.
- E. Contributions of Collaborating Institutions and Individuals towards Accomplishment of Objectives**
1. **HC:** In-kind contributions (land, laboratory space, equipment, etc.) U.S. \$20,000. In cash (salaries of researchers, technicians, drivers, support personnel, etc.) U.S. \$25,000.
 2. **U.S.:** In addition to salary, office and lab facilities, Dr. Scott Fedale, WSU Department of Information, has given many hours of his own and his staff's time to the production of the FPR video.
 3. **Other funding:**
 - a. **CIAT:** SADCC/CIAT grant for Dr. Nchimbi-Msolla for bruchid resistance research; U.S. \$14,000 to be divided among three regional bean research institutions; support of Drs. Nchimbi-Msolla and Mollé to take part in national bean research strategic planning workshop at Uyole in May.
 - b. **Rockefeller:** Scholarship to cover Mr. Magayane's research in Tanzania, including return travel between Illinois and Morogoro.
 - c. **International Crop Science Congress:** Scholarship for Drs. Teri and Nchimbi-Msolla covered the cost of their registration, accommodations and meals at the meeting in Ames, Iowa.
 - d. **Other:** Mr. Roshan Abdallah, Chief Officer at the Tropical Pesticides Research Institute in Arusha, is being supported for a M.S. and Ph.D. in plant pathology at WSU by TPRI and USAID.
- F. Interest, Involvement and Support of USAID Mission and/or U.S. Embassy:** The USAID Mission's program does not encompass production agriculture so there has been only nominal contact.

G. Evidence of Institutionalization in HC and U.S.

1. **Faculty (researcher) recognition for international activities and awards:** SADCC/CIAT regional bean team and affiliated scientists participated in the 11th Bean CRSP Workshop at SUA. Drs. Mink and Silbernagel are organizing an International Workshop on Taxonomy of Bean Common Mosaic Virus Subgroup to be held in Montreal, July 25-27, 1993.
2. **Integration of domestic program with CRSP project:** This project has developed a strong interdisciplinary capacity at SUA which attests to a long-term institutional commitment.
3. **Internal support for project management and institutional management:** Both U.S. and HC support has been outstanding.
4. **Opportunities for/frequency of student/professor interactions:** Graduate and senior students are collaborating with CRSP scientists in both the HC and the U.S.

H. Other Comments: None.

IV. WORK PLAN CHANGES: Since development of the FY 92 workplan, the HC PI has left the project for a sabbatical leave. An Interim HC PI has been appointed (Dr. Robert Mabagala, Department of Crop Science). Drs. Martha Quentin and Margaret Mmbaga took employment elsewhere after their studies under the project. Therefore, progress in the area of entomology (bruchid resistance) has been less than planned. However, cooperation with CIAT's entomologist may stimulate more work in this area. The project was a bit too ambitious in expecting that FPR data could be analyzed and reported in FY 92 given HC scientists' commitments and the limited amount of analysis time available when Dr. Butler was in Tanzania.

V. PUBLICATIONS AND PRESENTATIONS IN FY 92**A. Publications**

1. **Refereed journals:** 16
2. **Non-refereed journals:** 19

B. Presentations: 0

In another banner year, the team put several refereed and non-refereed publications in print. It is noted, however, that some of these are only tangentially related to the CRSP.

VI. OVERALL RATING: 1--Highly Satisfactory

- A. General Strengths:** The major strength is the well-developed HC interdisciplinary institutional capability.
- B. General Weaknesses:** No significant weaknesses are apparent.
- C. Recommendations:** The project should move aggressively to resolve the entomology problem.

GUATEMALA • CORNELL UNIVERSITY • WALLACE FINAL REPORT

Agronomic, Sociological and Genetic Aspects of Bean Yield and Adaptation

The final report of this project does quite a thorough job of condensing the concepts evolved over the several years of observations and analyses performed under this project. The EEP is gratified to observe that these concepts are now or soon will be more fully before the scientific community.

On the other hand, we are distressed at the continuing staff turnover in Instituto de Ciencias y Tecnologia Agricola (ICTA-Institute of Agricultural Science and Technology) and the implications for the bean program's future there. It also has implications for future interaction/collaboration between ICTA and Cornell. We are pleased to note, however, that firm plans are in place for preparation and publication of four additional papers that further elaborate and document the concepts that have evolved.

Finally, we again commend Dr. Wallace for his effective work with students, both those directly involved in this project and those funded from other sources. The professionals passing through the Cornell pipeline will surely have major impact in the years ahead.

INCAP • WASHINGTON STATE UNIVERSITY • SWANSON FINAL REPORT

Improvement of Dry Bean Nutritional Quality and Acceptability

The final report of this project does an outstanding job of summarizing the very extensive findings developed in this collaborative undertaking. The record is really quite impressive and the findings shed major points of light on the global constraints addressed.

The report also clearly documents the extensive training efforts, both formal and informal, in which the project engaged. This output will surely be a major factor in assuring availability of human resources for work in this general area.

Finally, we observe that there is ample groundwork for continued collaboration among the project participants. INCAP is a mature and reasonably stable institution that will continue to contribute to the solution to the food and nutrition problems of Latin America. We note the departure of Dr. Bressani from INCAP. He will be missed there, but we nonetheless thank him for his contributions to the CRSP and wish him well in his new assignment.

NIGERIA • UNIVERSITY OF GEORGIA • McWATTERS FINAL REPORT

Appropriate Technology for Cowpea Preservation and Processing and a Study of Its Socioeconomic Impact on Rural Populations in Nigeria

The final report of this project does a good job of summarizing more than ten years of effort. It's apparent that a great deal was done with a limited amount of resources. The success of this project is perhaps best attested by the fact that the UGA team's proposal for work in Ghana is an approved part of the CRSP's five-year extension.

The report cautions that sustainability is difficult to predict but hastens to add that the future of this line of work at the University of Nigeria and, in fact, across Nigeria looks bright. The Nigerian team is in place, the technology is working and is well-received, and the prospects for a continued collaboration look good. Those are important ingredients for success. The linkages with other research institutions (i.e., other CRSP projects, IITA, private companies) likewise project sustainability.

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