FY 2008 TECHNICAL PROGRESS REPORTS

April 1, 2008-September 30, 2008

Dry Grain Pulses Collaborative Research Support Program (CRSP)

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This publication was made possible through support provided by the Office of Economic Growth, Agriculture and Trade, U.S. Agency for International Development, under the terms of Cooperative Agreement No. EDH-A-00-07-00005-00. The opinions expressed herein are those of the Dry Grain Pulses CRSP and do not necessarily reflect the views of the U.S. Agency for International Development.

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PREFACE

Dry Grain Pulses Collaborative Research Support Program (CRSP)

FY 2008 TECHNICAL PROGRESS REPORTS (April 1 – September 30, 2008) Phase I Projects

The global pulse industry is entering a new era characterized by globalization of markets and fundamental changes in food value-chains, presenting many challenges as well as opportunities for small-holder farmers in developing countries and the United States.

Pulse crops, including such edible legumes as common bean, cowpea, pigeon pea, chickpea, lima bean, lentil, etc., represent an important group of staple food crops that contribute to addressing household food security, generate income, enhance soil quality and thus the sustainability of agricultural systems, and perhaps most importantly provide important nutrients (e.g., protein, dietary fiber, vitamin B and complex carbohydrates) essential for nutritious and healthy diets.

In September 2007, the U.S. Agency for International Development (USAID) awarded a five-year (2002-2012) contract (Cooperative Agreement No. EDH-A-00-07-00005-00) to Michigan State University to serve as the Management Entity for the Dry Grain Pulses CRSP.

The global program vision of the Dry Grain Pulses CRSP is to contribute to:

- Economic growth and food and nutritional security through knowledge and technology generation,
- Sustainable growth and competitiveness of pulse value chains utilizing socially and environmentally compatible approaches,
- Empowerment and strengthened capacity of agriculture research institutions in USAID priority countries,
- USAID's developmental objectives as defined in the *Policy Framework for Bilateral Foreign Aid* and the *Presidential Initiative to End Hunger in Africa* (IEHA), and
- Achievement of Title XII legislation objectives including the provision for dual benefits to developing country and U.S. agriculture.

The Dry Grain Pulses CRSP seeks to achieve its technical vision through support for a portfolio of integrated, multi-disciplinary research, training and outreach activities that focus on beans, cowpeas and related pulses and address four strategic themes.

- To reduce pulse production costs and risks for enhanced profitability and competitiveness,
- To increase the utilization of pulse grain, food products, and ingredients so as to expand market opportunities and improve community health and nutrition,
- To improve the performance and sustainability of pulse value-chains, especially for the benefit of women, and
- To increase the capacity, effectiveness and sustainability of agriculture research institutions which serve bean, cowpea and related pulse sectors and developing country agricultural industries.

For the initial five-year authorization of the Dry Grain Pulses CRSP, a two-phase technical program is being implemented with two project award cycles; Phase I (April 1, 2008 –

September 30, 2010) and Phase II (October 1, 2010 – September 29, 2012). To this end, the Management Office issued a Request for Proposals in November 2007. Of the 27 proposals that were received and reviewed by an External Advisory Panel, eight proposals were selected that best met the evaluation criteria identified in the RFP and provided the highest likelihood of developmental outcomes. The MO subsequently issued contracts to seven "Lead" U.S. universities for the management of these Phase I collaborative projects.

The eight Phase I projects presented in the FY 2008 Technical Progress Report involve collaborative research, long and short term training and technology dissemination activities in ten African countries (Burkina Faso, Mali, Niger, Nigeria, Senegal, Kenya, Rwanda, Uganda, Mozambique and Angola) and three Latin American countries (Haiti, Honduras and Ecuador). Within this group, five countries (Mali, Nigeria, Kenya, Uganda and Mozambique) have the distinction of being designated as USAID priority countries under the "Presidential Initiative to End Hunger in Africa" (IEHA). A total of 22 Host Country institutions are collaborating with the Lead U.S. Universities in the Phase I projects of the Dry Grain Pulses CRSP.

The FY 2008 Technical Progress Report corresponds to the initial six month (April 1 – September 30, 2008) funding period of the 30 month-long Phase I projects. During these six months, the subcontracted U.S. and Host Country institutions participating in Phase I projects of the Dry Grain Pulses CRSP were finalizing subcontracts, recruiting Host Country graduate students for training, and taking the first steps to implement their collaborative research, outreach and institutional capacity building activities outlined in the project workplans for the 18 month period (April 1 – September 30, 2009). It is therefore important when evaluating performance of these projects to keep this reality in mind.

For more detailed information on the Dry Grain Pulses CRSP including the global program technical vision, project workplans, technical progress reports, project funding, and brief biosketches of Principal Investigators, visit the program's Internet web page at (http://www.pulsecrsp.msu.edu/).

As the Director of the Dry Grain Pulses CRSP, I want to thank the Office of Agriculture, Bureau of Economic Growth, Agriculture and Trade (EGAT), USAID-Washington for its financial support for this worthy program. USAID's investment in this CRSP reflects its recognition of the vital importance of pulse crops in contributing to the nutritional and food security of rural and urban poor as well as to providing opportunities for resource-poor farmers and other value-chain stakeholders to generate income and escape poverty. The Host Country and U.S. scientists and institutions partnering in this endeavor are also to be thanked and commended for their commitment to generating new knowledge and technologies and to training a new generation of scientists and professionals who will provide leadership to the agriculture development of many African and Latin American countries.

Dr. Irvin E. Widders

Director
Dry Grain Pulses CRSP

Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya

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Abstract of Research Achievements and Impacts

Significant progress has been made on all 4 objectives of this project. A workshop was held for farmers from the Nandi District of Kenya to introduce concepts/strategies for enhancing vigor for improved pulse and maize production. Five vigor enhancing strategies, including KK8, a root rot tolerant bean variety; Lablab; seed priming; triple supper phosphate fertilizer; Minjingu rock phosphate fertilizer and boma compost, are being tested by 64 farmers from across a soil fertility gradient. Three replicated experiments, designed at a Project Initiation Workshop attended by all the project collaborators, were installed at each of four sites across the gradient to investigate nutrient and pest/disease impacts and interactions associated with the vigor enhancing strategies. Also cowpea and nutrient efficient bean germplasm, obtained from the University of California Riverside and Zamorano University in Honduras, are being evaluated under Western Kenya conditions. Three mid-career professionals were selected for Masters degree programs at the University of Nairobi, Moi University and Egerton University. Two of the students are currently doing coursework and the other has started her research program on the replicated experiments.

Project Problem Statement and Justification

Many rural households in the East African highlands are no longer self-sufficient in beans, a critical source of food and income. Farmers' inability to afford fertilizer inputs, coupled with continuous cropping on ever shrinking land holdings, has led to degraded and infertile soils and a concomitant decline in crop vigor, pest and disease tolerance and overall system productivity.

Low bean and maize productivity in Western Kenya is related to both soil fertility and biological constraints. Legumes can be important options for rebuilding soil fertility but poor utilization of applied P fertilizers, conflicts between soil renewal and immediate food and income needs and low fixed nitrogen returns from many grain legumes have limited expected returns. Additional production constraints and risks for beans in Western Kenya are presented by diseases and pests. Angular leaf spot and anthracnose are major bean foliar diseases, and root rots, bean stem maggot, nematodes and root-feeding insects are particularly serious problems in intensively cultivated, degraded soils. Bean root rot can become so severe that the amount of seed harvested becomes less than the amount planted, causing farmers to abandon bean cropping altogether. We hypothesize that vigorous establishment of pulse crops leads to increased pest/disease resistance, improved N fixation, and nutrient accumulation, which ultimately reduces risk, benefits system productivity, food security and human nutrition. Practices promoting early plant vigor and growth encourage bigger and deeper root systems which can explore larger volumes of soil for limiting nutrients and compete more effectively with soil borne pathogens.

Consumption of pulses is essential for addressing iron deficiency, anemia and stunting caused by inadequate intakes of zinc. Knowledge about the mineral nutrient content of staple food products, including iron and zinc, is needed to inform selection of appropriate cultivars that will benefit consumer's health and to assist policy makers in meeting desired national health outcomes. Recent national or regional level food composition data are often unavailable forcing researchers and policy makers to rely on international databases that do not adequately represent local environmental conditions, varieties, etc. Mineral nutrient contents of major foods grown under a representative range of smallholder farmer conditions are needed to develop local food composition tables and to determine food system nutrient outputs.

Determining how to effectively increase productivity of seriously degraded soils and to maintain the fertility of still productive lands is of paramount importance to all farmers living in the East African Highlands. To achieve this outcome, farmers and scientists need to form genuine partnerships, combining farmers' highly sophisticated and nuanced understanding of local conditions with scientists' insight into underlying processes and the powerful problem-solving ability of their scientific methods. Providing opportunities for current and future scientific leaders to gain experience and expertise with participatory research and development approaches needs to be an essential part of the education process. These experiences will help students understand that adoptable and sustainable technologies are those that reduce risk and effectively address farmer constraints and resource levels.

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: To develop and assess farmer capacity for improving vigor and growth of pulse crops on nutrient accumulation, pest/disease resistance and system productivity across a soil degradation gradient.

Approaches and Methods:

1. *In Community Farmers Workshops* - KARI will organize and conduct in-community workshops for selected farmers, local extension and NGO personnel with input from the rest of the research team. Farmers invited to the workshop will be selected from an existing characterized group of farmers who had participated in a former Cornell project of the National Science Foundation Biocomplexity Initiative. These farmers' plots fall along a soil degradation gradient of steadily decreasing levels of soil C, N, P, K, Ca, Mg. Participatory approaches will be used to engage participants and facilitate the exchange of farmer and scientific knowledge as well as the rationale behind vigor-enhancing practices (root rot tolerant bean germplasm, seed priming, boma compost, combining/ concentrating organic & inorganic fertilizers, multipurpose pulse crops lablab and cowpea). Farmers will share their own knowledge and may propose additional vigor-enhancing practices to be tested by the group.

2. *On Farm Verification Trials* - Specific strategies that farmers wish to evaluate on their own farms will be facilitated and supported by the project. Given the extremely limited resources of the farmers, it will be necessary for the project to supply sufficient quantities of seed and fertilizers to plant the verification plots. KARI personnel will provide technical backstopping and follow up with the farmers. The vigor enhancing practices will be tested with beans during the long rainy season when farmers plant their main maize/bean intercrop. The drought tolerant indigenous pulses, lablab or cowpea, will be evaluated during the more erratic short rainy season.

Results, Achievements and Outputs of Research:

Soil analysis data from the NSF Biocomplexity Project were used to select farmers along a gradient of soil fertility from low to high in Nandi District, Western Kenya. Farmers from the villages of Kapsengere & Kapkarer (Low soil fertility cluster), Kiptaruswo (Low and Medium soil fertility cluster), Bonjoge (Medium High soil fertility cluster) and Kiobem (High soil fertility cluster) were invited to participate in the project.

1. *Farmer Workshops* - A workshop, organized by KARI-Kakamega with contributions from Cornell University, was held June 23-25, 2008 at Kaimosi Farmers Training Centre in Western Kenya. Out of 68 farmers invited, 52 attended (45 men, 7 women). Two farmers from Kitale were also invited to share their experiences on the benefits of Lablab and boma compost. The principal activities included constraint analysis, discussing the concepts and rationale for enhanced plant vigor and demonstrating approaches to achieve enhanced vigor for improved production of pulses.

General farm constraints, methods for planting maize and beans and specific problems with maize-bean cultivation were discussed in break out groups and reported back to the workshop participants. High production costs, lack of money to buy inputs and lack of knowledge were common issues for all groups, but other farm constraints differed depending upon the soil fertility cluster. The high and medium high fertility clusters had problems with marketing and road infrastructure. The medium fertility cluster noted that changes in weather were leading to more diseases and hindering turnaround time between cropping seasons. Unique problems experienced in the low soil fertility cluster were Striga infestation, soil erosion and small farm sizes.

Maize and bean cultivation practices varied by soil fertility cluster, with very little use of fertilizer in the low and medium groups but 25-50 kg/A DAP in the medium high and high groups. Plant spacing and fertilizer application practices also differed by cluster. All groups planted traditional, non-root rot tolerant bean varieties and most planted hybrid maize. Numerous pest, disease and weather problems on maize and beans were reported by the low and medium fertility clusters. Extreme weather events also were mentioned by the medium high fertility group along with access to chemicals for pest and disease control and markets. The high soil fertility cluster farmers noted problems with labor shortages for land preparation and storage pests.

Photographs, seed and P fertilizer samples, potted plant displays and a compost demonstration were utilized to introduce concepts and strategies for improving plant vigor for higher productivity. Testimonials from the Kitale farmers reinforced the benefits of compost and Lablab for food, fodder and soil fertility. Since Lablab is a new crop, the grain was prepared and tasted by the participants. Feedback was positive and many farmers indicated that the cooked Lablab was indistinguishable from common bean.

KARI undertook follow-up visits in early July 2008 to engage the farmers in further discussions on vigor enhancing strategies for testing during the short rains season and the logistics for planting and management. Since a majority of the farmers who attended the workshop were male, the research team was particularly interested in finding out whether they communicated the concepts with their spouses upon returning home. This is important because in most households, women are responsible for planting and managing the bean crops. The women were generally aware of the discussions at the workshop and a majority of them were interested in participating. The KARI team also followed-up with those farmers who did not attend the workshop to determine whether they were interested in participating in the project.

2. *On-Farm Verification Trials* – Trials on 64 farms were initiated with the short rains season in August 2008 to evaluate: (i) KK8, a root rot tolerant bean variety; (ii) Lablab; (iii) seed priming; (iv) triple super phosphate fertilizer (TSP); and (v) Minjingu rock phosphate fertilizer (MRP). Each farmer selected one or more treatment combinations (Table 1) depending on land availability and interests. Treatments were established as a randomized complete block design with each farm as a replicate. Plots measured 6 m by 6 m or where space was a constraint, plots were 5 m by 4 m. The farmer practice treatment for the beans utilized the farmer's traditional variety and fertilizer practice (if any).

Table 1. Vigor enhancing treatment combinations for the short rains season farmer verification trials

Beans	**Lablab**
KK8 only	Lablab only
KK8 + TSP	Lablab + TSP
KK8 + MRP	Lablab + MRP
Farmer Practice	Lablab + Priming
	Lablab + Priming + TSP
	Lablab + Priming +MRP

All participants (30 women, 34 men) planted Lablab, compared to 57 who planted KK8 bean, presumably because Lablab is a new legume to them, and most had not seen Lablab prior to the workshop. TSP was used by 59 farmers and proved more popular than MRP, which was used by 47 farmers. Seed priming was relatively popular, attracting 51 farmers. Boma compost, which will be made during the short rains and utilized by farmers in the next season, was selected by 41 farmers.

The Lablab seed distributed to the participants was obtained from a farmer group in Kitale. Unfortunately the viability of this seed was suboptimal (70% germination), and when combined with unusually heavy rains at planting, plant stands were poor. Gap filling for the Lablab treatments was done to assure sufficient stand for the farmers to evaluate the crop. Despite the heavy rain, bean germination and emergence was good. Hail, especially in Bonjoge (medium high fertility cluster) and Kapkarer (low fertility cluster), severely damaged the crops on some farms.

A majority of the farmers have taken ownership for their trials and are consulting frequently with KARI technical staff. About 22% are less interested and do not maintain their plots well. So far farmers have noted the benefit of KK8 relative to their traditional varieties at most sites and the positive impact of both TSP and MRP on bean and Lablab vigor and growth. Seed priming has been beneficial at some sites but not all. While initial Lablab growth was slow, the plants are now at the stage where growth is rapid and farmers are able to see the potential of this crop. Bean harvest will be in November-early December, while Lablab harvests will begin in January-February 2009.

Objective 2: To disseminate and evaluate through participatory approaches simple, low cost strategies for vigorous establishment/growth of pulse crops leading to increased system productivity and sustainability.

Approaches and Methods:

1. *Create awareness and identify additional NGO and female farmer groups for collaboration and dissemination of vigor enhancing strategies* - Contacts will be made with NGO groups and the many informal farmer groups which exist within the target area in order to expand the impact of the project to a wider audience beyond the initial pool of selected farmers.

2. *Crop performance evaluation and in season exchange visits* - Farmers will collect crop establishment data (germination and 4 wks post-germination) and volumetric yield data (for maize, beans, and lablab or cowpea) from their verification trial plots in each cropping season. In addition, farmers will be shown how to assess and record the incidence and severity of pests and diseases (root rot, bean fly, others) with easily observed characteristic signs or symptoms. Results will be shared with the project. Each cropping season farmer-to-farmer exchange visits and visits to the replicated researcher-managed experiments will be supported to provide other opportunities for facilitating experiential learning and exchanges about successes and failures. Participant feedback after each group event will be solicited and reported.

3. *Initiate socioeconomic surveys of farmers* - A survey will be undertaken at the end of the long rains in 2009 (one full short rains-long rains cycle) to document farmer reaction to the tested strategies. Perceived benefits and constraints, changes in management approaches and labor requirements, farmer to farmer knowledge dissemination and likelihood of adoption will be assessed. Impacts on livelihood indicators also will be collected as available, such as cost-benefit analysis of the chosen strategy, status of household food self-sufficiency, as well as crop sales and disposition of cash. Input on the survey instrument will be sought from all project collaborators (KARI, Cornell, Universities, CIAT) and incorporated prior to field testing. Socioeconomic data gathered from the NSF Biocomplexity project will serve as baseline information.

Additional baseline information on bean cultivation practices not available from NSF dataset will be collected prior to the In-Community Farmer Workshops.

Results, Achievements and Outputs of Research:
1. *Create awareness and identify additional NGO and female farmer groups for collaboration* – A list of potential NGO, farmer groups and extension contacts has been gathered. Within the first quarter of the next project year, we will contact these organizations to solicit interest in the project and develop collaborations for disseminating increased pulse productivity and vigor enhancing strategies to their clients.

2. *Crop performance evaluation and in season exchange visits* – Crop establishment and pest/disease incidence data for the short rains bean and Lablab crops was gathered from all farmer plots by the KARI research assistant based near the farmers' fields. Because of the heavy workload in getting the farmer plots and replicated experiments established, there has been a delay in training farmers to gather this information. Over the next few months we will develop farmer capacity to make such field observations and to record bean and Lablab harvests as well. A protocol for measuring yields that will allow farmers to compare their yields with one another has been developed.

Farmer-to-farmer exchange visits between the 4 soil fertility clusters are scheduled for November 2008, prior to the short rains season bean harvest.

3. *Socioeconomic surveys of farmers* – Additional information about our farmer participants were gathered in August-September 2008 to supplement the baseline information available from the NSF Biocomplexity Project dataset. The survey instrument to be used at the end of the long rains 2009 is currently being developed by KARI.

Objective 3: To research factors (nutrients, pest/diseases and their interactions) affecting pulse productivity across a soil degradation gradient.

Approaches and Methods:
1. *Project Initiation Workshop* - Complex experimental designs will be used to test responses to the full complement of vigor enhancing strategies and to tease apart interactions among management practices, soils, crops and pests/diseases. All project collaborators (KARI, Cornell, Universities, CIAT) will convene to develop and detail the specific research questions, experimental design and data to be collected from the replicated trials. Research questions will likely emphasize incidence and severity of pests and diseases, characterization of soil chemical characteristics and agronomic evaluations of system productivity

2. *Implement replicated experimental trials* - KARI will establish and oversee the management of the replicated experiments on representative maize and bean fields at 4 sites across the soil degradation gradient. Farmer collaborators from each represented gradient zone will help to identify the most

appropriate site within that zone and the farmer who owns the field will be fully compensated in cash and kind. These replicated experiments will be carried out over the life of the project.

3. *Data collection and evaluation* - Data from the replicated experiments as identified during the Project Initiation Workshop will be collected by KARI staff. At the end of the short rains 2008 and long rains 2009 cropping seasons, results will be collected and shared among all collaborators.

4. *In-season field visits and annual meeting review of results* - Each cropping season site visits will be made to the replicated trials by project collaborators during early crop growth to assess the effectiveness and impacts of the tested vigor enhancing strategies. Observations and comments will be reported. Project collaborators will meet after one full short rains-long rains cycle to review and synthesize results from farmer and replicated experiments. Successful and unsuccessful features of the vigor enhancing strategies and impacts will be identified. Areas needing additional attention or modification will be identified.

5. *Collection and nutrient analysis of grain and edible leaf samples* - KARI staff will gather grain sub-samples from farmer and replicated trials. Samples will be sent to Cornell Unversity for mineral nutrient analysis (Ca, Mg, P, K, S, Zn, Cu, Mn) and calculation of cropping system yields and nutrient outputs.

6. *Pursue opportunities for germplasm testing and exchange* - Phosphorus efficient bean germplasm (2-3 lines) will be obtained from the Pennsylvania State University (PSU) project and tested during the long rains season in observational plots across the soil degradation gradient. Commonly adopted root rot tolerant bean varieties from the target area will be sent to PSU for P efficiency trait testing. Likewise early and late maturity cowpea cultivars will be obtained from University of California Riverside (UCR) and tested during the short rains for biomass and grain production.

Results, Achievements and Outputs of Research:

1. *Project Initiation Workshop* - The project held its initiation workshop in Kisumu, Kenya 17-19 June 2008. Collaborators from KARI-Kakamega, Cornell, Egerton University, Moi University, University of Nairobi and CIAT attended. Students selected for support by the project also participated in the workshop. As a result of our discussions, one main experiment and two smaller satellite experiments were developed for implementation at each of the four soil fertility clusters across the gradient.

A. Main Experiment Objectives

Across a soil degradation gradient:

i. During the short rains, determine the individual and combined effects of vigor enhancing strategies (P level, seed priming) on Lablab growth, production, nutritional outputs and pest/disease incidence and severity.

ii. During the long rains, quantify the effects of the short rains season factors on maize-bean intercrop growth, production and nutritional outputs, and on bean pest/disease incidence and severity.

iii. During the long rains, assess the contribution of boma compost+DAP application and bean variety on maize-bean intercrop growth and production, and on the incidence and severity of bean root rot and other pests and diseases.

The experiment utilizes a 2x2x2 factor Randomized Complete Block design with 3 replications during the short rains season. Plots will be planted with a sole crop of Lablab with treatment factors (i) Phosphorus Level: no P, TSP; (ii) Priming: no seed priming, seed priming; and (iii) Lablab biomass incorporation levels: Lablab for grain, Lablab for forage. During the subsequent long rains season, the same plots will be sown with an intercrop of maize and beans and split twice to assess the impacts of (i) Fertilizer: no fertilizer, ½ boma compost + ½ DAP and (ii) Bean variety: root rot susceptible, root rot tolerant. Data will be collected in both seasons on plant growth and performance, pest and disease incidence/severity and soil fertility changes.

B. Satellite Experiment #1 Objectives

Across a soil degradation gradient:

i. During the short rains season, determine the individual and combined effects of vigor enhancing strategies (phosphorus source, seed priming) on bean growth, production and nutritional outputs.

ii. In the short rains season, assess the impact of vigor enhancing treatments on incidence and severity of bean root rot and other pests with root rot susceptible and tolerant bean varieties.

The experiment utilizes a split-split plot design with 3 replications. Plots will be planted with a sole crop of beans with main, sub-plot and sub-sub plot treatments, respectively: (i) Phosphorus Source: no P, TSP and MRP; (ii) Priming: no seed priming, seed priming; and (iii) Bean variety: root rot susceptible, root rot tolerant. Data will be collected on bean growth and performance, root rot incidence and incidence/severity of other pests and diseases.

C. Satellite Experiment #2 Objectives

Across a soil degradation gradient:

i. During the short rains season determine the effects of phosphorus source on Lablab growth, production, nutritional outputs and pest/diseases.

The experiment has a single factor Randomized Design with 3 replications. Plots will be planted with Lablab comparing phosphorus sources: no P, TSP and MRP. Data will be collected on Lablab growth and performance and incidence/severity of pests and diseases.

2. *Implement replicated experimental trials* – KARI installed the replicated experiments on one farm in each of the 4 soil fertility clusters in mid-August 2008. Given the size of the experiments (0.5 Acres total) larger farms were recruited to host the experiments.

Prior to planting, investigations were conducted by Cornell and KARI to determine the safe limits for the Lablab and bean priming treatments in the Main and Satellite #1 experiments. Following the protocol of Harris (1996), germination times for seeds soaked in water 0, 2, 4, 6, 8, 10 and 12 hours were compared with seed soaked for the same time periods and left to dry prior to germination, thereby simulating a possible delay between soaking and sowing. For Lablab and bean, an 8 hour soak time was found to be best. Compared to dry seed, priming for 8 hours reduced the germination time 30-40% for Lablab and 40% for bean. Seed soaked longer than 8 hours germinated too quickly and so would be vulnerable if there was a delay in sowing.

The Lablab seed used for these experiments was obtained from KARI-Katumani and had good viability; however, heavy rain during planting lead to poor emergence of Lablab at some sites. At the high and low soil fertility cluster sites, Lablab emergence ranged from 65-100%, whereas at the medium and medium high fertility sites emergence was between 85 and 100%. Across all sites, bean emergence was 90-100%.

3. *Data collection and evaluation* - Soil samples were gathered from all the replicated plots across the soil fertility gradient and are currently with KARI-Kakamega awaiting laboratory analysis. Crop establishment data for the short rains bean and Lablab crops has been collected by the KARI staff managing the replicated plots. Pest/disease incidence data are being gathered by the University of Nairobi student. Final plant populations and yield data will be collected starting with the bean harvest in November-early December and in January-February 2009 for the Lablab harvests.

4. *In-season field visits and annual meeting review of results* – Field visits to the replicated experiments and farmer trials during the short rains crop were made in October 2008 by all project collaborators.

The impacts of heavy rains and hail on crop establishment and growth were noted. At the medium and low fertility replicated experiment sites, run-off from heavy rains on sloping land caused erosion and patchy crop stands. Hailstones also damaged the experimental plots at the low and high soil fertility sites.

Root rot and bean fly were observed on beans at all sites. In addition aphids were found at the medium, medium high and high fertility sites. Although not particularly severe at this point, halo blight on Lablab and angular leaf spot on beans were also noted. As halo blight and angular leaf spot are seed borne pathogens, selective harvest techniques will be employed to minimize inoculation of next years seed stocks.

Project collaborators observed that Lablab and beans responded to the P fertilizer treatments at all sites across the gradient. The response was greater with TSP than with MRP, presumably because MRP takes time to react with the soil. Seed priming appeared to improve Lablab vigor and growth at the medium high and high fertility sites, but there was less of an effect at the low and medium fertility sites. Both positive and negative interaction effects on Lablab growth were observed with the seed priming + TSP treatment at the medium high and high fertility sites. As expected the root rot tolerant bean variety, KK8 had consistently better growth than the root rot susceptible variety (GLP2) across all sites. P fertilizer helped GLP2 to resist root rot to some extent, but production will still be much lower than KK8.

The annual project meeting is scheduled for August 2009 after a full short rains-long rains cropping cycle.

5. *Collection and nutrient analysis of grain and edible leaf samples* – At the end of the short rains season in November-December 2008, bean grain samples will be collected from the farmer and replicated experimental plots. Nutritional outputs from the farmer practice, KK8+P fertilizer, GLP2 and KK8 only treatments will be compared. Likewise in January-February 2009, Lablab leaf and grain from the Lablab only and Lablab+TSP or MRP treatments will be gathered for nutrient analysis.

6. *Pursue opportunities for germplasm testing and exchange* – Seed from 35 cowpea cultivars were obtained from Dr. Jeff Ehlers at the Univ. California Riverside (UCR) and handed over to KARI for testing and evaluation in Western Kenya. The collection included a mixture of early and late maturity lines from Cameroon, Senegal, Ghana and Burkina Faso, IITA and ICIPE (International Centre for Insect Physiology and Ecology) in Kenya.

During the short rains season, a Moi University student (partially funded by KARI) established field trials on the KARI-Kakamega station to evaluate biomass and grain production by the UCR cowpea materials. A subset was also planted in pots in the greenhouse to generate more seed for future testing. The top five lines in terms of dry biomass after 30 days were: IT97K-556-6, IT82D-889, IT90K-284-2, ICV7 and CB46. Eight of the lines produced more biomass than the local check (white) and 13 of the UCR materials had more growth than the local black seeded check. While some grain will be harvested in late October 2008 from the field and greenhouse plots, yields will be low because of the unusually heavy rains. There will be insufficient quantity of seed for more extensive evaluation across the soil fertility gradient. The student is planning to generate more seed by growing the UCR materials at another drier KARI station before the next short rains season.

We recently obtained 50 nutrient efficient bean lines from Dr. Juan Carlos Rosas at Zamorano University in Honduras developed in collaboration with Dr. Jonathan Lynch at Pennsylvania State. The materials were transported to Kenya, where they will be tested under the biotic/abiotic stresses of the Western Kenyan highlands and bred with local materials to produce more desirable market characteristics.

Objective 4: To facilitate and support on-farm participatory research opportunities for Kenyan agricultural scientists and graduate students.

Approaches and Methods:

1. *Coursework in selected fields* - One student from each of the three Kenyan Universities will receive support to undertake a 2-year Masters Degree program in the areas of soil science (Egerton Univ.), plant protection (Univ. Nairobi) or agronomy (Moi Univ.). Staff from KARI, the Ministry of Agriculture and NGOs will be actively sought as students, thereby benefiting these institutions directly when the students complete their degrees and return to work. One staff member from KARI-Kakamega has already been nominated to work with Dr. Okalebo at Moi University. Once selected the students will be enrolled and undertake Master's level coursework during the first year of the project.

2. *Develop and implementation of student research projects* - Each student will prepare a student research proposal guided by the discussions during the Project Initiation Workshop and in consultation with their faculty advisor. The proposals will be shared with project collaborators for inputs and comments prior to initiation of the research. The researcher-managed and/or the farmer-managed trials will form the backbone of the students' thesis research. As needed students will establish additional satellite trials. For example, missing element experiments may be set up to assess the role of other limiting nutrients in these soils.

3. *Sharing of results in annual meetings* - Students will present results (as available) from their research projects during the project annual meeting for discussion and suggestions. Results will be incorporated into the project annual report as they become available.

Results, Achievements and Outputs of Research:

1. *Coursework in selected fields* – Three students were selected to participate in the program:

i Francisca Lusweti is a second year student from the University of Nairobi supervised by Drs. Muthomi and Nderitu in the Plant Protection field. She is employed by the Kenyan Ministry of Agriculture as an Extension Officer. Ms. Lusweti completed her coursework in June 2008 and now is working on her research project.

ii Crispus Njeru is a first year student at Moi University, studying soil science under Dr. Okalebo. He is employed by KARI-Kakamega as a Scientific Officer. Mr. Njeru is currently taking classes and also collecting data from the replicated experiments for the project.

iii Belinda Weya was recently recruited by Egerton University to work with Dr. Mwonga in soil science. She also is employed by the Kenyan Ministry of Agriculture as an Extension Officer. Ms. Weya is in her first semester of coursework at Egerton.

2. *Develop and implementation of student research projects* – Ms. Lusweti has prepared a research proposal which is currently being reviewed by her supervisors and project collaborators. She plans to study the impacts of seed priming and phosphorus treatments on the incidence and severity of root rot and bean fly in Lablab and common bean, utilizing the Main Experiment and Satellite Experiment #1 for data collection. Ms. Lusweti will be expected to present her findings at the upcoming project annual meeting.

Mr. Njeru and Ms. Weya will be developing their research proposals within the next few months and will present their plans at the upcoming project annual meeting. Mr. Njeru is expected to focus on the variable soil fertility benefits of Lablab biomass for grain and biomass for forage in the Main Experiment. Ms. Weya is interested in studying seed priming in more detail.

Explanation for Changes

1. *Farmer Participants* - We had initially planned to select farmer participants from both Vihiga and Nandi Districts in western Kenya; however, a reconnaissance of the Vihiga area revealed that these farmers had already acquired root rot tolerant bean varieties, claimed to have few bean disease problems

and were already involved with a number of other development projects. It was felt that little project impact could be achieved by working with the Vihiga area farmers, so participant selection was restricted to the Nandi district.

Networking and Linkages with Stakeholders

1. *USAID Mission Nairobi* - Courtesy visit on June 16, 2008; met with Director of Reginal Economic Growth and Integration, advisors from Agriculture, Business and Environment Office
2. *Site visits/Joint Activities* - June 2008 for Farmer Workshop; July- September 2008 for follow-up meetings with farmer participants; facilitating on-farm verification trial set-up; data collection and technical backstopping; October 2008 for field visits by KARI, Cornell and Kenyan University collaborators
3. *Germplasm Exchange* – Cowpea germplasm was obtained from the University of California Riverside (June 2008); nutrient efficient bean lines from Zamorano University, Honduras (October 2008)

Leveraged Funds

Name of PI receiving leveraged funds: Beth Medvecky
Description of leveraged Project: Building farmer's capacity and marketing skills
Dollar Amount: $52,000
Funding Source: Anonymous

Name of PI receiving leveraged funds: Christopher Barrett
Description of leveraged Project: Global Livestock CRSP
Dollar Amount: $390,000
Funding Source: USAID

Name of PI receiving leveraged funds: Alice Pell
Description of leveraged Project: Biocomplexity Initiative
Dollar Amount: $1,600,000
Funding Source: NSF

Name of PI receiving leveraged funds: Peter Hobbs
Description of leveraged Project: SANREM CRSP
Dollar Amount: $1,120,000
Funding Source: USAID

List of Scholarly Activities and Accomplishments

No information provided

Contribution of Project to Target USAID Performance Indicators

No information provided

Contribution to Gender Equity Goal

Women have been a major target of farm meetings and discussions to elicit interest in the project. A little less than half of the on-farm trials are being implemented by women, and in a few cases a husband-wife team is sharing leadership for the trials.

One female KARI staff member has actively participated on the project so far. As a Post Harvest-Value Addition specialist, she was responsible for preparing the Lablab grain for the farmers to taste during the workshop. Another female KARI staff member has been on maternity leave since the project began.

Two mid-career, professional women were recruited for the Masters degree programs at the University of Nairobi and Egerton University. Both will return to the Kenyan Ministry of Agriculture as Extension Officers when they complete their degrees.

Progress Report on Activities Funded Through Supplemental Funds

Not applicable

Tables/Figures Cited in the Report

Table 1 Vigor enhancing treatment combinations for the short rains season farmer verification trials

Literature Cited

Harris, D. 1996. The effects of manure, genotype, seed priming, depth and date of sowing on the emergence and early growth of Sorgum bicolor (L.) Moench in semi-arid Botswana. Soil Tillage Research 40: 73-88.

Capacity Building Activities: P1-CU-1

Degree Training:

Student #1

First and Other Given Names:	Crispus Mugambi
Last Name:	Njeru
Citizenship:	Kenyan
Gender:	Male
Degree:	M.S.
Discipline:	Soil Science
Host Country Institution to Benefit from Training:	Kenya Agricultural Research Institute Kakamega
Training Location:	Moi University
Supervising CRSP PI:	Okalebo, John
Start Date:	02/08
Project Completion Date:	02/10
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Full (Category 2a)

Student #2

First and Other Given Names:	Belinda Akinyi
Last Name:	Weya
Citizenship:	Kenyan
Gender:	Female
Degree:	M.S.
Discipline:	Soil Science
Host Country Institution to Benefit from Training:	Kenya Ministry of Agriculture Extension – Kisii
Training Location:	Egerton University
Supervising CRSP PI:	Mwonga, Samuel
Start Date:	08/08
Project Completion Date:	08/10
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Full (Category 2a)

Student #3

First and Other Given Names:	Jane Francisca
Last Name:	Lusweti
Citizenship:	Kenyan
Gender:	Female
Degree:	M.S.
Discipline:	Plant Protection
Host Country Institution to Benefit from Training:	Kenyan Ministry of Agriculture Extension
Training Location:	University of Nairobi
Supervising CRSP PI:	Muthomi, James
Start Date:	10/07
Project Completion Date:	10/09
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: **Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya**

	Abbreviated name of institutions											
	Cornell			KARI								
	Target	Achieved		Target	Achieved							
Benchmark Indicators by Objectives	10/1/08	Y	N *	10/1/08	Y	N *						
	(Tick mark the Yes or No column for identified benchmarks by institution)											
Objective 1	Develop and assess farmer capacity for improving vigor and growth of pulse crops ...											
Select farmers from NSF project pool	x	✓		x	✓							
Report on workshop & follow up meetings	x	✓		x	✓							
Farmer trials established				x	✓							
Objective 2	Disseminate and evaluate through participatory approaches simple, low cost strategies for vigorous establishment.											
Identify additional farmer groups												
Exchange visits conducted & technology evaluated												
Survey instrument developed & initiated												
Objective 3	Research factors (nutrients, pest/diseases and their interactions) affecting pulse productivity across a soil degradation gradient											
Research design and plan	x	✓		x	✓							
Research trials established				x	✓							
Seasonal research results reported												
Site visit trip reports	x	✓		x	✓							
Annual meeting report												
Nutrient analysis reports												
Observational trials with germplasm established	x	✓		x	✓							
Objective 4	To facilitate and support on-farm participatory research opportunities for Kenyan agricultural scientists and graduate students											
Students selected & registered				x	✓							
Student research proposals developed												
Student research inititated												
Research reports at annual meeting												
Faculty progress reports				x	✓							
PROJECT OVERALL												
Annual reports to MSU												

Name of the PI reporting on benchmarks by institution	Julie G. Lauren	John O. Ojiem		

Name of the U.S. Lead PI submitting this Report to the MO Julie G. Lauren

Julie G. Lauren — **Signature**

25 Sept. 2008 — **Date**

** Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 -- September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya

Lead U.S. PI and University: Julie G. Lauren, Cornell University
Host Country(s): Kenya

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	1	2	1	
Number of men	2	1	2	
Short-term Training: Number of individuals who have received short-term training				
Number of women	32	30	80	
Number of men	32	34	36	
Technologies and Policies				
Number of technologies and management practices under research	2	1	0	
Number of technologies and management practices under field testing	6	5	8	
Number of technologies and management practices made available for transfer	0	0	3	
Number of policy studies undertaken	0	0	0	
Beneficiaries:				
Number of rural households benefiting directly	64	64	116	
Number of agricultural firms/enterprises benefiting	0	0	0	
Number of producer and/or community-based organizations receiving technical assistance	0	0	4	
Number of women organizations receiving technical assistance	3	0	4	
Number of HC partner organizations/institutions benefiting	4	4	4	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	0	0	10	

Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda

Principle Investigators

Robert Mazur, Iowa State University, USA
Dorothy Nakimbugwe, Makerere, Uganda
Michael Ugen, NCRRI, Uganda
Henry Kizito Musoke, VEDCO, Uganda
Hilda Vasanthakaalam, KIST, Rwanda

Collaboratoring Scientists

Suzanne Hendrich, ISU, USA
Helen Jensen, ISU, USA.
Mark Westgate, ISU, USA
Barnabas Kiiza, Makerere University, Uganda
Gabriel Elepu, Makerere University, Uganda

Abstract of Research Achievements and Impacts

Common beans provide a strategic opportunity to meet Millennium Development Goal targets, but many problems confront producers, marketers and consumers in Africa. Through the Center for Sustainable Rural Livelihoods program in Uganda, food security and market readiness have increased from 9% to 77% in three years among 800 farm households which produce an increasing variety of crops. In this project, the collaborating institutions in Uganda and Rwanda have three strategic aims to enhance nutritional value and marketability of common beans: to improve harvested bean quality and yields, enhance nutritional value and appeal of beans through appropriate handling and processing, and to increase marketing and consumption of beans and bean products. Under the first strategic objective (improving harvested bean quality and yields), PRA guides/tools for understanding knowledge, attitudes, and practices (KAPs) have been developed for key informant interviews and focus group discussions with community-based groups; participatory rural appraisals were conducted; KAPs were documented and analyzed; production and quality constraints have been identified; certified seeds of bean varieties are being established; agricultural research locations were visited by the US team; farmer cooperators have been selected and been mobilized to participate in research and training. For the second strategic objective (enhancing nutritional value and appeal of beans through appropriate handling and processing), accomplishments include assessment of KAPs, prioritization of post-harvest losses, and identification of initial recipes of some of the bean products. Collaborative work for the third strategic objective (to increase marketing and consumption of beans and bean products) actions has involved engaging local stakeholders in identification of producers' marketing constraints; rural consumer demand and preferences for beans have been characterized; qualities of beans corresponding to farmers' preferences determined, and nutrition awareness levels of benefits of bean consumption have been determined. For the fourth strategic objective (collaboration), increasing capacity, and effectiveness and sustainability of the universities have been effected. Accomplishments to date include defining the roles of key partners, formalizing partnerships, initiating training of 3 M.S. students at MAK and 2 Ph.D. students at ISU, and active multi-institutional collaboration in all aspects.

Project Problem Statement and Justification

Agriculture in East Africa is characterized by women and men working in small scale, rainfed production, averaging 2 hectares per household (FAO 2006). Erratic bimodal rainfall patterns in recent years further challenge cropping results (ARB 2007). Farmers have very limited access to extension, training, inputs (quality seeds, fertilizers, etc.), improved agronomic practices, new technologies, and credit (KDA 2004; Nkonya et al. 2004). Producers not well linked with profitable markets, especially to emerging sectors of

domestic and regional markets (Ehui & Pender 2005). Private traders operate on a small scale with limited investment capability. Availability and use of processed products at present remains very modest. As a result of low production levels, hunger is widespread (WFP 2006) and the vast majority of the rural population lives in absolute poverty (KDA 2004).

Our recent efforts to introduce new agronomic practices and technologies demonstrate encouraging progress (Butler & Mazur 2007). Ongoing collaboration since 2004 of Iowa State University (ISU), Makerere University (MAK), and Volunteer Efforts for Development Concerns (VEDCO) in Uganda's Kamuli District (Mazur et al. 2006; VEDCO 2006) using a sustainable livelihoods approach has increased food security and market readiness from 9% to 77% among 800+ farm households in the past 2½ years (Sseguya 2007). The main crops grown in Kamuli district are maize, beans, sweet potatoes, cassava, bananas, rice and coffee (Sseguya & Masinde 2005). Most (90%) of participating households produce beans, but only 20% sell some in 2007. The SL approach livelihood focuses on understanding and supporting individual and community capabilities, assets (natural, physical, human, financial, social, cultural and political capital), goals, strategies and activities. Diversification of livelihood opportunities and activities is crucial to sustainability (Ellis 2000). In combination with SL approaches, scientific knowledge, improved technologies, financial assistance, and changes in government policies can have significant positive local impacts (Helmore & Singh 2001). Participatory research methods can generate knowledge that people can apply to improve their individual and collective well-being (Selener 1997).

Beans provide a *strategic opportunity* to help meet the Millennium Development Goal targets of reducing hunger and poverty. Improved beans production in Uganda and Rwanda offers unique opportunities to address the deteriorating food security situation there and elsewhere in sub-Saharan Africa. The short growth period and two growing seasons offers great opportunities to contribute to rural poverty alleviation - playing an essential role in sustainable livelihoods of small scale farmers and their families, providing food security and income to the most vulnerable group, the women and children. Testing whether yield improving technologies result in beans (Aim 1) with better nutritive value or processing characteristics (Aim 2) is an important under-researched issue in this region. Improved linkages to emerging markets is also essential (Aim 3).

Central problems limiting production of quality beans and higher yields

- Declining soil fertility and inefficient cropping systems unable to utilize available resources effectively and efficiently
- Limited accessibility and affordability of quality seeds, non-seed inputs and other yield improving technologies
- Effects of drought and other weather related factors compromise productivity and quality
- Diseases (root rot, anthracnose, angular leaf spot, common bacterial blight, viruses, rust, ascochyta blight) and insect pests (bean stem maggots, aphids, storage weevils)

Central problems relating to nutritional value and processing of beans

Pre- and post-harvest losses for beans are very high throughout the value chain, mostly due to poor harvest and post-harvest practices and poor on-farm storage facilities. Poor pre- and post-harvest handling also results in the majority of beans on the market characterized by mixed varieties and poor quality with high levels of foreign matter, rotten or shriveled beans, and infestation. The lack of value-added bean products having reduced preparation times makes bean preparation laborious with high fuel requirements; consumers also tire of monotonous flavor. As a result, an increasing number of people are abandoning or reducing their bean consumption despite its documented high nutrient content and health benefits.

The nutrition value of beans is negatively affected by anti-nutrients such as phytates, trypsin inhibitor, lectins, polyphenols, saponins, oligosaccharides and hemaglutinins (Kebede et al., 1995). However, treatments such as de-hulling, soaking, milling, fermentation and germination or malting and cooking enhance the digestibility and nutritional value (Matella 2005; Martín-Cabrejas 2006; Shimelis & Rakshit 2007; Nergiz & Gökgöz 2007; Cevdet & Gökgöz 2007).

Central problems inhibiting increased marketing of beans and derived food products

Prospects of marketing increased quantities of beans and new agro-processed bean products within the Ugandan and regional markets requires carefully examining production and marketing constraints (increased farm productivity, producer incentives, and access to better markets). Equally important is examining prospects for increasing demand for beans and agro-processed products (understanding consumers' tastes and preferences, increased consumer awareness of benefits of consuming beans and other value-added products, increasing consumer choices of value-added products, etc.).

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: To Improve Harvested Bean Quality and Yields.

Approaches and Methods:

*Objective 1a***:** Determine and Prioritize Key Production Constraints of Six Priority Bean Varieties

Approaches and Methods

- Conduct participatory rural appraisals (PRA) to determine current local knowledge, attitudes and practices related to planting, weeding, soil fertility/nutrient management, and mitigation/control strategies for diseases and pests in four varieties of common bean in Kamuli district, Uganda, and two common bean varieties in Nyagatare district, Rwanda
- Prioritize constraints to increased production
- Prioritize constraints to improved quality

Benchmarks

Apr. – Sept. 2008

- Participatory rural appraisal guides/tools developed
- Participatory rural appraisal conducted
- Production constraints prioritized
- Quality constraints prioritized

Oct. 2008 – Mar. 2009

- Knowledge, attitudes and practices documented
- KAPs analyzed and report written

Objective 1b. Improve Quality and Yields of Beans through Evaluation of Better Production Practices

Approaches and Methods

- Evaluate yield and quality of the beans (NABE 6 [white dry bean, small seeded] and K 131 [carioca dry bean] and K 132 and NABE 4 [red mottled beans] in Kamuli and Luweero districts in Uganda, and RWR 1668 and RWR 2245 in Nyagatare district in Rwanda)
- Evaluate practical management strategies to increase and stabilize seed yield and seed quality in participatory field research
- Carry out on farm demonstrations for farmers on better agronomic practices

Benchmarks

Apr. – Sept. 2008

- Availability of certified seeds for red and mottled bean varieties established
- Locations and farmer cooperators selected for research and demonstration
- Site and location visited by US team

Oct. 2008 – Mar. 2009

- Recommended irrigation and fertigation practices for profitable yields defined
- Field sampling and laboratory procedures to quantify bean quality established
- Trials planted, managed and harvested
- Seed samples submitted for analysis
- Yields under standard production practices from first crop season quantified and analyzed
- Crop production and soil management strategies evaluated
- Harvested bean quality for each demonstration site and experimental treatment quantified

Apr. – Sept. 2009

- Yield and quality of beans harvested from second crop season quantified and analyzed
- Impacts on bean quality from improved harvest and storage techniques documented

Objective 1c: Strengthen Farmers' Collective Capabilities to Learn and Share Innovative Practices

Approaches and Methods: Promote adoption of recommended practices to increase yield of quality beans through RDE and farmer training, and facilitating access to superior varieties and priority inputs

Benchmarks

Apr. – Sept. 2008

Selected farmers mobilized to participate in training in better management and evaluation of research process and outputs

Oct. 2008 – Mar. 2009

- Farmer and extension training manuals developed for use by trainers (researchers and extension agents)
- Farmer knowledge on participatory research methodologies/designs enhanced for better trial implementation

Apr. – Sept. 2009

Recommended research results incorporated in RDE training procedures and promotion protocols

Results, Achievements and Outputs of Research:

Objective 1a: Determine and Prioritize Key Production Constraints of Six Priority Bean Varieties

- PRA guides/tools for knowledge, attitudes, and practices (KAPs) developed
  - ✧ Key Informant Interviews
    - ❖ General information (sub-county, parish, village)
    - ❖ Livelihood (education, farm size and land tenure status, top five crops, bean production and marketing, income, crop husbandry activities and challenges, and animals reared)
    - ❖ Bean production (reason for bean growth, varieties, pests and diseases)
    - ❖ Harvesting (bean maturity, drying process, challenges)

- ❖ Storage (how, where, pests, pest control, and other causes of storage loss)
- ❖ Processing (production/consumption rates, different bean processes, challenges,
- ❖ Consumption patterns (production, eating habits, shelf life, and price)
- ❖ Marketing (allocations, location, value addition activities, transportation, income use)

✧ Focus Group Discussion (FGD) with community-based groups involved in growing, utilization and marketing of beans

- ❖ *Group 1*: Bean production (why, which varieties, input methods, values, barriers, opportunities, trends, extension information sources, credit availability/accessibility)
- ❖ *Group 2*: Bean utilization and value-addition (who consumes, how often, preparations, varieties consumed, desired attributes, barriers, opportunities, and products made)
- ❖ *Group 3*: Bean marketing (who makes decisions, who markets, arrangements, prices, community inquiry, variety successes, desirable attributes, barriers and opportunities)

- Participatory rural appraisals conducted, data collected and analyzed

- Local agronomic knowledge, attitudes and practices documented, analyzed and report written

- Production constraints and some solutions identified (listed in order of importance)
  - ✧ Constraints: unreliable or erratic weather conditions, small land holdings, *limited access to seeds, pests and diseases*, lack of capital to allow for commercialization of beans, *declining soil fertility* due to bad eco-management, *poor storage facilities, poor drying facilities* which result in losses in quality and quantity in storage, and *poor post-harvest handling methods*
  - ✧ Solutions: crop rotation, early and randomized planting, use of organic pesticides, providing subsidized inputs

- Quality constraints prioritized
  - ✧ Lack of methods to *monitor humidity for safe and longer storage*
  - ✧ *Poor storage facilities* leave beans vulnerable to pests, diseases, and contamination
  - ✧ Most farmers lack the knowledge and capacity to properly *handle pests and diseases* both in the field and in storage, resulting in heavy losses in quality and quantity

Objective 1b: Improve Quality and Yields of Beans through Evaluation of Better Production Practices

- Certified seeds of bean varieties established

  - ✧ Varieties most commonly grown and with characteristics suitable for the project include K 131, K 132, NABE 4, NABE 6
  - ✧ K 131 is a carioca type bean (*Kazibwe*), very resilient to hash environmental conditions and performs relatively well under extreme environments. This variety is deemed good for food security and can be a potential for flour-based recipe development. However, farmers in most places do not appreciate its color and small

seed size, and they claim it hardens when stored even for a short time period - therefore requiring more time and fuel for cooking.
- ✧ K 132 (*Nambale Omuwanvu*) and NABE 4 (*Nambale*) are red mottled beans popularly grown in most parts of Uganda including Kamuli (10% and 22% of farmers growing K 132 and NABE 4, respectively). They are preferred for their large seed size, desired marker qualities, short cooking time compared to K 131 and shorter maturity period.
- ✧ NABE 6 (*Obudandali Obweru*) is small seeded, white in color, matures early and has good markets in urban areas.
- ✧ In addition to the above 4 varieties selected for on-farm trials in Kamuli, NABE 2 (*Obudandali Obudugavu*) is black, small seeded; and several other land races are also grown by farmers in the area.
- ✧ NaCCRI is planting 20 kg of K 131, 40 kg of K 132, 8 kg of NABE 2, 30 kg of NABE 4, and 15 kg of NABE 6, respectively. The harvest from this season's multiplication efforts will be used for field trials in Kamuli during the first growing season of 2009.

- Livestock were identified as an important component in rural household livelihoods

  - ✧ Cattle (49%), goats (45%), pigs (39%), and chicken (34%)

- Locations and farmer cooperators selected
  - ✧ Uganda, Kamuli District (total of 85 respondents)
    - ❖ Butansi (sub-county): 21 in Naluwoli parish and 29 in Butansi parish
    - ❖ Bugulumbya (sub-county): 16 in Nawanende parish, 17 in Kasambira parish
    - ❖ 1 District Agricultural Officer (DAO) and 1 production officer

  - ✧ Rwanda, Nyagatare District (total of 32 respondents)
    - ❖ In Rwanda, research made use of an interpreter with knowledge of local farming situations, two members from CITT (Center for Innovation and Technology Transfer), and one from ISAR (Institut des Sciences Agronomiques du Rwanda)
    - ❖ one economically flourishing village
    - ❖ one poverty stricken village
- Site and locations visited by US team
  - ✧ ISU team visit in June 2008 included visits to locations in Uganda, various meetings with VEDCO, NaCCRI and MAK
  - ✧ Kamuli district was identified as the appropriate site for full project implementation; for the first phase of research, it was determined to be unnecessary to conduct field research in a second district (Mukono was also visited) as was originally anticipated.

Objective 1c: Strengthen Farmers' Collective Capabilities to Learn and Share Innovative Practices

- Selected farmers mobilized to participate in training in better management and evaluation of research process and outputs
  - ✧ VEDCO and NaCRRI training took place from September 23-28, 2008 and emphasized research methodologies to prepare farmers for the coming season involvement in experimentation.

- Existing farmer and extension training manuals are being reviewed; they will be revised and supplemented for future use by trainers (researchers and extension agents) when working with farmers during the first growing season of 2009 (March – May).

Objective 2: To Enhance Nutritional Value and Appeal of Beans through Appropriate Handling and Processing

Approaches and Methods:

Objective 2a: Establish the Key Causes of Post-Harvest Losses of Beans

Approaches and Methods

- Conduct participatory rural appraisals of current knowledge, attitudes and practices (KAPs) related to pre- and post-harvest handling
- Establish the basis and magnitude of post-harvest losses associated with different stages of post-harvest handling and storage (harvesting times, threshing method, drying, storage and packaging)
- Correlate knowledge, attitudes and practices with post-harvest losses, based on both the primary information obtained during the survey and the results of laboratory analyses

Benchmarks

Apr. – Sept. 2008

- MS and PhD students admitted
- Participatory rural appraisals conducted
- Knowledge, attitudes and practices assessed

Oct. 2008 – Mar. 2009

- Post-harvest losses prioritized
- Post-harvest management innovations promoted via training

Apr. – Sept. 2009

Post-harvest management innovation adoption evaluated

Objective 2b: Evaluate Impacts of Improved Post-Harvest Practices on Post-Harvest Losses in Study Sites

Approaches and Methods

- Promote adoption of recommended pre- and post-harvest handling practices that address the identified major causes to minimize post-harvest yield and quality losses
- Assess the effect of the above practices on post-harvest losses by comparing between two groups of bean farmers: one group using the recommended practices and the other group not

Benchmarks

Oct. 2008 – Mar. 2009

Pre- and post-harvest losses reductions documented and analyzed

Apr. – Sept. 2009

Further loss reductions documented and analyzed

Objective 2c: Develop Protocols for Bean Products with Enhanced Nutritional and Organoleptic Properties

Objective 2c-1: Determine Digestibility and Utilization, Amino Acid Quality and Iron Bio-Availability

Approaches and Methods

- Determine nutritional and physico-chemical properties of bean varieties, and influences of agronomic and post-harvest handling practices on those properties
- Investigate the effect of pre-treatment of beans (malting, pre-soaking, roasting) on nutritional value of products.

Benchmarks

Apr. – Sept. 2008

Initial recipes identified and disseminated

Oct. 2008 – Mar. 2009

- Nutritional and physico-chemical analysis initiated
- Analysis of benefits for nutritionally vulnerable people initiated

Apr. – Sept. 2009

Best processing techniques to enhance protein and carbohydrate digestibility determined

Objective 2c-2: Develop Nutrient-Dense Bean Flour and Value-Added Recipes Utilizing Developed Bean Flour

Approaches and Methods

- Develop a semi-processed bean flour using the response surface methodology using preferred bean varieties from Uganda and/or Rwanda
- Develop recipes for nutritious, value-added products, using the developed bean flour
- Determine the acceptability and shelf-life of the developed products
- Promote the recipes for uptake in communities
- Demonstrate flour preparation for participating farmers to take it up as an enterprise

Benchmarks

Oct. 2008 – Mar. 2009

- Bean flour development initiated
- Protocol for semi-processed bean flour initiated

Apr. – Sept. 2009

- Acceptability data for developed products generated and analyzed
- Processing protocols for adoption by bean processors refined and promoted

Results, Achievements and Outputs of Research:

Objective 2a: Establish the Key Causes of Post-Harvest Losses of Beans

- KAPs assessed
  - ✧ *Poor drying and storage facilities* were identified as factors that leave beans vulnerable to pests, diseases, and contamination, resulting in losses in quality and quantity

Objective 2b: Evaluate Impacts of Improved Post-Harvest Practices on Post-Harvest Losses in Study Sites

This objective will be addressed through project activities during the next year.

Objective 2c: Develop Protocols for Bean Products with Enhanced Nutritional and Organoleptic Properties

2c-1: Determine Digestibility and Utilization, Amino Acid Quality and Iron Bio-Availability

This objective will be addressed through project activities during the next year.

2c-2: Develop Nutrient-Dense Bean Flour and Value-Added Recipes Utilizing Developed Bean Flour

This objective will be addressed through project activities during the next year.

Objective 3: To Identify Solutions for Constraints to Increased Marketing & Consumption

Approaches and Methods:

Objective 3a: Identify Solutions to Production and Marketing Constraints Faced by Producers of Beans

Approaches and Methods

- Conduct baseline surveys of producers to generate information on production and marketing constraints, and terms of trade between farm and non-farm sectors
- Analyze value chain components and linkages to identify strengths and weaknesses
- Identify barriers and challenges farmers face in accessing emerging markets
- Initiate and facilitate farmers' interaction with small, medium and large scale wholesale and retail enterprises to promote distribution and purchase of beans and value-added bean products
- Train farmers and farm groups to more successfully market beans
- Identify ways to improve packaging methods, packaging materials and storage conditions

Benchmarks

Apr. – Sept. 2008

- Local stakeholders and partners identified to address adoption constraints
- Producers' marketing constraints identified

Oct. 2008 – Mar. 2009

- Value chain analysis initiated
- Priorities for education and training activities developed

Apr. – Sept. 2009

Farmers trained and facilitated to improve their marketing of beans

Objective 3b: Characterize Consumer Demand and Preferences for Beans and Agro-Processed Products

Approaches and Methods: Participatory appraisals and baseline surveys of producers and consumers to determine knowledge, attitudes and practices regarding processing and human consumption of beans

Benchmarks

Apr. – Sept. 2008

Qualities of beans corresponding to farmers' preferences determined

Oct. 2008 – Mar. 2009

Consumer demand and preferences for beans characterized

Apr. – Sept. 2009

Consumer demand and preferences for bean products characterized

Objective 3c: Increase Consumer Awareness of Benefits of Consuming Beans and Value-Added Products and their Access to New Products

Approaches and Methods

- Train community members on the benefits of consuming beans
- Demonstrate value addition in beans and preparation of bean recipes to community members

Benchmarks

Apr. – Sept. 2008

Nutrition awareness levels of benefits of bean consumption determined

Oct. 2008 – Mar. 2009

- Product improvement strategies identified
- Strategies and practices identified to promote consumer awareness and purchase

Apr. – Sept. 2009

- Farmers trained on benefits of bean consumption
- Community members trained on value addition and preparation of various bean recipes
- Follow-up on community trainings conducted

Results, Achievements and Outputs of Research:

Objective 3a: Identify Solutions to Production and Marketing Constraints Faced by Producers of Beans

- Local stakeholders and partners identified to address adoption constraints
  - ✧ Includes: input suppliers (sell seeds and other farming inputs to farmers including pesticides and fertilizers), producers (involved in the whole process of bean production from acquisition f the inputs to management of the crop to harvest, storage and sale of the outputs), wholesalers (very important and control the price setting mechanism in the trade [fix prices], collect produce from producers, transfer produce from one location to another, distribute grains to retailers), retailers (final point where grains reach and are accessible by the consumers), consumers (consumption of final product), and NGO's (VEDCO and extension agents (adversary services)

- Producers' marketing constraints identified (listed in order of importance)
  - ✧ Includes: subsistence nature of bean production that hinders commercialization, low prices from traders, lack of available credit, lack of market information, poor regulatory policies in bean marketing sector, poor market structures, and lack of diversified bean products

- ✧ Opportunities for value addition of beans: source of information on value addition (VEDCO), availability of near market (schools, hospitals and shops), availability of electric power in our area, collective value addition (formed groups), and chances of establishing links between farmers and market (VEDCO)

- Opportunities for increased bean production
  - ✧ Long experience in bean production and VEDCO trainings expected, provides the local community with a reliable resource base for the development of this industry, availability of seed and existence of two growing seasons a year and considerable favorable climatic conditions conductive for bean production, and existing local huge consumption market in institutions, world food programme and other relief agencies

Objective 3b: Characterize Consumer Demand and Preferences for Beans and Agro-Processed Products

- Rural consumer demand and preferences for beans characterized (in order of importance)
  - ✧ Good taste/flavor, early maturity period, easy to cook, high yield, market availability, and tolerance to drought and heavy rains

- Initial recipes identified
  - ✧ 'Recipes' used by farm household in Kamuli district were identified by the PRA's
  - ✧ Recipes have only been developed by NaCRRI thus far from their past participation in the development of simple bean-based recipes and collaborations with other countries and institutes

- Qualities of beans corresponding to farmers' preferences determined (in order of importance)
  - ✧ Marketability, resistance to weather conditions, high yields, taste, storage and ability to retain quality, and growth habit (bush type is preferred because of extra labor required for staking the climbing types)

Objective 3c: Increase Consumer Awareness of Benefits of Consuming Beans and Value-Added Products and their Access to New Products

This objective will be addressed through project activities during the next year.

Explanation for Changes

Not applicable

Networking and Linkages with Stakeholders

To realize project objectives and actively promote institutionalization of positive impacts of research project finds and impacts, we will effectively engage diverse key stakeholders throughout the project and in annual workshops:

- Work with farmers, groups and associations to understand local livelihoods, agronomic practices, their previous and current linkages with various types of institutions and service providers (governmental and non-governmental), private sector traders, and transporters
- Interact regularly with various types of institutions and service providers (governmental and non-governmental), private sector traders, transporters, small, medium and large scale processors and distributors etc., to gain and maintain appropriately broad perspectives on key

issues in the value chain, benefit from their special expertise, and build consensus and collaborative relationships for high levels of continued success
- Hold periodic planning and review meetings to involve all partners so that challenges and constraints are discussed and strategies to deal with them developed together
- Facilitate broad involvement in research design, data collection instruments and processes, and data analysis
- Share results from various stages of the project to encourage constructive criticism and strengthen usefulness, impact and sustainability of intervention results
- Involve other developmental partners with similar interests for complementarily and dissemination of results to other areas and countries
- Project results will be shared with the research and developments communities in Uganda, Rwanda and the region through workshops and various types of publications

Leveraged Funds

Name of PI receiving leveraged funds: Mark Westgate

Description of leveraged Project: Partial support for Ph.D. student from Uganda in Agronomy

Dollar Amount: $46,089

Funding Source: ISU

Name of PI receiving leveraged funds: Robert Mazur

Description of leveraged Project: Partial support for Ph.D. student from Uganda in Food Science & Human Nutrition

Dollar Amount: $46,089

Funding Source: ISU

List of Scholarly Activities and Accomplishments

Not applicable

Contribution of Project to Target USAID Performance Indicators

No information provided

Contribution to Gender Equity Goal

- 62 of 87 participating farmers in the field experiments are women.
- Among the team of research scientists and professional practitioners, there are 7 women and 5 men.
- Among students receiving training and engaging in research, there are 2 women and 4 men.

Progress Report on Activities Funded Through Supplemental Funds

Funds are in the process of being transferred to Makerere University and the Kigali Institue of Science and Technology.

Tables/Figures Cited in the Report

Not applicable

Literature Cited

Not applicable

Capacity Building Activities: P1-ISU-1

Degree Training:

Student #1

First and Other Given Names:	Cyrille
Last Name:	Syanobe
Citizenship:	Rwanda
Gender:	Male
Degree:	M.S.
Discipline:	Food Science & Technology
Host Country Institution to Benefit from Training:	
Training Location:	Makerere University
Supervising CRSP PI:	Mazur, Robert
Start Date:	08/08
Project Completion Date:	08/10
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Student #2

First and Other Given Names:	Gerald
Last Name:	Sebuwufu
Citizenship:	Uganda
Gender:	Male
Degree:	Ph.D.
Discipline:	Agronomy
Host Country Institution to Benefit from Training:	National Crop Resources Research Institute
Training Location:	Iowa State University
Supervising CRSP PI:	Westgate, Mark
Start Date:	08/08
Project Completion Date:	05/12
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Student #3

First and Other Given Names:	Geoffrey Arijole
Last Name:	Nyakuni
Citizenship:	Uganda
Gender:	Male
Degree:	Ph.D.
Discipline:	Food Science & Human Nutrition
Host Country Institution to Benefit from Training:	Makerere University, Uganda
Training Location:	Iowa State University
Supervising CRSP PI:	Hendrich, Suzanne
Start Date:	08/08
Project Completion Date:	05/12
Training Status:	Discontinued
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Student #4

First and Other Given Names:	Aisha Nakitto
Last Name:	Musaazi
Citizenship:	Uganda
Gender:	Female
Degree:	M.S.
Discipline:	Food Science & Technology
Host Country Institution to Benefit from Training:	Makerere University
Training Location:	Makerere University
Supervising CRSP PI:	Nakimbugwe, Dorothy
Start Date:	08/08
Project Completion Date:	06/09
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Student #5

First and Other Given Names:	Simon
Last Name:	Okiror
Citizenship:	Uganda
Gender:	Male
Degree:	M.S.
Discipline:	Agricultural Economics/Agribusiness
Host Country Institution to Benefit from Training:	Makerere University
Training Location:	Makerere University
Supervising CRSP PI:	Kiiza, Barnabas
Start Date:	08/08
Project Completion Date:	06/09
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 - September 30, 2009)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: **Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda**

	Abbreviated name of institutions in columns below														
	Iowa State Univ.			Makerere Univ.			NaCRRI			VEDCO			KIST		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *
	(Tick mark the Yes or No column for identified benchmarks by institution)														
Objective 1	***Improve Bean Quality and Yields***														
PRA tools for KAP study developed	x			x			x			x			x	Yes	–
PRA conducted and data collected				x			x			x			x	Yes	–
Local agronomic KAPs documented															
KAPs analysed and reported															
Production constraints prioritized				x			x			x			x	Yes	–
Quality constraints prioritized				x			x			x			x	Yes	–
Certified seeds of bean varieties establ.							x			x			x	Yes	–
Locations & farmer cooperators selected	x			x			x			x			x	Yes	–
Site and location visited by US team	x			x			x			x					
Irrigation/fertigation practices defined															
Field sampling tech. & lab proced. establ.															
Trials planted, managed and harvested															
Seed samples submitted for analysis															
Yields quantified and analyzed															
Crop & soil mgmt. strategies evaluated															
Harvested bean quality quantified															
Harvest & storage tech. impacts docum.															
Farmers mobilized for training							x			x					
Extension training manuals developed															
Farmers trained in research methods															
Research results incoporated in training															
Objective 2	***Enhance the Nutritional Value and Appeal of Beans***														
PRA conducted & KAPs assessed				x			x			x			x	Yes	–
Post-harvest losses prioritized															
Post-harvest mgmt. innovations promoted															
Innovation adoption documented															
Loss reductions documented & analyzed															
Recipes identified and disseminated	x			x			x			x			x		
Nutrit./physico-chem. analysis started															
Analyzing benefits for vulnerables initiated															
Best processing techniques determined															
Bean flour development initiated															
Bean flour product protocols dev. initiated															
Product accept. data generated/analyzed															
Processing protocols refined & promoted															
Objective 3	***Increase Marketing and Consumption of Beans and Bean Products***														
Local stakeholders & partners identified				x			x			x			x	Yes	–
Producers' mktg. constraints identified	x			x			x			x			x	Yes	–
Value chain analysis initiated															
Education & training priorities developed															
Farmers trained, facilitated for marketing															
Qualities of preferred beans determined	x			x			x			x			x	Yes	–
Consumer pref./demand characterized															
Nutrition awareness levels determined				x						x			x	Yes	–
Product improvement strategies identified															
Community training on bean consumption															
Follow-up on community trainings															
Objective 4	***Increase Capacity, Effectiveness & Sustainability of Ag. Research Institut.***														
Partnerships developed/formalized	x			x			x			x			x	Yes	–
Training 3 MS @ MU initiated, ongoing				x									x	Yes	–
Training 2 PhD @ ISU initiated, ongoing	x														
Research collaborat. (Univ.,NARO,NGO)	x			x			x			x			x	Yes	–
Research/dev. partnerships consolidated															
Inter-organizational learning fostered															
Prelim. results dissem. (conf., websites)															

Name of the PI reporting on benchmarks by institution	Robert Mazur	Dorothy Nakimbuwe	Michael Ugen	Henry Musoke	Hilda Vasanthakaalam

Name of the U.S. Lead PI submitting this Report to the MO Robert Mazur

Hilda Vasanthakaalam — **Signature**

30th Sept 2008 — **Date**

* *Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 -- September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: **Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda**

Lead U.S. PI and University: Robert E. Mazur, Iowa State University

Host Country(s): **Uganda, Rwanda**

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who **are receiving (or have received)** degree training				
Number of women	1	2	1	
Number of men	4	3	4	
Short-term Training: Number of individuals who **are receiving (or have received)** short-term training				
Number of women	0	0	0	
Number of men	0	0	0	
Technologies and Policies				
Number of technologies and management practices under research	4	4	5	
Number of technologies and management practices under field testing	4	0	5	
Number of technologies and management practices made available for transfer	2	0	3	
Number of policy studies undertaken	0	0	0	
72				
Number of rural households benefiting directly	60	72	120	
Number of agricultural firms/enterprises benefiting	0	0	2	
Number of producer and/or community-based organizations receiving technical assistance	4	12	16	
Number of women organizations receiving technical assistance	4	10	16	
Number of HC partner organizations/institutions benefiting	4	4	4	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	4	0	30	

Combining Conventional, Molecular and Farmer Participatory Breeding Approaches to Improve Andean Beans for Resistance to Biotic and Abiotic stresses

Principle Investigators

James D. Kelly, Michigan State University, USA
Augostine Musoni, ISAR, Rwanda
Eduardo Peralta, INIAP, Ecuador

Collaboratoring Scientists

George Abawi, Cornell University, USA
Sieglinde Snapp, MSU, USA

Abstract of Research Achievement and Impacts

In Michigan, three new bean varieties were released in black, pinto and Otebo commercial classes; high-yielding black, navy, pinto and kidney lines with resistance to common bacterial blight were identified; and two markers linked to major disease resistance genes for rust were identified on separate linkage groups on the bean map. In NY, root rot screening of new US germplasm nursery was conducted in the field; and germplasm from Ecuador was screened in the greenhouse against isolates of Rhizoctonia. In Ecuador three new lines are in the pre-release stage and are under seed multiplication prior to final release to CIALs. These include large red mottled line INIAP 430 Portilla, AND 1005 for green shell and medium-sized Canario seed type INIAP 480 Rocha. The program in Ecuador continues to actively use marker-assisted selection in breeding for disease resistance and all new lines under consideration for release have been preselected and seed increased through the local CIALs in the different production areas. In Rwanda six large seeded red and red-mottled lines are in the pre-release stage. These include the bush beans: RWR 2245, RWR 1145, Nyirabukara and the mid-maturity climbing bean lines MAC 49, MAC 9, and MAC 44. The program also received ten nurseries from Michigan, Puerto Rico and Ecuador that are being evaluated under local conditions and will serve as parental donors of useful traits in future breeding efforts. On farm evaluation of advanced lines continues to be a critical component of that breeding program. Two female students one from Rwanda and one from the U.S. initiated their doctoral studies at MSU.

Project Problem Statement and Justification

Common bean (*Phaseolus vulgaris* L.) is the most important grain legume (pulse) consumed in Ecuador, and the most important protein source in Rwandan diets. Around 120,000 hectares of beans are cultivated annually in Ecuador, and common bean is the most widely grown pulse in Rwanda on 300,000 hectares. Both bush and climbing beans constitute an important economic income for farmers, and staple food for thousands of Ecuadorian families, and the vast majority of small scale farmers in Rwanda. Improvement of bean genotypes for Ecuador environments has a potentially significant spinoff in terms of the high potential for adaptation to Rwanda upland farming systems, which is one of the most bean-dominated production areas in the world. Smallholder farmers, many of them widows supporting families, are keenly interested in rebuilding their bean genetic stocks and expanding into new market opportunities as stability has returned to their country. Building on international bean germplasm, but particularly on the Ecuador experience and germplasm, a tremendous opportunity is present to develop and deploy improved bean varieties in Rwanda, using the latest molecular and client-oriented plant improvement techniques. An improved understanding of plant traits and genotypes with resistance to multiple stresses from abiotic (e.g. drought) and biotic (root rot and foliar pathogens) sources will provide unique materials for small-scale farmers, while providing insights into plant tolerance mechanisms for enhanced plant breeding methods. Results of this project would contribute to improved yield, farm profitability and human resources in the host countries and indirect benefit to participating U.S. Institutions and bean producers.

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: Develop through traditional breeding and marker-assisted selection (MAS) a range of large-seeded Andean bean germplasm with differing combinations of resistance to major foliar diseases in contrasting bean growth habits for distribution and testing in the highlands of Ecuador, Rwanda and the Midwestern U.S.

Approaches and Methods:

1. Review breeding research activities, past and present in Ecuador
2. Review breeding research activities, past and present in Rwanda during in March-June growing season
3. Assemble a nursery of 20 bush types that includes collection of advanced lines in March four seed types from Ecuador and include 3 recently released climbing types
4. Increase seed in Ecuador for shipping to Rwanda prior to main planting season in September planting main cropping season. Include Andean types from the U.S.
5. Select parental breeding materials for crossing in Ecuador, Rwanda and U.S.
6. Identify select group of lines from Rwandan breeding for crossing with new introduced lines from Ecuador
7. Cross Rwandan sources of resistance for Fusarium wilt and Pythium and major foliar pathogens into large seeded lines with contrasting colors
8. Utilize markers in early-generation selection for major disease resistant traits in Ecuador
9. Initiate marker-assisted selection in Rwanda
10. Yield evaluation of advanced lines in range of seed types in Ecuador, Rwanda and U.S. Exchange of most promising materials among the three breeding programs
11. Initiate seed increase of most promising lines
12. On farm trials with advanced lines in Rwanda and Ecuador
13. Release of three bean varieties in three commercial classes for production in Michigan

Results, Achievements and Outputs of Research:

- Drs. Abawi and Kelly travelled to Rwanda in May 2008 to meet with HC PI Augustine Musoni, collaborators and administrators involved in the CRSP project, reviewed previous and on-going bean research in Rwanda, visited the major experiment stations around the country to observe research facilities and to assess needs, and discussed the initial project plans for 2008 with collaborators and administrators of the project. To assess the status of breeding program, a request was made for an inventory of the bean varieties released by ISAR bean program over the last 20 years. A listing of 37 released varieties in Rwanda and their characteristics is shown in Table 3. A nursery of the most popular old and new varieties was planted in Nyagatare to renew seed viability. In addition potential sources of resistance to major diseases were also identified and some of these sources and selected differential cultivars were planted to make crosses with selected commercial varieties during September/December season. The harvested F_1 generation seed will be planted during subsequent seasons to make 3-, 4-way and backcross crosses to improve the local commercial lines that are susceptible to anthracnose, ALS, rust and BCMV.
- In collaboration with CRSP program in Puerto Rico a nursery was assembled from elite resistant and released lines from Ecuador, UPR, MSU and EAP and sent to the two new programs in Angola and Rwanda. The program in Ecuador provided seed of six new varieties from their program along with a F2 population that will be used to map QTL for drought tolerance. Ten nurseries of Andean or Mesoamerican origin that consisted of six different bean market classes: red mottled, red, small and large whites, pintos and sugars types; and differentials for anthracnose, angular leaf spot and rust were sent to Rwanda (Table 1). The materials were planted in 2 replications at Nyagatare research station as observation nurseries and for the

purpose of seed increase before testing widely in other locations. Local checks were planted at intervals among the introduced entries for comparison purposes.

- Forty-six growers participated in the field day in San Clemente for the pre-release of three new bean varieties in Ecuador. Sucro 23 was released as a new red-mottled variety INIAP 430 Portilla. Farmers like Portilla for its larger plant size and height, its vigor due to improved root architecture, long pods and high pod number, and excellent seed quality at harvest. Promotional material regarding the variety was distributed. In addition CIAT line AND 1005 that was evaluated and selected during the 1990's was released as INIAP-429 "Paragachi Andino" principally for green shell market. AND 1005 has a round red-mottled seed like Paragachi but with additional anthracnose resistance. In addition, Sucro 26 was released as INIAP 480 Rocha for canario seed color and rust resistance. Roche is 15-days earlier than Canario Chota and has a high number of pods per plant (smaller plant). It exhibits high emergence rate equivalent to blacks and reds, whereas other yellow seeded types have lower emergence rates under less favorable conditions. The seed color of Rocha is little darker than Canario Chota and is preferred color in local markets. The intent is to release all three varieties officially in 2009 when adequate seed quantities have been produced and when farmers have had greater opportunity to see them in the field with different CIALs. The new varieties Paragachi Andino, Portilla and Rocha will be officially released in April 2009 to coincide with the celebration of the 50th anniversary of the founding of INIAP.
- Six large seeded red and red-mottled lines were planted for final characterization, demonstration and seed increase prior to their release next year in Rwanda. These include the bush beans: RWR 2245, RWR 1145, Nyirabukara and the climbing bean lines: MAC 49, MAC 9, and MAC 44. The lines are being considered for release for higher yield potential of up to 2t/ha for the bush and 3.5 t/ha for the climbers. The climbers also exhibit early maturity and tolerance to drought. In Rwanda, crossing is planned with new sources of resistance to major diseases and local cultivars listed on Table 3. New materials will be included in the crossing block following Nov-Feb season when lines received from Puerto Rico, Ecuador and Michigan (Table 1) have been grown and evaluated for adaptation.
- Three bean varieties released by MSU in 2008 included: high-yielding upright black bean Zorro; white mold resistant upright pinto suitable for direct harvest Santa Fe; and Otebo white bean, Fuji with resistance to BCMV.High levels of resistance to common bacterial blight (CBB) were identified in field trials in advanced navy, black, red, pink, pinto, red and white kidney lines, many of which are potential release candidates. The material represents first advanced high-yielding lines with resistance to CBB in our breeding nurseries. In addition we identified high levels of anthracnose resistance conditioned by the Co-4(2) gene in many materials. All resistances will be confirmed by screening with markers linked to resistance genes during the winter season.
- Identified marker linked to the Ur-11 gene for rust resistance. The marker is not tightly linked to the gene (12cM) but since the resistance source is highly valued by many breeding programs the marker should have wide application. Markers previously identified for the Ur-11 gene were either repulsion phase or had inconsistent expression in different genetic backgrounds. The application of the new marker still needs to be tested in a broader array of genetic backgrounds but the expectations are good given the size and quality of the band. The marker was originally linked to the Co-2 gene for anthracnose resistance and has now been shown to be loosely linked with the Ur-11 gene as it most likely identifies a resistance gene cluster on linkage group B11.
- QTL for yield that accounted for 19% of the variation was identified in an advanced black bean population. The QTL on linkage group B10 will provide opportunity to further improve yield potential in this bean class as parental material is in elite germplasm and could be transferred to other elite lines in a single cross. This is the first report of the localization of a QTL with large effect for yield in beans.

- A new strain of rust was identified in Michigan in 2007 that overcomes the Ur-3 gene which is widely deployed in most MSU bean varieties. The strain reappeared in 2008 but it was not widespread. We have identified resistance to the new strain in advanced black bean lines and have mapped and tagged the resistance to linkage group B4. The new TRAP marker is tightly linked to resistance gene (3cM) and the gene may have originated in the small red bean variety, Dorado. This is the first report of a TRAP marker linked to resistance in beans. The marker should provide an opportunity to quickly introgress the new resistance into breeding populations in anticipation that the strain will continue to reappear and possibly expand. This is the first report of the breakdown of Ur-3 resistance in North America and could be of concern to breeders in other production areas.

Objective 2: Develop inbred backcross lines in a range of commercial seed types for testing under drought and root rot pressure in Ecuador, Rwanda and the U.S.

Approaches and Methods:

1. Four inbred backcross line (IBL) populations will be evaluated in growers field under conditions of drought in Ecuador
2. Identify specific populations for in depth study in Rwanda
3. Advance other IBL populations with specific drought and root rot resistance traits are being developed
4. Evaluate 120 drought tolerant lines in a range of seed types from CIAT in Ecuador; a sub-set of the best lines will be tested in Rwanda
5. Complete characterization of 80 new local traditional lines collected from growers in Ecuador to determine level of drought tolerance
6. Trials will be conducted for root rot resistance sources in Ecuador each season
7. In Rwanda two screening locations have been identified for drought based on lower rainfall levels – no irrigation available; identify field site for root rot evaluation
8. Characterize germplasm for individual root pathogens at Cornell

Results, Achievements and Outputs of Research:

- A large germplasm evaluation trial was conducted in the experimental root rot field at the NYS Agricultural Experiment Station in Geneva, New York. A total of 38 bean germplasm were included in this trial including 15 and 18 dry bean germplasm from the MSU and NY breeding programs, respectively. Root rot severity ratings determined at full bloom ranged from 4.0 to 6.7 on a scale of 1 (no disease symptoms observed, health roots) to 9 (most sever symptoms with root at later stages of decay). For example, the MSU lines B05055, B04554 (Zorro), N05311, and K06012 (DRK) scored 4.9, 5.0, 5.3, and 6.7, respectively. Also, B05055 was the most tolerant to CBB that occurred naturally in the plot area.
- A total of 29 dry bean lines including materials form the Ecuador breeding program were evaluated under greenhouse conditions for resistance to Rhizoctonia solani in soil artificially infested with an isolate of this pathogen. Untreated seeds were used in this test. Although there were differences in the initial emergence count among the lines tested, all become heavily infected and eventually died probably due to the heavy infestation level and most favorable disease development conditions provided. This test will be modified and repeated soon.
- A study on the genetic diversity of Rhizoctonia solani and Rhizoctonia-like fungi attacking vegetables in New York, including beans was completed recently as the M.Sc. thesis by Mana Ohkura. One of the interesting results obtained was that a number of the isolates of this pathogen recovered from vegetables has developed the ability to infect and survive on grain crops, especially corn. A recently completed experiment in the greenhouse showed that isolates of R. solani and Rhizoctonia-like fungi that are the most virulent on grain crops are also highly virulent

to beans. The latter has significant implication on the managing of diseases caused by Rhizoctonia through crop rotations and cover crop use.

- A group of 123 lines from CIAT with tolerance to drought were evaluated under stress at Tumbaco, Ecuador. 13 lines exhibiting drought tolerance were selected and 12 showed rust resistance. One line SAB 680 was particularly vigorous and well podded under the stress conditions. The selected lines will be tested further before integrating them into the program. In addition, 92 germplasm collections made in the latter part of 2007 in bean production areas in the valleys del Chota y Mira, Pallatanga y el Corazón, were planted for evaluation and seed increase. 13 accessions were selected as possible donors of genes for resistance to root rot and drought stress. In September 2008, an additional 27 new accessions were collected in the provinces of Cañar, Azuay, and Loja and will be tested.
- Four F_5 generation IBL populations between commercial varieties Fanesquero, Canario del Chota and Concepción and sources of drought tolerance (L88-63, RAB-651) were evaluated for tolerance under water stress at Tumbaco and 17 lines were selected of which 13 will be evaluated further next season. Other sources of drought tolerance (SEA3, SEA11, PJ1, L88-63, CO3131, NSL, A55, SEQ1016) are being used in breeding with commercial parents (Concepción, Blanco Belén, Canario Chota, Portillo, Yunguilla).

Objective 3: Collect and characterize pathogenic and genetic variability of isolates of root and foliar pathogens in Ecuador and Rwanda.

Approaches and Methods:

1. In Rwanda conduct surveys to diagnose major root diseases and collect isolates of root pathogens for characterization. Initial survey will be conducted in Northern highland production region
2. In Ecuador complete characterization of root rot isolates collected previously in both Northern and Southern production regions at Cornell and Ecuador
3. Access potential for germplasm/isolate interaction in greenhouse at Cornell
4. Collect isolates of anthracnose, angular leaf spot (ALS) in Rwanda for race typing
5. Continue race typing of rust and anthracnose isolates, and initiate characterization of ALS in Ecuador

Results, Achievements and Outputs of Research:

- In Rwanda, crossing is planned with new sources of resistance to major diseases and local cultivars listed on Table 3. New materials will be included in the crossing block following Nov-Feb season when lines received from Puerto Rico, Ecuador and Michigan (Table 1) have been grown and evaluated for adaptation.
- A preliminary disease survey was done during May, when the collaborating host institution scientists from the U.S. visited several ISAR stations and on farm activities in the north, south and east of Rwanda. Angular leaf spot, root rots (*Rhizoctonia, Pythium and Fusarium spp*) bean rust, BCMV were among the most noticed prevalent diseases. A larger and more detailed nationwide survey and collection is planned for November through January, 2009. Characterization of the races of the different pathogens will follow the surveys and collection of the isolates.
- The program in Ecuador continues to combine marker assisted selection and routine greenhouse screening in breeding for resistance. Under greenhouse conditions 236 F2 plants were inoculated for resistance to anthracnose and angular leaf spot (ALS) and 142 were resistant to both diseases. Plants from the cross of AND277 were also selected using linked marker, SH13 and results coincided with the greenhouse inoculation (resistant individuals had the marker). 13 populations generated for resistance to ALS were evaluated for the SH13 marker linked to the Phg-1 gene. The line AND 277 used as the resistance source and carries the gene and was crossed with the varieties INIAP-424 “Concepción”, INIAP-420 “Canario del Chota” and the breeding line G 916; 146 individuals were evaluated and 24 lines had the

marker linked to the resistance gene. The marker was present in four populations indicating the presence of the Phg-1 gene that conferring resistance to ALS. In addition 344 F2 individuals from four populations with white and yellow seed types were inoculated for anthracnose and 112 were found resistant.

Objective 4: Employ participatory plant breeding to assist the breeding process in Ecuador and Rwanda to enhance productivity and marketability of beans under development.

Approaches and Methods:

1. Design and validate sustainable farming practices including integrated nutrient and pest management systems for small farmers in Rwanda
2. Compare and contrast advanced line selection practiced by breeders and farmers in different agroecological regions in Rwanda
3. Evaluation of 10 tests in 10 CIALs each growing cycle in Ecuador
4. Facilitate non conventional seed production in Ecuador
5. Release of two bean varieties using farmer participation in Ecuador
6. Organize visit of Rwandan scientists to Ecuador to participate to interchange experience between investigators, breeding population management, germplasm banks, screening, and crossing at different INIAP research stations; interchange of experience on participatory methods and seed production for local community use with small farmer members in CIALs in Choto and Mira, Ecuador- anticipated date November 2009.

Results, Achievements and Outputs of Research:

- Seven advanced lines including 2 check varieties were planted at Karama, Nyagatare, Rwanda. These materials were replicated in six sites on farm in collaboration with an NGO, ADRA and among the watershed partner farmers. These included advanced drought tolerant lines and different sources and of early maturity climbers being tested for adaptation in multi-location trials.
- Ten tests were evaluated with advanced lines in 7 CIALs from the Choto Valley (Imbabura y Carchi). The farmers consistently selected Concepcion and Portilla, type I large Calima type seed, and lines TP6 and AND1005, type II. The farmers selected principally on basis of plant vigor, freedom from disease, good yield and pod and seed quality. In CIAL Intaga one test was evaluated at four locations and conditions favored the presence of web blight and the lines PJ-1 and ARME 2 showed intermediate resistance to the pathogen. In addition seed increase lots of the following lines were established with CIALs in the Chota valley: TP6 (type II, red-mottled), ARME2BC2 S143 (type II, red-mottled), ARME II (type II, red mottled) and two small black-seeded types, G21212, ICA PIJAO.

Explanation for Changes

None

Networking and Linkages with Stakeholders

In May 2008, Kelly visited the Agricultural Officer, Ryan Washburn and Fina Kayisanabo, Agribusiness Specialist in the USAID Mission in Kigali to discuss the role and work of the PULSE CRSP in Rwanda and introduce HC partners Mr. Musoni and Ms. Mukeshimana. The mission is housed in the new US Embassy recently dedicated by President Bush during his trip to Rwanda in 02/2008. Mr. Washburn was quite emphatic that there would be no support for training of Rwandan nationals from the mission if the project is not extended beyond the initial 30-month startup period. The Mission in Quito is aware of CRSP activities in Ecuador and publications of project on variety releases and bean production practices prepared by INIAP were provided to the Mission Director during visit made by PI in 2006.

Government Extension, Farmers cooperatives and seed production agencies,NGO in Rwanda; World Vision, CARE, ADRA, CARITIUS, Catholic Relief Services. NGO in Ecuador; PRODECI, PRODER, CRUZ ROJA, Agricultural Organizations; COPCAVIC, 10 CIALs, Grupo de Evaluadores de Frijol de Bolivar, Assoc. de Productores de Frejol de INTAG. Government Organizations; MAGAP, INIAP, Univ. Tecnia del Norte, and Univ. Catolica de Ibarra.

Funding through AGRA from Bill and Melinda Gates/Rockefeller Foundations is being pursued by HC PI in Rwanda. In Ecuador, the national government approved the project entitled: "Investigation and development of edible grain legumes (bush and climbing bean, peas, broad beans and lentils) to aid in the food security and safety in Ecuador". The project will strengthen research being conducted by INIAP for a four year period to increase and improve the activities in edible grain legumes as part of the strategy of food security and safety. The project started July 3, 2008.

Leveraged Funds

Name of PI receiving leveraged funds: Eduardo Peralta

Description of leveraged Project**:** Food Security in Ecuador

Dollar Amount: Undisclosed

Funding Source: Ecuador

List of Scholarly Activities and Accomplishments

Project PI, Kelly was recognized as 2008 Fellow of Crop Science Society of America;

Plant Variety Protection Certificate No. 200700410, was issued for 'Sedona' pink bean variety on 4/7/2008;

Plant Variety Protection Certificate No. 200700411 was issued for 'Capri' cranberry bean variety on 4/7/2008.

Contribution of Project to Target USAID Performance Indicators

No information provided

Contribution to Gender Equity Goal

Two women students currently in doctoral training at MSU

Progress Report on Activities Funded through Supplemental Funds

Louis Butare from Rwanda will visit program in Ecuador to review breeding methods, germplasm, program managment and participartory breeding projectsunder with farmers and CIALs in November. He will be accompanied by PI Kelly.

Tables/Figures Cited in Report

No information provided

Literature Cited

Published papers:
Awale, H. E. Falconi, J. C. Villatoro and J.D. Kelly. 2008. Control y caracterizacion de aislamientos de *Colletotrichum lindemuthianum* de Ecuador y Guatemala. Revista Agronomía Mesoamericana 19: 1-6.

Ernest, E.G., E. Falconí, E. Peralta and J. D. Kelly. 2008. Uso de una encuesta a agricultores para orientar el fitomejoramiento de frijol en Ecuador. Revista Agronomía Mesoamericana 19: 7-18.

LOS COMITÉS DE INVESTIGACIÓN AGRÍCOLA LOCAL (CIALs) EN LOS VALLES DE LOS RÍOS CHOTA Y MIRA (Imbabura y Carchi), Ecuador: Avances y Retos. Boletín Divulgativo. (Agosto 2008). Mejore su nutrición, salud y alimentación…Consuma Fréjol. Hoja Divulgativa.

Capacity Building Activities: P1-MSU-1

Degree Training:

Student #1

First and Other Given Names:	Gerardine
Last Name:	Mukeshimana
Citizenship:	Rwandan
Gender:	Female
Degree:	Ph.D.
Discipline:	Plant Breeding and Genetics
Host Country Institution to Benefit from Training:	ISAR and National University of Rwanda
Training Location:	Michigan State University
Supervising CRSP PI:	Kelly, James
Start Date:	08/08
Project Completion Date:	08/11
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Student #2

First and Other Given Names:	Krista
Last Name:	Isaacs
Citizenship:	US
Gender:	Female
Degree:	Ph.D.
Discipline:	Ecology, agronomy, nutrition
Host Country Institution to Benefit from Training:	US and Rwanda
Training Location:	MSU
Supervising CRSP PI:	Snapp, Sieglinda
Start Date:	08/08
Project Completion Date:	08/11
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Short-term Training:

Type of Training: Participatory plant breeding

Description of training activity: Organize and conduct participatory plant breeding and root/soil health training workshop in Rwanda planned for third year in 2010 but may be offered earlier in 2009 if possible

Status of this activity:

Reason if training activity not completed as planned:

When did the activity occur?:

Location: Rubona, Rwanda

Who benefited from this activity?:

Number of Beneficiaries: 30

Male:

Female:

Total:

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: rticipatory Breeding Approaches to Improve Andean Beans for Resistance to E

	Abbreviated name of institutions											
	MSU			Cornell			Ecuador			Rwanda		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *
	(Tick mark the Yes or No column for identified benchmarks by institution)											
Review breeding program	x	x		x		x*				x	x	
Andean bean nursery-Increase							x	x				
Plant Andean nursery												
Selection parental lines	x	x										
Selection elite lines	x	x					x	x		x	x	
Nursery evaluation				x	x		x	x		x		x*
crossing	x	x		x		x*	x	x				
Marker assisted selection	x						x					
Advanced yield trials	x	x					x	x		x	x	
On farm trials	x	x		x			x	x		x	x	
Variety Release	x	x										
Objective 2												
Advanced Population development	x						x	x				
Test Populations in Rwanda												
Other population development	x						x	x				
Characterize CIAT resistance sources							x	x				
Increase, characterize local germplasm							x	x				
Characterize germplasm to root pati	x			x			x	x				
Objective 3												
Survey root pathogens in Rwanda												
Characterize root rot isolates							x	x				
Root Pathogen x germplasm interaction												
Collect foliar pathogens in Rwanda												
Race characterization							x	x				
Objective 4												
Visit of Rwandan scientists to Ecuador												
Workshop Participatory in Rwanda												
Evaluation of elite lines in CIALs							x	x				
Variety releases in Ecuador												
Non conventional seed production							x	x				
Farmer vs. Breeder Selection												
Sustainable practices, nutrient mgt												

Name of the PI reporting on benchmarks by institution	James D. Kelly	George Abawi	Eduardo Peralta	Augustin Musoni

Name of the U.S. Lead PI submitting this Report to the MO James D. Kelly

James D. Kelly — Oct. 1/2008
Date

* *Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 -- September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: **Combining Conventional, Molecular and Farmer Participatory Breeding Approaches to Improve Andean Beans for Resistance to Biotic and Abiotic Stresses**

Lead U.S. PI and University: MSU

Host Country(s): Ecuador and Rwanda

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	1	2 in training		
Number of men			1	
Short-term Training: Number of individuals who have received short-term training				
Number of women			1	
Number of men			2	
Technologies and Policies				
Number of technologies and management practices under research	8	4 + 8 =12*	8	
Number of technologies and management practices under field testing	4	3 + 4=7	4	
Number of technologies and management practices made available for transfer	8	2 +2=4	8	
Number of policy studies undertaken				
Beneficiaries				
Number of rural households benefiting directly	3000	2400+1000=3400	3100	
Number of agricultural firms/enterprises benefiting	9	2 + 4 =6	9	
Number of producer and/or community-based organizations receiving technical assistance	54	15 +10 =25	54	
Number of women organizations receiving technical assistance	8	0 + 5 =5	8	
Number of HC partner organizations/institutions benefiting	18	8 + 8=16	18	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	5400	1200 +1500=2700	7000	

*Indicators are presented for Ecuador + Rwanda =Total

Expanding Pulse Supply and Demand in Africa and Latin America: Identifying Constraints and New Strategies

Lead U.S. Principle Investigator and Institution

Richard H. Bernsten, Michigan State University, USA
Duncan Boughton, Michigan State University, USA
Cynthia Donovan, Michigan State University, USA

Collaboratoring Host Country and U.S. PIs and Institutions

David Kiala, Universidade Agostinho Neto, Angola
Feliciano Mazuze, Instituto de Investigação Agrária Moçambique, Mozambique
Juan Carlos Rosas, Escuela Agricola Panamericana-Zamorano, Honduras

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Abstract of Research Achievements and Impacts

In Angola, the HC-PI identified a university student to participate in the value chain analysis, potential key informants for the subsector analysis, and a participant trainee who will do a MS (agricultural economics, Federal Univ. of Vicosa, Brazil). World Vision received funds (Sept, 2008) for the proposed smallholder survey. Fieldwork was delayed due to late arrival of project funds, scheduling conflicts between the HC/US PIs, late arrival of World Vision funds, and difficulties the US-PI has to obtain an Angolan visa. In Mozambique, discussions were held with IIAM researchers about project implementation, The MOA?s statistical database is being compiled, initial tables have been produced. Time series data are being prepared for analysis. Donovan/Mazue, incorporated bean-related information into the SIMA?s annual market season rapid appraisal. Formal interviews were conducted with bean subsector participants, including large-scale traders. A report on the rapid appraisal/price analysis from of SIMA data base will be available in late 2008. Discussions were held with IIAM about creating a bean/cowpea task force. A participant training (MS degree, Univ. of Pretoria) was identified. Compiling the TIA dataset (to be used by the student in her thesis analysis) is almost complete. For Honduras, contacts were made with US retailers of organic beans interested in buying third-party certified organic/fair trade beans. Fieldwork identified a USDA-approved organic certifier (ECOHONDURAS). As standards do not exist for fair trade beans, it is impossible to obtain fair trade certification, but certification by the Rainforest Alliance (sustainable practices) is acceptable for retailers. Certification will be sought via ICADE (local Rainforest Alliance affiliate). A meeting with local farmers/literature review identified organic bean practices. Field trials were delayed due to the late arrival of project funds. A meeting with leaders/farmers of a farmer organization (ARSAGRO) identified farmers interested in growing organic beans. Meetings with private sector actors identified third-party certifiers (ECOHONDURAS, organic; ICADE, sustainable practices) and a bean processor/exporter (Rojitos). These meeting identified requirements for obtaining third-party certification and for exporting beans.

Project Problem Statement and Justification

Markets are critical to farmer adoption of new technologies and management practices, as they offer farmers an opportunity to specialize and take advantage of comparative advantage to capture gains from trade. Market-oriented pulse production depends on many factors in addition to technology, including the level of pulse prices and price risk, quantity premia/discounts, and the cost of bringing products to market. These factors are influenced by the level of market infrastructure and public and private institutions, including enforceable contracts (to reduce risk), formal grading systems, the availability of price information, the ability of farmers to reduce transaction costs via membership in an association, and

the physical proximity of markets. Pulse markets in Angola, Mozambique, and Honduras present a continuum in terms of the level of market infrastructure. Angola is characterized as having minimal price information, low yields/production, unpredictable market channels, and poor quality although improving infrastructure. Mozambique is characterized by a relatively effective market information system, low yields/production, and some farmer organizations, but minimal production for markets (market participation) due to a lack of information on quantity/demand. In contrast, Honduras is characterized by an effective market information system, strong farmer organizations, widespread adoption of improved bean varieties, market-oriented production, and a potential to produce for specialty/niche markets. The proposed action research will help to better understand how different levels of market development affect incentives for technology adoption--a ladder of learning. A key priority of the research is to expand market opportunities and accelerate the transformation from semi-subsistence to commercial farming.

Minimal research has been conducted to identify constraints and opportunities to expanding market participation in the three countries, which is the focus of this project.

Angola: Improving smallholder productivity and marketed surplus is a key element of the Government of Angola's (GOA) poverty reduction strategy. Expanding bean/cowpea production is key to the strategy's success, since they are the country's most important legume crops (370,000 ha), are grown throughout the country, and have been identified by the government as high potential crops. Currently, imports are required to meet demand, as demand exceeds domestic production. Smallholders are in the process of shifting from subsistence to more market-oriented production and the GOA is making investments in developing markets. This project contributes to these efforts.

Mozambique: Beans/cowpeas, the most important legume crops after peanuts, have considerable production potential. The Ministry of Agriculture's (MINAG) development strategy recognizes the importance of strengthening value chains for market-led development. Bean/cowpea production flow into different marketsheds, each with different consumer preferences. However, consumer preferences of the different markets are not well documented. To date, little work had been done to improve the market performance and the sustainability of dry pulse value chains, which are the foci of this proposal.

Honduras: Common beans, the second most important food crop (95,000 ha) after maize, are an important source of cash income for smallholders. However, typically most smallholders sell their surpluses to traders at the farmgate and receive low prices. With the recent ratification of CAFTA, bean imports are expected to increase, thereby reducing bean prices and farmers' incomes. Smallholders need new markets that will add value to their crop. This project focuses on developing a new market opportunity for smallholders--producing and exporting organic fair trade beans to the US market.

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: Angola - This project component has 4 sub-objectives: sub-objective 1.1: summarize secondary data on bean/cowpea production and marketing, including the identification of gaps to guide future research; sub-objective 1.2: identify production areas, marketing channels, and marketing margins; and sub-objective 1.3: identify constraints, opportunities, and potential pilot interventions to improve competitiveness.

Approaches and Methods:
Objective 1.1: Visit Key Informants to Identify Information and Data Sources

Visit key informants in order to identify information and data sources. This includes public sector agents for production and areas in beans/cowpeas. Collect/analyze secondary information to document trends in production, marketing, trade, consumption, etc., and identify information gaps

Objective 1.2: Interview Key Subsector Participants to Develop a Value Chain Diagnosis

Interview key subsector participants (e.g., agricultural scientists, traders, processors, importers/exporters, NGOs) to develop a value chain diagnosis, plus information needed to improve performance and identify constraints to subsector growth.

Objective 1.3: Conduct a Smallholder Survey

Undertake a smallholder survey under the World Vision Smallholder Horticultural Value Chain Development project. It is anticipated that the student will participate, with C. Donovan as design consultant for World Vision. The survey will include information on farmer characteristics and practices, including marketing strategies, trade, and transport—thereby documenting linkages between farmers and markets.

Results, Achievements and Outputs of Research

Objective 1.1: Visit Key Informants to Identify Information and Data Sources

During the first 6 months of the project, the Angola researcher, David Kiala, identified students from the University that will be participating in the value chain analysis. Due to the changes in travel plans, the work will be initiated before the end of 2008, if Dr. Donovan is able to travel to Angola as planned. (Difficulties obtaining visas are currently a problem.)

Objective 1.2: Interview Key Subsector Participants to Develop a Value Chain Diagnosis

During the first 6 months of the project, Dr. Kiala has begun identifying participants, but further research is waiting for Dr. Donovan to be in Angola to conduct the training on how to conduct value chain research. This guidance is critical to ensuring that the time and resources are well-used.

The benchmarks are for the full 18 months period through September 2009 and are still pending. There are delays in initiating the activities, but the researchers are confident that there will be good progress after the training and rapid appraisal can be accomplished in late 2008 or early 2009.

Objective 1.3: Conduct a Smallholder Survey

Implementing the smallholder survey has been delayed because World Vision only received the funding for this project in September 2008. Design of the baseline survey has begun and implementation of the baseline will be implemented occur in February 2009. The team is confident that the baseline will be implemented and related activities to achieve the benchmarks will be accomplished by September 2009.

Objective 2: Mozambique - This project component has 3 sub-objectives: Sub-objective 2.1: analyze spatial and temporal patterns of bean/cowpea production and marketing, using national survey data (TIA), disaggregated by gender; Sub-objective 2.2: map marketsheds for bean/cowpea production areas, document market preferences and work with breeders to test varieties with desirable market characteristics to improve competitiveness and spur adoption of improved bean/cowpea varieties; and Sub-objective 2.3: undertake econometric analysis of the determinants of market participation by producing households, including sex of household head as an explanatory variable.

Approaches and Methods:

Objective 2.1: Multidisciplinary Action Research, Spacial and Temporal Analysis, and Institutional Capacity Building

During the first 18 months, the project will implement a multidisciplinary action research approach that engages stakeholders from public and private sectors and NGOs. This research approach includes the development of a working group across sectors. Researchers will assess with partners the development of

a formal Bean/Cowpea Task Force, if the stakeholders support and commit their time and efforts, but at the very least, an informal bean/cowpea task force will be brought together as a working group. The task force will have input into the design of the activities and receive regular feedback on findings. The task force will be relevant for all objectives.

Spatial and temporal analysis of existing national agricultural survey databases will be carried out and the production and marketing data will be presented tables and in the form of maps using GIS. The tables for the descriptive analysis will be specified jointly by PI from MSU and IIAM/CESE with the participation of the staff from SIMA. The PI/IIAM will be responsible in carrying out the statistical analysis. The GIS mapping will be led by the PI from MSU with on the job training of CESE staff. Report write-up will be led by the PI from MSU with participation of PI from IIAM. Production of the policy brief will be under the responsibility of the PI from IIAM

Institutional capacity building will take the form of on-job training of two staff from CESE and two from SIMA to gain skill in using statistical package STATA for descriptive analysis of survey data and in the use of GIS to present results in maps. The on-job training will be provided by MSU staff.

Objective 2.2: Multidisciplinary Action Research

This objective will be met using the previously described multidisciplinary action research approach with the task force--including focus group discussions with smallholders and field observations in the main agro-ecologies, as well as a rapid appraisal of markets during the major marketing season. Focus group discussions will also solicit detailed information about bean/cowpea production and access to input and output markets. The rapid appraisal will focus on marketing channels and margins. Through focus group discussions with producers and traders, relevant constraints and opportunities will be identified; and potential pilot interventions will be identified and prioritized to improve competitiveness of beans and cowpeas in the principal production agro-ecologies. Existing marketing channels and marketing margins will be documented.

The focus group discussion will be facilitated by staff from IIAM/CESE with backstopping from PI from MSU. The rapid appraisal of markets will be led by staff from SIMA with backstopping by the PI from MSU.

Institutional capacity building will take the form of in-service training on focus group discussion methods and rapid appraisal and will benefit staff from CESE, SIMA and IIAM Zonal Research Centers.

Objective 2.3: Participant Training and Organization of Data Set

During the first 18 months of the project, it was initially proposed that: a) a participant trainee (IIAM/CESE staff member) would be enrolled at MSU to pursue MS degree program in Agricultural Economics at MSU. During his/her degree program s/he would acquire skills to undertake sophisticated econometric analysis using appropriate and relevant statistical packages; and b) the participant trainee would organize existing household survey data and, if needed, conduct fieldwork to gather additional data to perform the econometric analysis (MS thesis).

Results, Achievements and Outputs of Research:
Objective 2.1: Multidisciplinary Action Research, Spacial and Temporal Analysis, and Institutional Capacity Building

During the first six months of the project, discussions with IIAM bean researchers have been held. The Ministry of Agriculture database is being compiled with the Directorate of Economics. Initial tables on production over time are available and further analysis for spatial characteristics of production are needed.

The spatial analysis (by province) using simple tables will be completed as soon as the cleaned time series data on production and other aspects are available from the Directorate of Economics of MINAG. The price data analysis will be included in the Rapid Appraisal Report, as the data are already compiled for the various markets.

Objective 2.2: Multidisciplinary Action Research

During the first six months of the project, SIMA conducted the rapid appraisal of bean markets in June 2009, using research methods that had been taught by MSU in earlier years. MSU PI Donovan participated in the rapid appraisal and worked with PI Mazuze and others to incorporate bean research into the market season rapid appraisal. Thus, the rapid appraisal instrument was developed and then implemented. In addition to formal interviews with bean subsector participants,several more intensive interviews were conducted with large scale traders. There was limited participation of IIAM researchers in the market research. Given a difficult cropping year and contradictorary information on the production quantities, a second rapid appraisal is being conducted in October 2008 to follow up on marketing. A combined report on the bean value chain structure will be available later in 2008, which will include basic price analysis from the SIMA database.

Regarding the bean/cowpea task force, discussions have been held with IIAM researchers and a couple of NGOs, but further progress will be made in the upcoming periods.

Objective 2.3: Participant Training and Organization of Data Set

During the first 6 months of the project, there were changes in the training plan—see details under Objective 6. Initially, qualified candidates were identified and assessed to find the best candidates for training. The candidate who was initially identified was found to lack the basic English skills necessary to succeed. After evaluation, Ms. Ana Lidia Gungulo was selected for the training. As explained in Objective 6, the MS training will be at the University of Pretoria, rather than Michigan State University, for reasons explained below. As a result, she will be organizing some of the basic data prior to departure for English training, but the majority of the data set work will begin after beginning MS training in February 2009.

The TIA dataset is almost complete, up through 2007. The thesis proposal will be developed jointly with Ms. Gungulo's advising professor in South Africa.

Other training programs on value chains and data analysis will be held in early 2009, when IIAM analysts are available and PI Donovan can travel to Mozambique to work with PI Mazuze and others.

Objective 3: Honduras - This project component has 4 sub-objectives for this period. The sub-objectives in the current workplan are the following: sub-objective: 3.1) identify markets in the US for organic fair trade common beans, including the grades and standards required by these markets; 3.2) validate via field trails existing agronomic recommendations for growing organic beans; 3.3) identify interested smallholders and train the farmers to produce organic beans that meet the grades and standards required by US retailers; 3.4) establish local market linkages required for small-scale bean farmers to export organic fair trade beans to US markets.

Approaches and Methods:
Objective 3.1: Identification of Organic Fair Trade Bean Markets in the US

During the first 18 months of the project, key informant interviews and web searches will identify agents involved in international and domestic bean markets in the US. Researchers will contact US

distributors/retailers of organic/fair trade commodities to identify interested buyers, determine required grades and standards, and negotiate purchase commitments.
Objective 3.2: Identification of Organic Methods for Producing Beans

During the first 18 months of the project, EAP researchers will identify organic production methods that meet international standards for organic production and test these methods via on-farm trials. Such aspects as IPM and soil fertility enhancements with organic improvements will be included.

Objective 3.3: Identification of Farmer Gropups to Produce Organic Beans

During the first 18 months of the project, EAP researchers will use identify interested farmer groups (CIALs) and collaborating NGO interested in growing organic beans and train them on organic bean production methods.

Objective 3.4: Identification of Private Sector Agents

During the first 18 months of the project, private sector participants will be identified who are interested in participating in the project.

Results, Achievements and Outputs of Research:
Objective 3.1: Idnetification of Organic Fair Trade Bean Markets in the US

Initial contacts have been made with potential buyers/retailers of organic bens produced in Honduras, including Whole Foods, Sam's Club, United Natural Foods, and Alter-Eco—all retailers/distributors of organic and/or fair trade food products. These firms will be contacted again to negotiated purchasing commitments (e.g., quantity, price, market classes, grades/standards) after field trials in Honduras establish the feasibility of producing organic bean using sustainable farming practices and the costs associated with their production.

US retailers are most interested in purchasing beans that are certified by a third party as organic and/or fair trade. Fieldwork in Honduras identified two third-party certifiers. Regarding organic certification, ECOHONDURAS—a firm associated with Guatemalan-based MAYACERT—is the most promising firm that could provide USDA-approved organic certification. Staff of the firm provided information on the protocols that must be followed and the cost of certification. Regarding fair trade certification, since an international standard for fair trade beans has not been established, it will not be possible to obtain fair trade certification. However, the Rainforest Alliance offers a similar/substitute type of certification (i.e., certification for farmers using sustainable agricultural practices) that is accepted by most US retailer. In Honduras, the PIs met with the Director of Certification for ICADE--the local third-party certifier for the Rainforest Alliance--who provided information on the protocols that must be followed to obtain certification and the cost of certification.

Objective 3.2: Identification of Organic Methods for Producing Beans

During the first 6 months of the project, a meeting was held with members of a farmer association to solicit information regarding traditional organic farming practices that they used. In addition, a literature review was initiated to identify possible IPM-based crop management practices/strategies that could be used to control crop pests and maintain soil fertility. A protocol for the organic field trials is being developed in consultation with farmers, including local organic practices. However, as project funds did not become available until after the beginning of first planting season. However, no field activities were initiated during this reporting period because the planting season had begun before funds were available. Field trials to compare organic vs conventional bean production will be conducted during the postrera (Oct-Dec) season.

Objective 3.3: Identification of Farmer Gropups to Produce Organic Beans

During the first 6 months of the project, a meeting was held with the leaders and farmer members of ARSAGRO--one of the largest bean farmer association in Honduras, which is based in Danli. At the meeting, the PIs outlined the goals of the project, including the requirements that the beans be grown in accordance with organic and sustainable production practices. The association members noted that Danli was a good place to grow beans and expressed interest in participating in the project. In addition to the area being a good bean-growing environment, the association recently built a new processing/bagging facility. The association is a major player in domestic bean marketing (previously making large sales to Horti Fruti/Walmart-Honduras) and has previous made export sales to traders.

Objective 3.4: Identification of Private Sector Agents

During the first 6 months of the project, meetings were held with key private sector agents, including third-party certifiers and a bean processor/exporter. As mentioned above, the PIs met with representative of two firms that provide third party certification--ICADE/Rainforest Alliance (Mr. Jose Torres, Director, Program Certification) and ECOHONDURAS/MAYACERT (Cesar Portillo, Director of Organic Certification), These meeting clarified what is required for certification and the timetable for obtaining certification. In addition, a meeting was held with with Rojitos—a bean processor and exporter (Michael Hawit, General Manager and owner; Ms. Kira Husbun, Director of Quality Control).

These meeting identified two issues that must be resolved for the project to be able to export organic beans to the US. First, dry beans destine for the US must be certified (via USDA's representative at Puerto Cortez, Honduras) that they are insect free. Currently, exporters meet this requirement by fumigating the shipment with phostoxin. However, organic standards prohibit the use of this chemical. Thus, we are exploring alternative strategies for meeting this requirement. Second, according to the General Director of Rojitos, in recent years when bean prices have increased, the Government of Honduras has placed an embargo on bean exports. Thus, in order to insure that the project would be able to export beans, he strongly recommended that the Project first obtain a letter from the Ministry of Agriculture authorizing a specific quantity of exports during the marketing year.

Explanation for Changes

Angola: Delay in receiving funding, delays in funding of the World Visions project, and the difficulty that Donovan has had in obtaining a visa to travel to Angola has delayed implementation of research activities in Angola. MS training changes reflect PI evaluation of candidates and needs.

Mozambique: Delay in receiving funding has delayed implementation of some of the research activities in Mozambique. MS training changes reflect PI evaluation of candidates and needs.

Honduras: Objective 3.2 - Project funds did not become available until after the beginning of first planting season. Consequently, no field activities were initiated during this reporting period. Field trials to compare organic vs conventional bean production will be conducted during the postrera (Oct-Dec) season. A protocol for this trial is being developed in consultation with farmers, including local organic practices. No producers or organization received technical assistance or benefit for the reasons explain above.

Networking and Linkages with Stakeholders

Angola: During the forst 18 months of the project, MSU and UAN will collaborate with various agencies. It is anticipated that the MSU PI will participate in monitoring and evaluation activities with World Vision on their new Gates Foundation Project on Horticultural Value Chains. This work will enable a strong collaboration between MSU, UAN and World Vision in the implementation of a

smallholder baseline survey and the data from that survey may be available for research and analysis focused on beans and cowpeas. Other NGOs in Angola are also involved in activities for agricultural production and marketing, including CLUSA, SNV, and ADRA, and the HC PI will reinforce to linkages with those partners, to share research results on the value chain as well as learn from their experiences.

The Ministry of Agriculture in Angola has several units that will be involved for they are currently active in either market information system development (DSA (Food Security Department) and INCER (Cereals Institute)) or in extension activities with smallholders (IDA (Extension Service). The working relationship between IIA (Angolan Research Institute) and UAN is strong and both are based in Huambo, facilitating the linkages. There are two other Pulse CRSP activities in Angola, both based with IIA. Continued discussions with the breeding program with University of Puerto Rico will be particularly important as work on the value chain proceeds.

Private sector agents will be interviewed and later involved in outreach concerning the value chain analysis. These include Nosso Super (supermarket chain), Shoprite (supermarket chain), Jumbo, Angolan Chamber of Commerce, and UNAC (farmers association).

During the first 6-months of the project, given the delays in travel to Angola for the MSU PI, much of the networking has been delayed. MSU PI Donovan is in regular contact with the World Vision team, and UAN PI Kiala has been involved with World Vision on development of the rural survey. A trip in late 2008 will help to solidify the relationships and the participation of UAN in the survey work.

Mozambique: During the first 18 months of the project, a bean/cowpea taskforce including the principal stakeholders will be created and will have the following functions: 1) review the activities to be undertaken by the project; 2) participate in the evaluation pilot production and market interventions; and 3) promote the uptake of the recommendations arising from the study

During the first 6 months of the project, while the task force was not organized, various stakeholders, especially private sector and NGOs, were met during the rapid appraisal. Of particular interest is the CISTER group of Portugal who are investing in bean production for the export market to their processing facilities in Portugal. Operating in the north of the country, they are building standards and varietal demands that will help to create quality criteria on the local markets. In addition to other large scale traders of beans, the rapid appraisal team also met many of the informal sector traders that are the most active in moving product from production to consumption zones. While these traders are not organized, several have a base in the Maputo wholesale markets and so have valuable experience in the interface between demand and supply for beans on local markets. During interviews, the team identified issues relating to seed availability, varietal release, differing consumption characteristics for different markets, and possible quality issues.

Honduras: During the first 18 months of the project, the PI's will meet periodically with staff of various HC-institutions (e.g., Ministry of Agriculture and Animal Husbandry, EAP, NGOs, processors/packers, exporters, third-party certifiers) to present an overview of the action research project and solicit their suggestions for implementations. The project will invite a limited number of key parties to serve on a project advisory team.

During the first six months of the project, the PIs met with several stakeholders/HC institutions to provide an overview of the research project and solicit their suggestions for implementation, including: USAID (Mr. Eduardo Chirinos; Trade, Environment, and Agricultural Office), ICADE/Rainforest Alliance (Mr. Jose Torres, Director, Program Certification): ECOHONDURAS/MAYACERT (Cesar Portillo, Director of Organic Certification), Rojitos—a bean processor and exporter (Michael Hawit, General Manager and owner; Ms. Kira Husbun, Director of Quality Control), Millennium Challenge Account (Mr. Orlando

Mejia, economist), Ministry of Agriculture (Dr. Arturo Galo, Director of DICTA; Danilo Escoto, Director of the National Bean Program; Rigoberto Nolasko, Director of Technology Generation; Ms. Enid Cuellar, SIMPAH—price monitoring program), ARSAGRO (bean cooperative leaders and farmer members), ASOCIALAYO (CIALS leaders and farmer members, Santa Barbara Department), and several faculty at Zamorano (Dr. Ernesto Gallo, agricultural economist; Dr. Javier Bueso, food science; Dr. Zaira Colindres, Assistant Director of PROEMPREZAH--a farmer commercialization outreach project; Alejandra Sierra, organic production specialist in charge of the university's Organic Production Unit).

Leveraged Funds

Name of PI receiving leveraged funds: Cynthia Donovan
Description of leveraged Project: ProRenda in Angola with World Vision International
Dollar Amount: $5,000
Funding Source: Gates Foundation

Name of PI receiving leveraged funds: Cynthia Donovan
Description of leveraged Project: Market Information Systems in Mozambique with SIMA
Dollar Amount: $5,000
Funding Source: Rockefeller Foundation

List of Scholarly Activities and Accomplishments

N/A

Contribution of Project to Target USAID Performance Indicators

The attached form demonstrated the strong linkage between projective objectives and those of USAID, particularly the IEHA goals under pillars 1, 2 and 4.

It should be noted that Mozambique is a priority country for IEHA and the USAID mission strategy in Mozambique is closely aligned with IEHA, focusing on increased rural incomes through productivity growth and market access. While not an IEHA country, Angola's mission strategy also includes many of the same features for smallholder agriculture market development.
The current proposal is aligned with IEHA goals and focuses on IEHA pillars 1, 2 and 4.

Although Mozambique has not yet inaugurated its CAADP process the current proposal addresses CAADP pillars 2, 3 and 4. The research undertaken will also be relevant to the COMESA regional food staples trade program since Malawi, as well as other potential neighboring trade partners are COMESA member countries.

Contribution to Gender Equity Goal

Angola: Due to delays in implementation, the gender goals have not yet been met.

Mozambique: The selected trainee for MS training in South Africa is a woman, Ana Lidia Gungulo.
During the rapid appraisal of markets, approximately 42% of the traders interviewed were women.

Honduras: Two women participated in the organic production workshop/training program.

Progress Report on Activities Funded Through Supplemental Funds

Not Applicable--no supplemental funds received

Capacity Building Activities: P1-MSU-2

Degree Training:

Student #1

First and Other Given Names:	Maria da Luz
Last Name:	Quinhentos
Citizenship:	Mozambican
Gender:	Female
Degree:	M.S.
Discipline:	Agricultural Economics
Host Country Institution to Benefit from Training:	IIAM
Training Location:	Michigan State University
Supervising CRSP PI:	Boughton, Duncan
Start Date:	08/08
Project Completion Date:	08/10
Training Status:	
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Student #2

First and Other Given Names:	Ana Lidia
Last Name:	Gungulo
Citizenship:	Mozambiquan
Gender:	Female
Degree:	M.S.
Discipline:	Agricultural Economics
Host Country Institution to Benefit from Training:	IIAM
Training Location:	University of Pretoria, South Africa
Supervising CRSP PI:	Boughton, Duncan
Start Date:	2/09
Project Completion Date:	10/10
Training Status:	Delayed
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Student #3

First and Other Given Names:	Estaveo
Last Name:	Chaves
Citizenship:	Angolan
Gender:	Male
Degree:	M.S.
Discipline:	Agricultural Economics
Host Country Institution to Benefit from Training:	UAN
Training Location:	University Federal Vicosa, Brazil
Supervising CRSP PI:	Donovan, Cynthia
Start Date:	2009
Project Completion Date:	2011
Training Status:	Pending
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Short-term Training:

Type of Training:	In-service training
Description of training activity:	Provision of skills to the trainees on using value chain concepts to evaluate bean and cowpea supply and demand systems nationally and regionally
Status of this activity:	Postponed
Reason if training activity not completed as planned:	Due to scheduling conflicts, this activity has been postponed until early 2009. Training materials are in development.
When did the activity occur?:	
Location:	UAM, Huambo
Who benefited from this activity?:	
Number of Beneficiaries:	20
Male:	
Female:	
Total:	

Type of Training: In-service Training

Description of training activity: Provision of skills to the trainees on data entry and processing and econometric analysis of bean and cowpea production and marketing data

Status of this activity: Postponed

Reason if training activity not completed as planned: Due to scheduling conflicts, this activity has been postponed until 2009.

When did the activity occur?:

Location: UAM, Huambo

Who benefited from this activity?:

Number of Beneficiaries: 10

Male:

Female:

Total:

Type of Training: In-service Training

Description of training activity: Provision of skills to the trainees on participatory focus groups discussions to gather insights on beans and cowpeas based farming systems, major constraints and opportunities for bean/cowpea sub-sector development and new strategies for development of bean/cowpea markets towards increased bean and cowpea production and productivity

Status of this activity: Postponed

Reason if training activity not completed as planned: Due to scheduling conflicts, this activity has been postponed until 2009.

When did the activity occur?:

Location: IIAM, Maputo

Who benefited from this activity?:

Number of Beneficiaries: 6

Male:

Female:

Total:

Type of Training: In-service Training

Description of training activity: Provision of skills to the trainees on participatory rapid rural appraisals to elicit key informants to provide insights on beans and cowpeas based farming systems, production constrains and potential demand for beans and cowpeas nationally and regionally

Status of this activity: Postponed

Reason if training activity not completed as planned: Due to scheduling conflicts, the training has been postponed until 2009

When did the activity occur?:

Location: Zonal Center of IIAM

Who benefited from this activity?:

Number of Beneficiaries: 6

Male:

Female:

Total:

Type of Training: In-service Training

Description of training activity: Provision of skills to the trainees on using value chain concepts to evaluate bean and cowpea supply and demand systems nationally and regionally

Status of this activity: Postponed

Reason if training activity not completed as planned: Due to scheduling and time conflicts, the training has been postponed until early 2009

When did the activity occur?:

Location: IIAM, Maputo

Who benefited from this activity?:

Number of Beneficiaries: 4

Male:

Female:

Total:

Type of Training: Practical Training

Description of training activity: Practical training for farmers who will grow organic beans and EAP staff interested in learning about organic bean production methods.

Status of this activity: Completed as planned

Reason if training activity not completed as planned:

When did the activity occur?: September 2008

Location: Honduras

Who benefited from this activity?: Farmer groups participating in organic bean production, and NGO technicians/EAP staff interested in learning how to grow organic beans

Number of Beneficiaries:

Male: 13

Female: 2

Total: 15

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: Expanding Pulse Supply and Demand in Africa & Latin America: Identifying Constraints & New Strategies

	Abbreviated name of institutions											
	MSU			Univ. Agos. Neto			IIAM			EAP		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	**10/1/08**	**Y**	**N ***	**10/1/08**	**Y**	**N ***	**10/1/08**	**Y**	**N ***	**10/1/08**	**Y**	**N ***
	Tick mark the Yes or No column for identified benchmarks by institution											
Angola												
Objective 1. Collect/analyze secondary information to document trends, information gaps												
Draft literature review on agricultural production and markets in Angola, focused bean and cowpeas				1		x						
Objective 2. Interview subsector participants to develop value chain diagnosis, collect info. needed improve performance & identify constraints to subsector growth												
Diagnostic: Lic. Thesis proposal: Farmer marketing				1		x						
Diagnostic: Lic. Thesis proposal: Public markets: Sources and sales				1		x						
Diagnostic: proposal: Formal Private sector sources and destination				1		x						
Diagnostic: Lic. Thesis: Farmer marketing												
Diagnostic: Lic. Thesis: Public markets: Sources and sales												
Diagnostic: Formal Private sector sources and destination												
Draft Value chain diagnostic												
MS Thesis proposal												
Objective 3. identify, constraints, opportunities, and potential pilot interventions to improve competitiveness												
Participative survey with NGO in Planalto region	1		x									
Draft article on smallholder marketing												
Outreach with NGO on smallholder marketing results												
Mozambique												
Objective 1. Analyze spatial & temporal patterns of dry bean production & marketing, using national survey data (TIA), disaggregated by gender												
Tabular results of spatial analysis from TIA												
Summary report on price analysis (SIMA data)	1	x					1	x				
Synthesis Paper on spatial and temporal analysis of production												
Policy brief on production												
Objective 2. Map marketsheds for dry bean production areas, document market preferences & work with breeders to test varieties with desirable market characteristics to improve competitiveness												
Maps on production and marketing (TIA results)												
Draft rapid appraisal (Windshield Survey) bean/c	1	x					1	x				
Conduct focus group discussions on preferences												
Conduct rapid appraisal with SIMA participation	1	x					1	x				
Report on focus group discussions												
Report on rapid appraisal (Windshield Survey)												
Establishment of bean/cowpea task force												

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: Expanding Pulse Supply and Demand in Africa & Latin America: Identifying Constraints & New Strategies

Presentation of diagnostic results to stakeholders												
Joint meeting with IIAM breeders on market results and consumer preferences to identify potential interventions with production												
Working paper (for obj 1& 2)												
Policy brief (for obj 2)												
Objective 3. Undertake econometric analysis of the determinants of market participation by producing HHs, including HH head/gender as an explanatory variable												
Organize unified TIA dataset							1		x			
Draft M.Sc. thesis proposal												

Honduras

Objective 1. Contact US retailers to identify markets for organic fair trade beans												
List of US retailers with potential for organic fair trade beans												
Identification of potential certification agency and the standards that are to be met for fair trade organic certification (preliminary assessment, confirmation assessment assessment)												
Objective 2. Validate via field trials agronomic recommendations for growing organic beans												
identify production technologies for field trials										1	x	
Establish initial field trials										1	x	
Report on initial trial results												
Establish second set of field trials												
Report on second set of field trials												
List of best practices for growing organic beans												
Objective 3 Train farmers to grow organic beans												
Identify farmer groups/NGOs interested in producing organic beans												
Train farmers on organic bean production methods												
Initiate production of organic beans for the US market												
Objective 4. Establish market linkages with private market participants												
Establish list of firms available to transport, clean, and export organic beans; cost of these services (initial assessment, confirmation assessment)												

Objective 4: Institution Building

Angola: Identify trainee for MS training at U. Pretoria				1	x							
In-service training STATA												
In-service training on value chain a	1		x									
Begin/continue MS degree training in SA												
Begin thesis fieldwork in Angola												
Mozambique: Identify trainee for MS training at MSU							1	x				
Begin MS degree training at MSU												
Conducts thesis fieldwork in Mozambique												
In-service training STATA	1		x									
In-service training GIS	1		x									

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: Expanding Pulse Supply and Demand in Africa & Latin America: Identifying Constraints & New Strategies

	In-service training on value chain a	1		x									
	Draft Focus group guide												
	In-service training focus group discussion methods												
	In-service training on Rapid Rural Appraisal												
Honduras:	Conduct first practical training for organic bean farmers											x	
	Conduct second practical training for organic bean farmers												

Name of the U.S. Lead PI submitting this Report to the MO

Richard. H. Bernsten — **Signature**

9/30/08 — **Date**

* *Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 -- September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: Expanding Pulse Supply & Demand in Africa and Latin America: Identifying Constraints & New Strategies
Lead U.S. PI and University: Bernsten, Boghton, and Donovan, Michigan State University
Host Country(s): Angola, Mozambique, and Honduras

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	1	0	1	
Number of men	1	1	2	
Short-term Training: Number of individuals who have received short-term training				
Number of women	8	2	18	
Number of men	20	13	34	
Technologies and Policies				
Number of technologies and management practices under research	6	0	0	
Number of technologies and management practices under field testing	0	0	6	
Number of technologies and management practices made available for transfer	0	0	9	
Number of policy studies undertaken	3	0	4	
Beneficiaries:				
Number of rural households benefiting directly	0	0	0	
Number of agricultural firms/enterprises benefiting	0	0	0	
Number of producer and/or community-based organizations receiving technical assistance	3	0	13	
Number of women organizations receiving technical assistance	0	0	3	
Number of HC partner organizations/institutions benefiting	8	0	15	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	0	0	0	

Comments: Honduras
1) A workshop on Organic Production was offered to 15 participants including technicians from collaborating institutions (OG and NGO) and farmers from ARSAGRO and CIAL of the Yojoa Lake and Yorito regions. The workshop was coordinated by Alejandra Sierra, organic production specialist from Zamorano.
2) The funds were available after the first planting season was already started, so no field activities were initiated during this period. Field trials to compare organic vs conventional bean production will be conducted during the postrera (Oct-Dec) season. A protocol for this trial is being developed in consultation with farmers, including local organic practices.
No producers/organization received technical assistance or benefit for the reason explain above.

Improving Bean Production in Drought-Prone, Low Fertility Soils of Africa and Latin America – An Integrated Approach

Principle Investigators

Jonathan Lynch, Pennsylvania State University, USA
Juan Carlos Rosas, EAP, Honduras
Magalhaes Miguel, IIAM, Mozambique

Collaboratoring Scientists

Celestina Jochua, IIAM, Mozambique
Soares Xerinda, IIAM, Mozambique
Jill Findeis, Penn State, USA
Kathleen Brown, Penn State, USA Jonathan Lynch, Penn State, USA

Abstract of Research Achievements and Impacts

Plant breeding: At Zamorano, crossing continued to generate lines combining specific root traits for drought and low P adaptation. Two promising lines were evaluated in on-farm trials of drought and low fertility It is expected that one of these lines will be released in 2009. Several drought and/or low fertility tolerant lines developed previously were included in the advanced lines small red and black bean nurseries (VIDAC) and trials (ECAR) distributed for testing in Central America and the Caribbean to members of the Regional Bean Research Network. In addition, some tolerant lines were included in the set of 50 lines recently sent to Julie G. Lauren, Cornell University, for testing in Kenya, and in the set of 34 lines sent to Tim Porch, USDA/TARS, Puerto Rico, for testing in Angola. Facilities and expertise for conducting studies in drought and low fertility tolerance in beans have been upgraded at Zamorano. At IIAM, a method to evaluate root traits in the field was evaluated and applied to regional bean germplasm, and crossing continued to study the inheritance of root hair traits. Integrated Crop Management: sites were identified for erosion studies, and contacts initiated with an NGO with experience with rock phosphate (RP). Sites that are biggest RP reserves in Mozambique were identified; and from there, samples are to be collected in the next months. An intercropping study at Penn State showed that bean/maize and bean/maize/squash polycultures may have better tolerance to low P soil fertility than monocultures. Progress in Mozambique has been delayed by slow processing of the subcontract by the Penn State administration. Socioeconomics: The Mozambique Vulnerable Soil Vulnerable Household Survey (VSVH) survey instrument has been developed. The survey instrument includes two parts: the CORE survey instrument and the TARGET survey. The CORE survey has been completed, translated into Portuguese, and is now being verified by an independent translator for Penn State IRB/ORP human subjects approval. The TARGET survey also has been developed, and will be conducted next month. Capacity Building: A bean breeder from Malawi, Virginia Chisale, has been accepted to the graduate program at Penn State and will begin her studies in the Spring of 2009.

Project Problem Statement and Justification

This project is premised on four well-established facts:

1. Drought and low soil fertility are principal, pervasive constraints to bean production in Latin America and Africa.
2. The vast majority of bean producers in poor countries cannot afford irrigation and intensive fertilization.
3. Bean genotypes vary substantially for root traits that determine their tolerance to drought and low soil fertility, making it feasible to increase yields in low-input systems through genetic improvement.

4. To exploit the potential of this approach, we need intelligent deployment of root traits in bean breeding programs, and better understanding of the socioeconomic and agroecological factors determining the adoption and impact of stress tolerant crops and cropping systems.

Drought and low soil fertility are primary constraints to crop production throughout the developing world, and this is especially true of common bean, which in poor countries is typically a smallholder crop grown in marginal environments with few inputs. Phosphorus limitation is the most important nutrient constraint to bean production, followed by the acid soil complex of excess Al, excess Mn, and low base supply. The importance of nutritional stress in bean production systems of Latin America and Africa cannot be overstated. Fertilizer use is negligible in many developing countries, especially in sub-Saharan Africa, which generally have the poorest soils. What is needed is *integrated nutrient management*, consisting of judicious use of fertility inputs as available, management practices to conserve and enhance soil fertility, and adapted germplasm capable of superior growth and yield in low fertility soil.

We have shown substantial variation in bean P efficiency that is stable across soil environments in Latin America. Analysis of the CIAT germplasm collection identified several sources with outstanding P efficiency - from 100 to 200% better than existent checks such as Carioca. Studies with these genotypes identified a number of distinct root traits that contribute to P acquisition through topsoil foraging, including root hair length and density, adventitious rooting, basal root shallowness, and traits that reduce the metabolic costs of soil exploration such as root etiolation and root cortical aerenchyma. Genetic variation for these traits is associated with from 30 – 250% variation in growth and P uptake among related genotypes in field studies. Several of these traits can be evaluated in rapid screens with young plants, greatly facilitating breeding and selection.
Drought is a primary yield constraint to bean production throughout Latin America and Eastern and Southern Africa. Beans vary substantially in drought tolerance, due primarily to variation in root depth and thereby access to soil water, earliness (drought escape), and secondarily to seed filling capacity. Drought tolerance has been identified in several races of common bean, but is complex and associated with local adaptation. Utilization of specific traits in drought breeding, through direct phenotypic evaluation or genetic markers (eg QTL) would be useful.

Genotypes that are more responsive to inputs may promote the use of locally available inputs in improved Integrated Crop Management (ICM) systems. Several African countries have reserves of sparingly soluble rock P whose effectiveness may be improved by the use of nutrient-efficient bean genotypes. Beans are superior to maize in their ability to solubilize P in their rhizosphere. The introduction of bean genotypes with superior root systems may enhance the utilization of rock P, thereby improving P availability and N availability (through symbiotic N fixation) in maize/bean systems. Similarly, bean genotypes with deeper root systems may be synergistic with soil management techniques to conserve residual moisture. Our project will test these hypotheses.

We also need a better understanding of socioeconomic factors determining adoption of stress tolerant bean germplasm and the likely effects such adoption may have on household income and nutrition. Factors such as family structure may play a role in determining whether the introduction of more productive germplasm is likely to have positive or even negative effects on household income and nutrition.

Drought and poor soil fertility are primary constraints to pulse production in developing countries. Recent developments in our understanding of root biology make it possible to breed crops with greater nutrient efficiency and drought tolerance. Such crops will improve productivity, enhance economic returns to fertility inputs, and may enhance overall soil fertility and system sustainability, without requiring additional inputs. The overall goal of this project is to realize the promise of this opportunity to substantially improve bean production in Africa and Latin America.

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: Develop bean genotypes with improved tolerance to drought and low P

Approaches and Methods:
Drought and poor soil fertility are primary constraints to pulse production in developing countries. Several specific root traits that enhance bean productivity under drought and low fertility stress have been identified. The overall goal of under objective 1 is to improve bean production in Africa and Latin America through genetic improvement.

The activities under this objective include collection of germplasm, phenotyping root traits, screening root traits for low P/drought tolerance, introgression of root traits into elite lines in Africa and Latin America, and evaluation and development of low P/drought tolerant varieties for farmers using PBV and PVS. Bean germplasm will be collected from various breeding programs in Africa and Latin America: CIAT, SABRN, BILFA and BIC, regional landraces, improved cultivars, advanced lines. Bean germplasm will be systematically screened for key root traits including root hair length, root hair density, basal root whorl number (BRWN), basal root growth angle (BRGA), and adventitious rooting. Phenotypic screens will be conducted under controlled conditions and also as field root crown evaluations. The Latin America germplasm to be screened will also include landraces and improved lines from the Mesoamerican and Andean gene pools of *Phaseolus vulgaris* useful for Central American and the Caribbean, and Interspecific lines from *P. vulgaris* x *P. coccineus* crosses developed by the LAC project during the previous Bean/Cowpea CRSP.

Introgression of root traits conferring greater drought tolerance and P efficiency will be carried out by developing inbred backcross (IB) populations. These IB populations will be composed of breeding lines which combine key root traits with multiple disease resistance and preferred seed types in the target regions. The initial cross will be made between the recurrent parent (selected elite cultivars and/or advanced lines for CA/C and African target countries) and the donor parents (selected germplasm with the higher expression of key root traits), followed by two backcrosses to the recurrent parent and three generations of selfing by single seed descent to develop IB populations.

Field selection will be based on the average performance of advanced IB lines in replicated drought and low P trials, complemented with field and greenhouse evaluations of root traits. Selected lines will be tested individually or in multiline combinations. The identified locations for testing include Lichinga, Gurue, Angonia, Sussundenga and Chokwe in Mozambique, and Zamorano, Yojoa Lake, Yorito and El Paraíso in Honduras. Selection for some disease resistance will be conducted in the field. In addition, advanced lines will be evaluated in Malawi, Nicaragua and Haiti.

Participatory plant breeding (PPB) and PVS approaches will be used in the field trials for evaluation of the performance of the IB lines under drought/low P, agronomic adaptation and commercial seed types. Participants in the value chain of common beans (production, processing, commercialization and export) in the target countries will be invited to participate in these evaluations.

Results, Achievements and Outputs of Research:
EAP/Honduras

During the previous Bean/Cowpea CRSP Program, three inbred backcross (IB) populations were developed using Amadeus 77, the most grown small red bean cultivar in Central America, as a recurrent parent and three lines from the L88 population developed in MSU (L88-13, L88-33 and L88-62) and evaluated intensively at PSU facilities for studying root traits. The L88 lines were used as donor parents and they have higher expressions of root traits associated with tolerance to drought

and/or low fertility stresses. The IB recombinant lines are expected to be used for on-farm testing of the multiline approach, which have been study previously in Honduras and the results submitted for publication recently (Henry et al. 2008, Crop Science). During this period, 275 BC2S3 lines from three populations were selfed and seed increased for further greenhouse studies to identify lines which recombine desirable root traits that have been identified to be important for better performance of bean genotypes under drought and low fertility stresses.

Two promising lines derived from our previous PSU/Zamorano collaborative project under the Bean/Cowpea CRSP are included in on-farm validation trials of drought and low fertility tolerant common bean lines conducted in Honduras and Nicaragua, in collaboration with researchers from CIAT (S. Beebe), DICTA (D. Escoto) and INTA (A. Llano), with partial funding of the Red SICTA Project. The six lines included in this validation trial have been root phenotyped using soil tubes for greenhouse evaluation and field trials. The two promising lines developed by the project recombine tolerance to these two abiotic stresses with good architecture, resistance to major diseases including to BGYMV and commercial small red seed type. It is expected that one of these lines will be released in 2009.

Several drought and/or low fertility tolerant lines developed previously were included in the advanced lines small red and black bean nurseries (VIDAC) and trials (ECAR) distributed for testing in Central America and the Caribbean to members of the Regional Bean Research Network. In addition, some tolerant lines were included in the set of 50 lines recently sent to Julie G. Lauren, Cornell University, for testing in Kenya, and in the set of 34 lines sent to Tim Porch, USDA/TARS, Puerto Rico, for testing in Angola.

Facilities and expertise for conducting studies in drought and low fertility tolerance in beans have been upgraded at Zamorano. The soil tubes methodology for studying root traits involved in drought and low fertility tolerance has been implemented. Root studies are being conducted using the WinRhizo program and other root phenotyping techniques, which were learned after training received at PSU and during the stays of Melissa Ho and Amelia Henry, former PSU graduate students that conducted part of their PhD research in Honduras, in previous years.

IIAM/Mozambique

1) Development of a method to evaluate bean root traits in the field

Objective:

- Develop a simple method to evaluate root traits of bean in the field
- Compare results of root traits evaluated in the field with laboratory methods
- Identify bean genotypes with root traits adapted to low P soils.

Material and Methods:

The trial was installed in a RCBD with 30 genotypes (Table 1) and 4 replications under irrigation. The root traits were evaluated at 45 days after germination (podding stage). The space between plants in the row was 25 cm and between lines was 70 cm. Each genotype was planted in 3 rows of 2 meters. Due to seed limitation, 2 plants were selected at random in each replication making a total of 8 plants per genotype. A shovel was used to excavate within 20 cm of shoot, the roots were gently removed from the soil by hand. The excavations were performed by one person for consistency. A 1 to 9 rating scale was used to rank the traits of adventitious, basal and primary roots:

1. Adventitious root length: 1 = 1cm; 3 = 4-5cm; 5 = 8-9cm; 7 = 12-13cm; 9 = > 16cm.
2. Adventitious root branching: 1 = no lateral branching; 3 = 1 order of ramification; 5 = 2 orders of ramification; 7 = 3 orders of ramification; 9 = multiple branches with up to 4 orders of branching.
3. Basal root length: 1cm; 3 = 4-5cm; 5 = 8-9cm; 7 = 12-13cm; 9 = > 16cm.
4. Basal root branching: 1 = no lateral branching; 3 = 1 order of ramification; 5 = 2 orders of ramification; 7 = 3 orders of ramification; 9 = multiple branches with up to 4 orders of branching.
5. Basal root deep: 1 horizontal; 5 intermediate; 3 = Vertical
6. Primary root length: 1 = < 3cm; 3 = 7-9cm; 5 = 13 15cm; 7 = 19-21cm; 9 = 25-30 cm
7. Primary root branching: 1 = no lateral branching; 3 = 1 order of ramification; 5 = 2 orders of ramification; 7 = 3 orders of ramification; 9 = multiple branches with up to 4 orders of branching.
8. Nodulation: 1 = Excellent; > 80 pink/red nodules; 3 = Good: 41-80 nodules; 5 = Intermediate: 21-40 nodules; 7 = Poor: 10-20 nodules; 9 = less than 10 nodules (CIAT, 1987).
9. Root rots: 1 = no visible symptoms; 3 = 10% hypocotyl and root with light lesions; 5 = 25% hypocotyl and root with lesions ; 7 = 50% hypocotyl and root with lesions ; 9 = 75% or more of hypocotyl and root with severe lesions (CIAT, 1987).

Results:

Root trait variation

Preliminary results show variation in root traits among genotypes. Significant differences among genotypes were found for adventitious root number (P = 0.004), basal root length (P = 0.00), basal root number (P = 0.001), basal root branching (P = 0.018) and primary root length (P = 0.001).

The average number of adventitious root and basal root number varied from 7 to 24.125 and 3.75 to 7.125 respectively. Genotypes with greater than 20 adventitious roots included CAL 96, SER 118, RAB 655, A 774 and, G 19833 (Fig 1). Most of the genotypes had few basal roots even the ones with 3 whorls that have potential of 12 basal roots. The average root whorl number varied from 1.65 to 2.25 (Fig 2). More analyses including other root traits will be performed. These field data will be compared with data obtained in the laboratory. Although the nodulation had significant differences, most of the genotypes had inactive nodules or lacked them entirely.

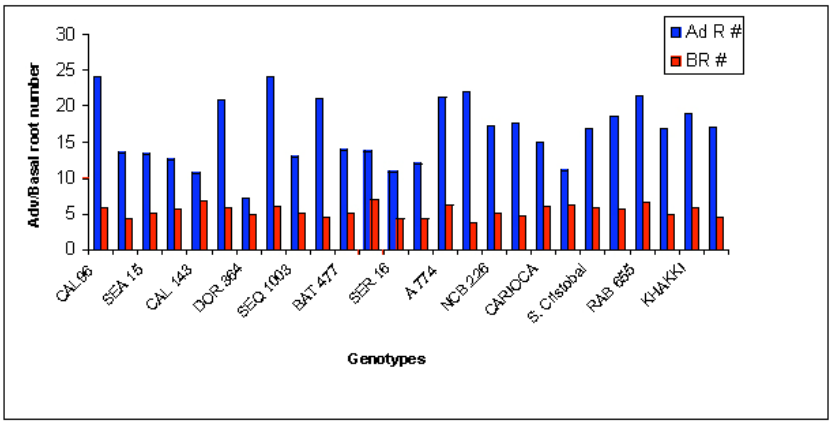

Fig 1. Average number of adventitious and basal roots of 26 genotypes. The values are average of 8 plants per genotype. Ad R # = adventitious root number; BR # = Basal root number.

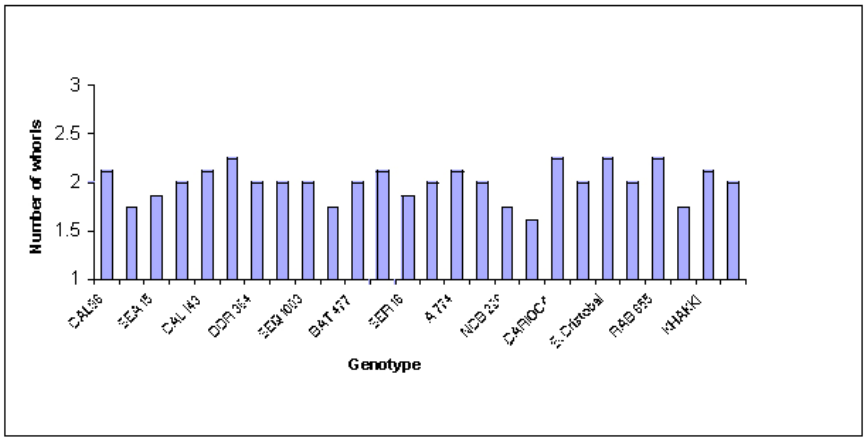

Fig 2. Average number of whorls of 26 genotypes. The values are average of 8 plants per genotype.

Table 1. List of common bean genotypes used in the field evaluations of root traits

Entry #	Genotype
1	CAL 96
2	DOR 390
3	SEA 15
4	TIO CANELA 75
5	CAL 143
6	G 19833
7	DOR 364
8	PINTO VILLA
9	SEQ 1003
10	G 2333
11	BAT 477
12	DOR 500
13	SER 16
14	SAB 258
15	A 774
16	SER 118
17	NCB 226
18	NCB 280
19	CARIOCA
20	G 4523 (Ica Palmar)
21	SAN CRISTOBAL 83
22	SXB 412
23	RAB 655
24	A 286
25	KHAKKI
26	ICA PIJAO

2) Inheritance of root hair traits of common beans

The objective is to study the inheritance of root hair traits in common bean, and introgress root hair traits conferring P efficiency into varieties adapted to Mozambique. The F2 seed of 3 crosses were planted in February-April of 2008 in Sussundenga and Chokwe. About 200 plants were harvested individually at random in each of the 3 crosses and the reminding plants were harvested in bulk. The F3 seed from individual plants and bulk will be planted in February in Sussundenga. Due to irrigation instability in Sussundenga we could not plant the F3 seed in August 2008 estimating the amount of seed obtained from each cross. The advanced 5 crosses are shown below:

Root hair traits: Long and dense root hair x Short and less dense root hair

1 - SEA 5 x SXB 418	Advanced to F3
2 - VAX 1 x SXB 418	Advanced to F3
3 - AFR 298 x PVA 773	Advanced to F3
4* - G 14665 x SUG 47	Advanced to F2
5*. - Entry 63 (G 19833xBRB 183) x SUG 47	Advanced to F2

* For the 4th cross (G 14665 x SUG 47) and 5th cross (Entry 63 (G 19833xBRB 183) x SUG 47) the parents SUG 47 and G 14665 did not germinate, therefore I plan to get more seed of these parents to advance the generations.

3) Characterization of root traits of common bean in the field

To identify bean genotypes with root traits suitable for low P soils, more than 100 bean genotyes from CIAT (82 are BILFA lines) and germplasm and landraces from Mozambique were planted in Chokwe. Field evaluations of root traits were done in lines from Lichinga and BILFA using the excavation method described on project one. Four plants were excavated in each genotype. Preliminary data show genetic variation among genotypes in root traits of adventitious, basal and primary root traits. The data is being processed.

Objective 2: Develop integrated crop management systems for stress tolerant bean genotypes.

Approaches and Methods:

A) Evaluation of the effect of P efficient bean genotypes on soil erosion:

To conduct this study we will install erosion lysimeters at IIAM station in Lichinga in Mozambique. Using methods we have developed and used successfully in Costa Rica and Ecuador, these 2 by 1.6 m plots allow the measurement of soil and P lost from erosion from specific genotypes.

B) Evaluation of the utility of local rock P with P efficient bean genotypes:

In this activity we will first obtain ground local rock phosphates from Monapo and Montepuez districts and evaluate the their efficacy for bean genotypes with contrasting root traits in greenhouse and field conditions at Sussundenga and Lichinga. Results will test the hypotheses that more P efficient bean genotypes will have better utilization of local rock P than traditional genotypes, and that local rock phosphate can be a useful source of both P and Ca in red acid soils of Central and Northern Mozambique.

C) Evaluation of synergy of water conserving soil management with drought tolerant genotypes:

Various methods of soil management such as mulching, crop residue management, crop rotations, microcachement systems, and minimum tillage may conserve residual moisture during the dry season and periodic drought. Root traits may have synergy with these methods by for example permitting better exploitation of water deep in the soil profile. These issues have never been investigated.

In this activity we will establish soil moisture plots to compare traditional and drought-tolerant genotypes under traditional versus moisture-conserving soil management to text the hypothesis that combined packages of novel genotypes and integrated soil management have greater potential impact than either approach in isolation. Plant materials to be evaluated will include those developed for drought tolerance by CIAT-Malawi.

D) Evaluation of the effect of root traits in maize/bean intercrops:

The effects of BRGA, BRWN, and root hair length on root competition in maize intercrops will be the MS thesis research of one of the IIAM students at Penn State. Closely related bean genotypes contrasting for root traits (RILs of L-88) will be grown in sole crop or intercropped with maize, with and without irrigation and at high and low P fertility, in field studies at the Rock Springs research station at Penn State. Root phenotypes will be confirmed through destructive sampling of root crowns as well as nondestructive root imaging with minirhizotrons. Soil cores at R5-R7 will permit analysis of root length by depth. Plant P acquisition and water status will be assessed over time. Results will test the hypothesis that root traits that benefit bean growth under drought and low P may or may not affect yields of maize intercrops depending on spatial niche segregation. Parallel studies with more genotypes and less intensive physiological sampling will be conducted at the IIAM Sussundenga research station in Mozambique.

Results, Achievements and Outputs of Research:
Activities in Mozambique were restricted since subcontractual arrangements with Penn State have just been finalized- funds are expected to be wired to IIAM Oct 1 2008- without funds for travel to field sites etc activities were limited. Nonetheless, IIAM partners achieved two goals; ie

- Identified of the location to be used for installation of erosion lysimeters for studies under objective 2, which is to develop integrated Crop management systems for stress tolerant bean genotypes. The lysimeters will be installed in November at experimental field of the Lichinga Research Station.
- Contacts have been made with Care International, a non-government organization with experience in excavating rock phosphate in Northern provinces of Nampula and Cabo Delgado. In collaboration with IIAM colleagues based in Nampula Research Station, we planned and scheduled to travel to Montepuez (Cabo Delgado Province) and Monapo (Nampula Province) to collect RP samples. Then, the RP samples will be ground and used for the planned greenhouse studies to be conducted in the next growing season of common beans.

Research at Penn State consisted of a study of root traits and adaptation to low P and N availability as affected by intercropping. The “three sisters” polyculture, consisting of maize, bean and squash, is one of the oldest and most successful cropping systems on earth. We hypothesized that part of the resilience of this system is due to belowground synergies in resource acquisition. We tested this hypothesis in a field experiment in summer 2008 with monocropped vs intercropped maize, bean, and squash under contrasting N and P availabilities. Results indicate that the “three sisters” system has greater yield than the constituent monocultures in low fertility soils common to low input agriculture.

Objective 3: Understand constraints to adoption of new bean technologies, income and nutrition potential, and intra-household effects and impacts.

Approaches and Methods:
Farm households in the four study areas in Mozambique will participate in identification of a) barriers to widespread adoption, b) constraints to achieving potential income and nutrition impacts, and c) intra-household impacts of introduction of new bean technologies. Questions related to the implications of human disease for production, marketing and health status will be included. To achieve Objective 3, a quantitative survey of farm households will be conducted in villages proximate to the four project study areas (Sussundenga, Lichinga, Gurue, and Angonia).

The Mozambique Vulnerable Soil Vulnerable Household (VSVH) Survey will be conducted in a face-to-face format. Male and female surveys will be conducted, with one adult male (primary decision-maker) and one adult female (a spouse of primary decision-maker) surveyed in each household. It is recognized that not all households will include both spouses; in these cases, two adult decision-makers will be interviewed or only one adult will be interviewed, if two are not available. The location of each surveyed household will be geo-identified using GPS.

The survey instrument will be developed, translated and cleared through the Human Subjects approval process at Pennsylvania State University in the first 6 months of the project. The face-to-face survey will then be pretested at the Sussundenga site; the face-to-face surveys will be conducted at the four Mozambique sites in the period October 1, 2008-September 30, 2009 period.

Results, Achievements and Outputs of Research:
The Mozambique Vulnerable Soil Vulnerable Household Survey (VSVH) survey instrument has been developed. The survey instrument includes two parts: the CORE survey instrument and the TARGET survey. The CORE survey is asked of one adult in the household, and includes questions to yield a demographic profile of the Mozambique farm households in the four study areas (Sussendenga, Lichinga, Gurue, and Angonia). The CORE survey has been completed, translated into Portuguese, and is now being verified by an independent translator for Penn State IRB/ORP human subjects approval.

The TARGET survey also has been developed, and will be conducted among an adult and an adult female (separately) in the farm household. The TARGET survey is designed to gain knowledge of social and economic networks existing in the villages and ways in which existing networks can be utilized to enhance the probability of adoption and achieve more widespread diffusion of the new cultivars being developed. The survey also includes questions on the impacts of high incidence of disease on legume adoption, production, marketing and consumption, and approaches for using networks to reduce disease incidence and simultaneously boost food security and legume diffusion. To better understand the preferences and behaviors of farm households in the areas in which the new low-P bean varieties will be introduced, the survey instrument asks questions related to 1) the household's income sources and reliance on beans for own consumption vs. income, 2) decision-making structure of households including participation in legume adoption, production, marketing and consumption decisions, 3) understanding and indicators of poor soil quality, 4) intra-household differences in preferences for specific bean varieties and characteristics, and 5) constraints to achieving income and nutrition potential relative to legumes. The application to the Penn State IRB and letters of survey participant consent have been drafted, with the consent form translated into Portuguese. The materials will be submitted to the Penn State IRB/ORP for human subjects approval following translation verification.

The survey is scheduled to be pretested in mid-October, with the revised survey being conducted in two villages near Sussendenga and two near Lichinga in October and November of 2008. Three Penn State faculty – Rachel Smith, Mike Jacobson and Jill Findeis – are traveling to the selected Sussendenga villages (Munhinga and Messambuzi) in mid-October to pretest the survey. Luis Sevilla, a PhD student working with Jill Findeis, has been working in Mozambique since August 4 to collaborate with Ana Lidia

Gungaro, CESE, IIAM, to pre-visit the villages selected for the pre-test, and to generate GPS coordinates for large-scale high resolution Google maps being made to facilitate the survey effort, to help in understanding village networks, and to gain a better understanding of location of fields, quality of infrastructure and market access. Survey personnel will be trained when the Penn State faculty are on-site. The Social Science Research Institute (SSRI) at Penn State is financing the travel of Dr. Smith for this effort.

Explanation for Changes

Research progress in Mozambique was retarded by delayed delivery of funds caused by slow processing of the award and subcontract by the Penn State administration. The Penn State administration has informed us that funds will be wired to IIAM and EAP Oct 1 2008. Training progress has been delayed by the failure of all 5 MS candidates from IIAM to pass the TOEFL. Since the project began April 2008, time required for graduate applications for August 2008 was already short- the additional burden of the TOEFL for IIAM staff proved to be a major problem for graduate training on such an accelerated and abbreviated schedule. We hope to have two alternate candidates from Anglophone countries (Malawi and Kenya) begin their studies in the next reporting period.

Networking and Linkages with Stakeholders

The PIs participate in a range of research networks including Central American and African bean research networks.

Networking Activities with Stakeholders

The PIs participate in a range of research networks including Central American and African bean research networks.

Leveraged Funds

Name of PI receiving leveraged funds: Juan Carlos Rosas

Description of leveraged Project: Validation of drought and low fertility tolerant bean lines in Honduras and Nicaragua

Dollar Amount: $240,000

Funding Source: Red SICTA/

Name of PI receiving leveraged funds: Jonathan Lynch

Description of leveraged Project: Increasing phosphorus efficiency and production of grain legumes in China and Africa

Dollar Amount: $800,000

Funding Source: McKnight Foundation

Name of PI receiving leveraged funds: Jonathan Lynch

Description of leveraged Project: Characterization of root traits contributing to enhanced phosphorus acquisition from low fertility soil

Dollar Amount: $30,000

Funding Source: IAEA

Name of PI receiving leveraged funds: Jonathan Lynch

Description of leveraged Project: Basal root architecture and drought tolerance in common bean

Dollar Amount: $900,000

Funding Source: GCP

List of Scholarly Activities and Accomplishments
No information provided.

Contribution of Project to Target USAID Performance Indicators
No information provided.

Contribution to Gender Equity Goal
No information provided.

Progress Report on Activities Funded Through Supplemental Funds
No information provided.

Tables/Figures Cited in the Report
No information provided.

Literature Cited
No information provided.

Capacity Building Activities: P1-PSU-1

Degree Training:

Student #1

First and Other Given Names: IIAM Scientist 1
Last Name: TBD
Citizenship: Mozambique
Gender: Male
Degree: M.S.
Discipline: Agronomy
Host Country Institution to Benefit from Training:
Training Location: Penn State
Supervising CRSP PI: Lynch, Jonathan
Start Date: 10/08
Project Completion Date: 10/10
Training Status:
Type of CRSP Support (full, partial or indirect): Full (Category 1)

Student #2

First and Other Given Names: IIAM Scientist 2
Last Name: TBD
Citizenship: Mozambique
Gender: Male
Degree: M.S.
Discipline: Plant Nutrition
Host Country Institution to Benefit from Training: IIAM
Training Location: Penn State
Supervising CRSP PI: Lynch, Jonathan
Start Date: 10/08
Project Completion Date: 10/10
Training Status:
Type of CRSP Support (full, partial or indirect): Full (Category 1)

Short-term Training:

Type of Training: In service

Description of training activity: in service training of INTA agronomists in root biology

Status of this activity:

Reason if training activity not completed as planned:

When did the activity occur?:

Location: Penn State

Who benefited from this activity?: INTA agronomists

Number of Beneficiaries: 2

Male:

Female:

Total:

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: Improving bean production in drought-prone, low fertility soils of Africa and Latin America - an integrated approach

Abbreviated name of institutions

	IIAM			EAP			PSU		
	Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *
	(Tick mark the Yes or No column for identified benchmarks by institution)								
Objective 1									
Aggregate germplasm	x	x							
Phenotyping root traits									
Screen for drought/low P tolerance									
Field evaluation/trials of identified genotypes									
Introgress root traits for drought/low P tolerance				x	x				
Objective 2: agroecology									
install erosion lysimeters Lichinga	x		x						
conduct erosion studies Lichinga									
analyze erosion results Lichinga									
obtain ground local rock phosphate (RP)	x		x						
conduct greenhouse studies w RP									
establish soil moisture plots									
intercropping study conducted									
Objective 3: socioeconomics									
develop survey instrument							x	x	
human subjects approval of survey							x	x	
interviewer training completed									
filed test survey instrument									
quantitative survey conducted									
Objective 4: capacity building									
recruit IIAM MS students	x		x						
MS student practicum				x	x				
MS student coursework									
MS student research begun									
INTA training									
internet access Chokwe									
analytical capacity at Sussundenga									
web resource root methods									
root phenotyping methods				x	x				
Name of the PI reporting on benchmarks by institution	Miguel			Rosas			Lynch		

Name of the U.S. Lead PI submitting this Report to the MO Lynch

Signature ##### **Date**

* *Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 -- September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: Improving bean production in drought-prone, low fertility soils of Africa and Latin America - an integrated approach
Lead U.S. PI and University: Jonathan Lynch, Pennsylvania State University
Host Country(s): Mozambique, Honduras

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	0	0	0	
Number of men	0	0	2	
Short-term Training: Number of individuals who have received short-term training				
Number of women	0	0	1	
Number of men	0	0	1	
Technologies and Policies				
Number of technologies and management practices under research	3	5	6	
Number of technologies and management practices under field testing	0	2	6	
Number of technologies and management practices made available for transfer	0	0	4	
Number of policy studies undertaken	1	1	1	
Beneficiaries:				
Number of rural households benefiting directly	0	0	256	
Number of agricultural firms/enterprises benefiting	0	0	10	
Number of producer and/or community-based organizations receiving technical assistance	0	0	10	
Number of women organizations receiving technical assistance	0	0	2	
Number of HC partner organizations/institutions benefiting	1	1	3	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	0	0	0	

Modern Cowpea Breeding to Overcome Critical Production Constraints in Africa and the US.

Principle Investigators

Philip A. Roberts, University of California-Riverside, USA
Ndiaga Cisse, ISRA, Senegal
Issa Drabo, INERA, Burkina Faso
António Chicapa Dovala, IIA, Angola

Collaboratoring Scientists

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Abstract of Research Achievements and Impacts

Progress was made in three areas for the objective "Develop improved, pest resistant and drought tolerant cowpea varieties for target regions in sub-Saharan Africa and the US." Final testing and release of cowpea varieties: In California, Breeder and Foundation Seed of new 'blackeye' cowpea CB50 was increased, its release approved by UCR Variety Release Committee, and filing made for PVP and Variety Registration. Elite novel dry grain 'all-white' and 'dry green' cowpea lines were evaluated in three on-station trials for grain quality, yield, disease and insect resistance. In Burkina Faso, final yield testing of two new varieties were made in 5 provinces. In Senegal, on-farm tests were made and Foundation Seed produced to complete release of line ISRA-2065 with both thrips and aphid resistance for the wetter cowpea production zone. Advanced yield trials: These were conducted in Burkina Faso (2), Senegal (2) and California (3) on a total of 180 lines for release selection based on grain quality, yield, and disease and insect resistance data. Crosses for developing new breeding lines: crosses were made in Burkina Faso (7), Senegal (12) and California (21) to combine high yield, grain quality, and abiotic and biotic stress resistance traits. F1 and in some cases F2 seed were produced for use in population selection and recurrent backcrossing efforts. Under the Objective "Strengthen cowpea seed production and delivery systems in Angola, Burkina Faso and Senegal to ensure delivery of improved varieties" the following was achieved: In Burkina Faso, Breeder Seed of 10 improved varieties was grown in Pobe-Mengao, with anticipated yield of 100 kg seed of each entry. Foundation Seed of four varieties was produced at Saria and Pobe- Mengao, and preparations made for producing Foundation Seed of four varieties during the off-season under irrigation at three locations. In Senegal, Melakh and Yacine Foundation Seed was produced (50-100 kg per variety) to EWA seed producer network. In Thilmakha area, Senegal, Foundation Seed was distributed to two farmers for production of 1 ha each of Melakh and Yacine Certified Seed. Certified Seed production was also initiated in the Mekhe and Merina areas and farmer training for seed production conducted. Foundation Seed was provided to Producers Professional Training Center, Sangalkam and 1 ton of Melakh and Yacine seed was produced. Fields were visited by 44 producers representing 10 farmer organizations from 2 villages. In Angola, initial assessment of the infrastructure available for developing a viable seed production and distribution system was initiated, recognizing that no system exists currently. This effort is being coordinated with Dr. Beaver who is assessing the bean breeding and seed distribution setup.

Project Problem Statement and Justification

The primary project focus is to 1) increase productivity of African and U.S. cowpea producers through improved varieties that possess resistance or tolerance to the major abiotic and biotic stresses impacting production in these areas; 2) expand grower marketing opportunities by breeding cowpea varieties with desirable grain characteristics; 3) help ensure adequate seed of improved cowpea varieties; and 4) provide

training and capacity building in modern cowpea breeding to African researchers. This project addresses primary constraints under the Topical Areas of Inquiry for *Theme A* "reducing cowpea production costs and risks for enhanced profitability and competitiveness", and *Theme B* "increasing the utilization of cowpea grain, food products and ingredients so as to expand market opportunities and improve human health." Genomics and modern breeding methods will be used to improve cowpea for yield limiting constraints. By leveraging genomic resources developed under a complementary cowpea project, we will implement a comprehensive application of modern breeding protocols for cowpea. Until now cowpea, as an 'orphan crop', has lacked genomic resources for modern breeding despite its importance in African agriculture.

Increasing Cowpea Productivity. Low agricultural productivity is central to rural and urban poverty in Africa. On-farm cowpea yields in West Africa average 240 kg/ha even though potential yields (on-station and on-farm trials) are five to ten times greater. Drought, poor soil fertility, insect pests and diseases are major constraints. Cowpea varieties that yield more without purchased inputs especially benefit poor farmers, many being women who lack access to the most productive lands.

Productivity is central to increasing rural incomes irrespective of changes in cowpea acreage, because less land, labor, and capital are needed to produce the same amount of cowpeas. The resources can then be invested in other activities that help boost total family income. Productivity increases also help reduce prices to urban consumers since some farmer cost-savings can be passed through to consumers. Sustainable increases in cowpea productivity in Africa and the U.S. can be achieved by developing varieties with resistance to insects, nematodes and pathogens, drought tolerance, and ability to thrive under low soil fertility.

Increasing Marketing with Improved Varieties: New cowpea varieties must have features desired by consumers as well as farmers, including rain appearance, coupled with desirable cooking qualities and processing characteristics for specific products. Landrace grain types are often preferred locally, and if over-produced, prices offered to farmers can be low because of limited demand. Large white grains with rough seed-coat are preferred throughout West Africa and can be marketed over a wide area, buffering supply (and prices) in the region. Large white grains are also amenable to direct dry milling for use in value-added foods such as 'akara', 'moin-moin', and prototype value-added products. Development of adapted cowpea varieties with large white grain and resistance to pests would increase the marketing opportunities of cowpea farmers and traders in both Africa and the U.S. There is also considerable demand for large rough-brown seed type, especially in urban centers in Nigeria, but the standard rough-brown 'Ife Brown' is susceptible to pests and diseases. Other opportunities exist for new cowpea products based on the 'sweet' trait; sweeter and milder taste could help broaden cowpea consumption in the U.S. and Africa and to Latin America and elsewhere.

Increasing Seed Supply of Improved Varieties: Cowpea breeding by the CRSP, African NARS, and IITA (Senegal, Burkina Faso, Nigeria, and other countries) has led to improved cowpea varieties that are near release. However, only about 5% of the cowpea area in Africa is planted to improved varieties and their potential goes largely unrealized. Common bean research showed that rural African farmers will buy seed when it is available, suggesting that there is probably a market for cowpea seed as well.

Recently, effective models for production and dissemination of improved cowpea seed have evolved in Burkina Faso and Senegal, based on collectives (e.g. women farmer organizations) and for-profit seed cooperatives (NGO-established, but now largely self-sustaining). However, their limited scope reflects insufficient quantities of Breeder and Foundation Seed. We propose to help support increased production of Breeder Seed and work with producers of Foundation Seed to strengthen their production and marketing. Strengthening seed production and delivery at the early breeder-involved stages will promote availability of high quality planting seed.

Training and Capacity Building: The research under these topical areas will provide an excellent framework for training current and new African scientists and capacity building for Host Country Institutions (*Theme D* "increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the cowpea sector in developing countries).

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: Develop improved, pest resistant and drought tolerant cowpea varieties for target regions in sub Saharan Africa and the US using modern plant breeding tools.

Approaches and Methods: Three main paths of work will be followed to achieve our research objective. We will complete final testing and release protocols of lines developed under the previous Bean/Cowpea CRSP of other germplasm in the development 'pipeline', and initiate new short- and long-term breeding strategies to develop high-yielding improved varieties.

Final Testing and Release of Varieties
Several advanced breeding lines have been developed under the previous Bean/Cowpea CRSP at UCR and in Burkina Faso and Senegal that are nearing release (Table 1). Limited experiment station and/or on-farm tests are needed to complete the final evaluation of these lines.

Table 1. Varietal candidate lines

Candidate Line	Developing Institution	Releasing Institution	Type	Steps Needed in Workplan Period
03Sh-50	UCR	UCR	Blackeye	Completion of Release, PVP Documentation
07-11-572	UCR	UCR	All-white	Experiment station tests. Breeder and Foundation seed increase
03-11-747	UCR	UCR	'Dry Green'	Experiment station tests. Breeder and Foundation seed increase
IT98K-205-8	IITA	INERA	White	Seed production and on-farm evaluations
Melakh	ISRA	INERA	White	Seed production and on-farm evaluations
KVx421-2J	INERA	INERA	White	Seed production and on-farm evaluations
ISRA2065	ISRA	ISRA	White	Final on-farm evaluation, Breeder and Foundation seed increase

In Burkina Faso and Senegal, final on-farm evaluations of four lines (Table 1) will be conducted, and the lines released by the end of workplan period. In Senegal, candidate ISRA 2065 will be compared to 'Melakh' in on-farm trials grown at five sites in the 'Peanut Basin' area of the country. Each on-farm trial will consist of plots ¼ ha in size. Also, 60 advanced lines will be evaluated in on-station trials at 3 locations (Bambey, Nioro, Louga). The trials will have 4 replications with each plots being four rows and 5 m length.

In Burkina Faso, the 3 varietal candidate lines will be grown in on-farm trials by 5 farmer groups at Pisela Village and at 10 other sites in Central and Northern Burkina Faso. Sites will be considered as

replications and each plot will be 300 m^2. In addition, six other new candidate varieties that have been developed at INERA will be evaluated in on-farm trials at the same 10 sites in Central and Northern Burkina Faso.

At UCR, breeder and foundation seed of 03Sh-50 was produced in 2007 in anticipation that this variety would be released in 2008. We will continue to work with at least two farmers and one cleaning warehouse (Cal Bean and Grain, Pixley, CA) by monitoring these fields from planting through sales of the product. The farmers will grow two 15-ha production-scale fields of 03Sh-50 and the standard cultivar CB46. The grain produced will be cleaned at Cal Bean and Grain and this warehouse will supply commercial 'clean-out' information. During the first six months, we will collate existing information from on-station and on-farm trials conducted between 2003 and 2007 with this variety, request formation of a UCR Variety Release Committee, and file for Plant Variety Protection and Variety Registration through the Crop Science Society of America. For 07-11-572 and 03-11-747 (or a related 'sister line'), a 'fast-track' release protocol will be followed to accommodate the needs of potential licensees for these varieties to be made available as quickly as possible. We will be able to do this because these varieties represent new grain types that do not have existing standard varieties with which they can be compared. In anticipation of release of these lines, Breeder and Foundation Seed of these lines will be produced by the end of the workplan period.

A set of five advanced blackeye lines have already been identified as potential blackeye cowpea varieties for the US. These will be included in advanced trials that will be conducted in trials conducted at two locations (Shafter and Kearney) during the workplan period. Each trial will have at least four replications with plots consisting of 4 rows, with rows 8m long. One or more of these varieties may be advanced to candidacy for release by the end of the workplan period.

We will initiate a new two-tiered breeding strategy to meet the immediate and longer term needs of farmers. The **Short-Term Strategy** will use improved and local varieties having both grain quality and agronomic features appreciated by farmers such as appearance, taste, cooking qualities, yield stability, appropriate plant type and maturity. Obvious defects in local and improved varieties will be improved by breeding in resistance to diseases and pests plus other traits, using a rapid recurrent backcrossing approach that will improve productivity and be accepted by farmers. During the first six months, selected varieties to be improved by this approach are given in Table 2.

Table 2. Lines to be improved by introgression of specific traits using backcrossing.

Recurrent Parent Line	**Institution**	**Trait being introgressed**	**Trait donor (non-recurrent) parent**
Yacine	ISRA	Macrophomena	IT93K-503-1
Yacine	ISRA	Flower thrips resistance	58-77
Yacine	ISRA	Striga	SuVita 2
Mouride	ISRA	Large grain	Montiero derived line
Melakh	ISRA	Striga resistance	IT97K-499-39
Melakh	ISRA	Green grain	UCR 03-11-747
KVx396-4-5-2D	INERA	Striga resistance, Large grain	IT81D-994
KVx396-4-5-2D	INERA	Green grain	UCR 03-11-747
IT98K-205-8	INERA	Large seed	Montiero derived line
CB5	UCR	Fusarium wilt	CB27
CB46	UCR	Green grain	UCR 03-11-747
CB46	UCR	Root-knot nematodes	IT84S-2049

During the workplan period crosses between the recurrent and non-recurrent parents will be made, plus the first and second backcrosses, followed by inbreeding the second backcross progenies to develop BC_2F_2 families. Early in the second workplan period, these progenies will be evaluated for trait expression, and a third backcross made onto selected individuals. Molecular markers for some of the target resistance traits emanating from the EST-derived SNP-marker genotyping effort under the GCP-TL1 cowpea project will be used to select progenies carrying required alleles at each BC generation before flowering. This will allow quick identification of individuals without phenotyping for another round of backcrossing.

The **Longer Term Strategy** is to pyramid resistance and grain quality factors in varieties desired by farmers using crosses between elite parents having complementary parental lines. To develop high performing, drought tolerant varieties we will use a 'two-stream' recurrent selection approach. One stream will include the six possible biparental crosses between highly drought tolerant lines SuVita 2, 58-57, TN88-63, IT93K-503-1. The F_1's will be made at UCR, then advanced to the F_2 generation and subjected to seedling screening for drought tolerance. A set of 100 drought-tolerant F_2 individuals will be identified and advanced to the F_3 for each population. By the end of the workplan period, the 100 F_3 lines of each population will be developed. They would then be selected again for drought tolerance at the seedling stage, and 50 F_4 lines selected at UCR. Two of the six populations of 50 F_4 lines would be distributed to each program (UCR, ISRA, and INERA) for drought tolerance phenotyping. A smaller subset of 10 lines would be selected from this evaluation, and reevaluated for drought tolerance at the F_5 generation. Individuals from the most drought tolerant lines will be used for crossing to the improved lines developed under the backcrossing program described earlier and in Table 2. Also in the workplan period, breeders in Senegal and Burkina Faso will choose a set of popular local cowpea varieties for targeted genetic improvement through MAS or MARS. These will be hybridized to sources of known thrips resistance and heat/drought tolerance. Using greenhouse and off-season nurseries, the F_1 and F_2 generations will be advanced as quickly as possible. Individuals selected with markers will be evaluated for trait expression to validate the usefulness of the markers in different genetic backgrounds.

Results, Achievements and Outputs of Research:

Final Testing and Release of Varieties:

At UC Riverside a combination of experiment station and on-farm test sites were used to conduct near final evaluations of the advanced lines for pre-release performance data and seed multiplication for release requirements. For the new 'blackeye' cowpea variety released in 2008 03Sh-50, 1.6 ha of 'Foundation to Foundation' seed was produced by the UC Foundation Seed Program, yielding about 6,500 lbs of 'new crop' Foundation Seed. 400 lbs of the 2007 Foundation seed crop was used to plant 3.2 ha for Certified Seed production on a grower's ranch. The crop was harvested recently and yielded approximately 9,000 kg of Certified Seed,A 15-ha production-scale field of 03Sh-50 and the standard cultivar CB46 were grown during the 2008 season. The grain produced is being cleaned at Cal Bean and Grain Cooperative, Pixley, CA and this warehouse will supply commercial 'clean-out' percentages and market demand information received from grain legume brokers and sales personnel.

Existing information from on-station and on-farm trials conducted between 2003 and 2007 with this variety was collated and submitted to the UCR Variety Release Committee who approved the release in May 2008. We worked with our campus Intellectual Property Office and their designated legal representatives to file for Plant Variety Protection (PVP). We are developing a Crop Science manuscript describing the new release registration and Variety Registration through the Crop Science Society of America.. The new variety is named 'California Blackeye 50' ('CB50'). Three kg seed was deposited with the USDA germplasm repository in October 2008 as part of the release requirement. In developing the 'fast-track' release requirements for the novel dry grain 'all-white' and 'dry green' cowpeas, the elite lines 07-11-572 and 03-11-747 and related 'sister lines' were evaluated in on-station trials in 2008 at Parlier (Kearney Center) and Shafter (UC Research and Extension Centers both located in the San

Joaquin Valley main production area) and at the UC Riverside station, in comparison with standard blackeye varieties CB46 and CB27During the spring of 2008, 5 kg of seed all-white breeding line 07-11-572 was planted on 0.4 ha the UC Riverside Coachella Valley Research Station to produce sufficient seed for a large-scale grower trial during the main summer season. 125 kg of seed was harvested and given to the grower who planted the seed on 5.3 ha on July 2. This trial was recently harvested (13,250 kg produced) and yielded approximately 2,500 kg/ha, which is comparable to California blackeye yields for this location and planting date. Grain samples of this variety have been shipped to a major US food company for evaluation for use in several products. Evaluations were made for grain quality, yield, disease (nematode and root-rot) and insect (lygus and aphid) tolerance and resistance. Harvest stage data from these trials is being collected at time of reporting. These field evaluations will be used to support release applications in 2009, when Breeder and Foundation Seed of these lines will be produced.

In Burkina Faso, field evaluations for final yield testing to support release of new varieties IT98K-205-8 and Melakh were made during the 2008 season. These are improved varieties obtained from the previous Bean/Cowpea CRSP collaborative activities. They are early (60 days to maturity), high yielding varieties that are adapted to the main cowpea growing area of Burkina Faso, and as such, represent an excellent opportunity to have immediate impact for cowpea farmers through INERA release. On-farm yield tests were conducted in 5 villages of 5 different provinces of the country. In each village, 3 farmers conducted the evaluation trial. At time of reporting the trials has been harvested at all the sites and yield and grain quality data are being processed. Hundreds of visitors from the farming community and cowpea sector have visited the trial. The positive responses to these evaluations indicated that cowpea farmers are ready to adopt these new varieties.

In Senegal, the breeding line ISRA-2065 was developed under the previous Bean/Cowpea CRSP from a cross between the high-yielding CRSP cultivar 'Mouride' and aphid and thrips resistant local landrace accession '58-77', with the objective of developing a cultivar with the yield and stability of Mouride but with resistance to aphids and thrips. ISRA-2065 ISRA-2065 is as early as Melakh (60 days from planting to maturity) and has the same desirable grain quality. It has been tested extensively in the peanut basin of Senegal and additional on-farm assessments were made during 2008. This variety is being targeted for release in the wetter part of this cowpea production zone where flower thrips are especially damaging since it has stronger resistance to thrips than Melakh. On-farm tests in 2008 were conducted in collaboration with the NGO 'ANCAR' in the Kaolack (Nioro) area and with the NGO 'EWA' in the Southeastern region of Sedhiou. In this zone the tests were also coupled with Foundation Seed production in preparation for formal release.

Advanced yield trials:
In Burkina Faso, two advanced yield trials were conducted at Saria and Pobe Mengao. A set of 23 improved insect tolerant lines were compared to a popular released variety (KVx 396-4-5-2D) This variety will be used in the recurrent backcrossing program. Each trial had a randomized block design with 3 replicates. The trials have been harvested at the two sites and performance data are being analyzed. The best performing lines will be re-tested in the 2009 season at multiple sites in anticipation of decisions on release of one or more of the lines.

In Senegal (ISRA) two advanced yield trials were conducted at the Bambey and Thilmakha ISRA field stations. The first trial included 98 lines from the cross Nd. AW x Yacine and the two parents. The experimental design was a 10 x 10 lattice with 2 replications. Two-row plots 5 m long were used. The second trial included 54 lines from the following crosses: Mélakh x UCR 232; CB 27 x Mélakh; Mélakh x Monteiro derived lines, and ND. AW x Yacine. The control entries were Mouride, Mélakh, Yacine, and ISRA 2065. A randomized block design with 4 replications was used. Individual plots were 4 rows, 5 m long. The two center rows are being used for yield and agronomic characterization of each line, and harvest data are being collected at time of reporting.

In California, a set of five advanced blackeye lines previously identified as potential blackeye cowpea varieties for the US were evaluated during the 2008 season in advanced trials conducted at two locations (Parlier and Shafter). Each trial had six replications with plots consisting of 4 rows, with rows 8m long. The grain quality, yield and disease and insect resistance data will be finalized during the off-season. We anticipate that one or more of these varieties will be advanced to candidacy for release by the end of the current workplan period, following further field testing in 2009.

Crosses for developing new breeding lines:
In Burkina Faso, Dr. Drabo made all the planned crosses except those with Montiero as a trait donor parent. These are summarized in Table 3. The F1 generation seed will be advanced to F3 stage during the current workplan period. The Montiero crosses will be made during the 2008-2009 off-season during the current workplan period. The ultimate goal of the crosses is to increase seed size of the improved varieties for Burkina Faso since large seed size is one of the most important characteristics of preference in the sub-region. The range of crosses should allow selection of new larger seeded varieties carrying important insect, disease and Striga resistance traits. The national cowpea plan of action for Burkina Faso has stressed the Importance of exporting the surplus cowpea production to the neighboring countries that have deficits of more than 500,000 metric tons.

In Senegal, all the planned crosses were made by Dr. Cisse at ISRA except for Melakh x UCR 03-11-747 because of seed viability problems. This cross will be made during the period January-March 2009. The crosses are summarized in Table 4. For introgressing Striga resistance, Yacine was crossed with a more recent line (IT90K-76) instead of Suvita 2. Advanced lines from Melakh and Montiero derived genotypes with large seeds are in yield trials. The Mouride x Monteiro lines will introduce large grain quality into a drought and striga resistant background. Additional crosses were also made and included ISRA-2065, Yacine and Melakh each crossed with the Striga resistant lines IT82D-849 and IT90K-77, and 58-57 x Suvita which is part of the 'High x High' elite line long-term breeding strategy.

In California, Dr. Ehlers made the planned crosses at UC Riverside during the summer of 2008 for use in the recurrent back-crossing program (Table 4). Some of these were based on previous introgression crosses with the trait donors, whose best looking late backcross progeny were crossed with the recurrent CB5 and CB46 backgrounds. Small replicated plot field tests of the back-cross populations were made at on–station evaluation sites during the 2008 season to assess seed size and quality, and several promising lines were selected. A significant challenge is to select improved lines with acceptable grain size, especially in the CB46 x IT84S-2049 cross because the nematode resistance donor is a small-seeded African line.

Under the planned 'Longer Term Strategy' to pyramid resistance and grain quality factors in varieties desired by farmers using crosses between elite parents having complementary parental lines, several activities were initiated during the reporting period. To develop high performing, drought tolerant varieties we will use a 'two-stream' recurrent selection approach. For the first stream, five bi-parental crosses between highly drought tolerant lines SuVita 2, Mouride, IT97K-499-39, IT97K-556-6, IT84S-2246, and IT93K-503-1 were made during the spring of 2008 at UC Riverside. The resulting F1's were then advanced to the F2 generation during the summer in the greenhouse. 100 F2 individuals per cross are now being advanced in the greenhouse to create 100 F3 families that will be subjected to seedling screening for drought tolerance during 2009 (Table 6). Other sets of F2 populations between drought tolerant lines Mouride, IT93K-503-1, IT97K-499-39, IT98D-1399, and Ein El Ghazal (Sudan) and elite African breeding lines KVx61-1 and KVx544-6-151 (both from Burkina Faso), Apagbaala and Marfo-Tuya (both from Ghana), UCR 779 (Botswana), and IT82E-18, IT95K-1479, IT97K-819-45 and IT98K-558-1 were planted at the Coachella Valley Agricultural Research Station in mid-August under drip-irrigation and subjected to terminal drought conditions by withholding water just prior to flowering to the end of the crop cycle. Single plant selections from these F2 will be made based on visual performance

under drought. Thus we are on track for later generation selections being distributed to each program (UCR, ISRA, and INERA) for drought tolerance phenotyping and for use in crossing to the improved lines developed under the backcrossing program summarized in Tables 3-5.

Objective 2: Strengthen cowpea seed production and delivery systems in Angola, Burkina Faso and Senegal to ensure delivery of improved varieties.

Approaches and Methods: Cowpea seed production and delivery systems in Burkina Faso and Senegal will be strengthened to ensure delivery of improved varieties. Adoption of improved varieties is constrained by inadequate supply of Breeder and Foundation Seed, which in turn limits the Certified Seed that can be produced. Insufficient resources limit growing, harvesting and storing Breeder Seed increases, in turn limiting Foundation Seed and Certified Seed for farmers is due to the lack of Foundation seed coupled with the relatively low interest in cowpea by public and governmental organizations and private seed companies.

We will increase directly amounts of Breeder and Foundation Seed available to Certified Seed producers, help identify new Certified Seed producers, and strengthen and expand proven activities in Senegal and Burkina Faso through leveraged funding from NGOs and USAID Mission funding, if possible. We will work with the national extension services in Senegal (ANCAR), Burkina Faso, and Angola (SENSE) to reach the farmers' organizations in different communities. We will also seek to strengthen the small private seed producers, some of them already working on cowpea.

A strategy adopted by the newly created GCP/ICRISAT 'Legumes for Livelihoods' project that is on-going in Niger, Nigeria, Mali, Tanzania, and Mozambique for cowpea is to improve farmers' access to seed and enhance widespread adoption of improved cowpea varieties through the development and promotion of community seed production and promotion of local markets for seed. Their well-considered view is that no single agency can produce and provide the required quantities of high quality planting seed. Seed of improved varieties can be disseminated through rural retail networks based on government schools. In Senegal, Burkina Faso, and Angola, schools can act as a seed supply center in each village, with teachers trained on procedures for quality seed production. Several progressive farmers will be selected per village and given guidance in seed production and supplied with quality Foundation Seed for multiplication. They will become the source of improved seed for the entire village. From these efforts, local entrepreneurs may arise to form local seed companies. Strong linkages will be developed with PASS (Program for Africa's Seed Systems), WASNET (West African Seed Network) and other programs to derive synergy in promoting local seed enterprises.

In Burkina Faso, Breeder Seed will be produced in the off-season for five varieties (IT98K-205-8, Melakh, KVX421-2J, KVX414-22-2, Gorom Local) on 200 m^2 per variety. The seed will be produced at Bazega under irrigation. Foundation Seed production will be made to ensure an adequate capacity on each of the three INERA stations (Saria, Pobe, and Kamboinse). This activity will generate about 4 tonnes of Foundation Seed on 5 ha planting. This will address the estimated 20 % shortage of Foundation seed, kick-starting an expansion of the self-sustaining system seed production system. Training of farmers as Certified Seed producers will be done in three locations (ZandomaProvince and SenmatengaProvince in the north, and NayalaProvince in the center). At each location, 25 seed producers, a mix of women and men, will be trained. Foundation Seed will be provided and farmers will be trained in seed production, harvest and post-harvest handling, recognizing that this process differs from the production of cowpea for consumption.

In Senegal, availability of Foundation Seed has been identified as a bottleneck for adequate supply of seed to farmers. Foundation seed is used to produce the Certified Seed that is distributed to farmers for production planting. To overcome this, N. Cisse will produce ½ ha of Melakh and ½ ha of Yacine to

complement the Foundation Seed production by the ISRA seed unit at Bambey. This effort will help to identify the demand level for Foundation Seed and provide seed for establishing new Certified Seed growers in cowpea production areas where there is currently no formal Certified Seed production effort. To achieve new Certified Seed grower establishment, we will work with the national Extension Service (ANCAR) and farmer organizations at 3 locations (Thilmakha region, Merina district, Mekhe). At each location, Foundation Seed will be provided and farmers will be trained in seed production, harvest and post-harvest handling, recognizing that this process differs from the production of cowpea for consumption. Organizations who contact ISRA for Certified Seed will be directed to the new Certified Seed producers, to establish a supply and demand relationship that should become self-sustaining.

In Angola, we will conduct an initial assessment of the infrastructure available upon which to develop a viable seed production and distribution system, recognizing that no system exists currently. We will link with government and NGO institutions, including World Vision, Africare, CRS and ADRA-Angolana, to determine opportunities for initiating the cowpea seed system. We will provide guidelines and descriptions for Angolan nationals in multiplication of high quality seed of selected varieties for farmers. In parallel to this effort, the cowpea field evaluations will be conducted under Objective 1, with the aim of identifying candidate varieties among local landraces, and Bean/Cowpea CRSP (in Ghana, Senegal and/or Burkina Faso) and IITA varieties. One or more of these candidates will become the first varieties to be formally produced for farmers under the new seed system. We will plan to use the data from the primary season trials, planned for completion in March 2009, to make the variety selection and produce the first generation (G1) of Breeder seed by the end of the workplan period.

Results, Achievements and Outputs of Research:

In Burkina Faso, in order to satisfy the demand for Certified Seed production, Breeder Seed of ten improved cowpea varieties was produced at the northern location of Pobe-Mengao during the 2008 season. The varieties were KVx 396-4-4, KVx 396-4-5-2D, KVx 414-22-2, KVx 421-2J, KVx 771-10, KVx 775-33-2, Gorom Local, Melakh, KVx 745-11P, and IT98K-205-8. Will harvesting and cleanout is ongoing at time of reporting, we anticipate that at least 100 kg of seed of each entry will be obtained. One hectare of Foundation Seed for each of four varieties (KVx 61-1, KVx 396-4-4, KVx 396-4-5-2D, KVx 745-11P) was produced at Saria and Pobe- Mengao. The objective was to complement the national Foundation Seed demand, estimated to be35 metric tonnes this year for Burkina Faso. Planting preparations have been made for Foundation Seed of varieties KVx 414-22-2 (2 ha), IT98K-205-8 (0.5 ha) and Melakh (0.5 ha) that will be produced during the off-season in October 2008 and February 2009 under irrigation at three identified sites. Money obtained by selling the Foundation Seed will be used for supporting next year's seed production activities in attempts to establish a self-sustaining plant seed production and delivery system. Plans and materials are in preparation for training at least 40 leader-farmers to produce and conserve Certified Seed in the next year before the 2009 rainy season.

In Senegal, with additional support of EWA, 1 ha each of Melakh and Yacine Foundation Seed was produced at the ISRA Bambey station. An agreement was made to provide 50 kg seed of each variety to EWA network of seed producers, but it is expected that at least twice this amount will be made available to the NGO based on the 2008 yield. This network has several women seed producers as members. In the Thilmakha area, Foundation Seeds were distributed to two farmers for production of 1 ha of Melakh and 1 ha of Yacine Certified Seeds during the 2008 season. These lead-farmers were part of the mini-kit on-farm testing network established under the previous Bean/Cowpea CRSP and they were familiar with the improved production practices promoted by ISRA. Certified Seed production was also initiated in the Mekhe and Merina areas on 1 ha each. In both areas a women seed producer was included. Training of farmers during the 2008 season for seed production consisted of field selection, rouging of off-types and diseased plants, and both harvest and post-harvest handling. Double bags will be provided to farmers for storage. Foundation seeds were also provided to the Producers Professional Training Center (CPFP) of Sangalkam (West of Thiès) for production of 1ha each of Melakh and Yacine. About 1 metric tonne of

seeds was obtained. The fields were visited during the season by 44 producers composed of women and men, representing 10 farmer organizations from 2 villages.

In Angola, we are conducting an initial assessment of the infrastructure available upon which to develop a viable seed production and distribution system, recognizing that no system exists currently. This effort is in conjunction with Dr. Beaver who is visiting Angola in November for similar assessments of the bean breeding and seed distribution setup.

Explanation for Changes

The following provides explanation for the non-achievement of benchmark indicators:
Under Objective 1 Breeding: Germplasm assembly and seed increase in Angola. There was considerable delay between UCR and MSU in finalizing the main sub-contract for the project. This in turn caused delay in the execution of the sub-agreement between UCR and IIA. Unfortunately, unlike the other HCs under this project, IIA had little capability to initiate the work without funding. Nevertheless, the assembly of cowpea germplasm has made good progress, but the seed increase will be made during the next cropping season, in early 2009.

Angola (Univ. PR) started.

Under Training: MS Training (Breeding) -
Difficulty was encountered in identifying an appropriate Angolan student for this program. The initial student identified will not now participate in the project training through UPR. However, an excellent alternative student has been identified and is now processing his application through UPR. Because of the delay, the revised plan is for the student (Mr. Antonio David) to come to UCR during the 2009 summer to work with the cowpea research and breeding program, before starting the MS degree training at UPR in Fall Semester 2009.

Networking and Linkages with Stakeholders

We are working closely with national and international cowpea breeders and other scientists, including Drs. Ousmane Boukar and Christian Fatokun, Senior Scientists and Cowpea Breeders at IITA, Dr. Mohammed Ishiyaku of the IAR in Nigeria, Rogerio Chiulele at Eduardo Mondlane University in Maputo, Mozambique, Michael Timko at University of Virginia and Larry Murdock at Purdue Univ. In June 2008 we sent seed of 150 cowpea accessions and breeding lines to Eduardo Mondlane University. We are working closely with the California Dry Bean Advisory Board and its Blackeye Council on research priorities of the industry. We are working with Inland Empire Foods, an important legume processor based in Riverside, on developing Akara (or 'Bean Tots') for inclusion into the California school program and with another major US manufacturer on utilization of several products that our varieties are well suited to as described in the results section above. We are also collaborating with Dr. Julie Lauren of the Dry Pulse CRSP project and provided seed of 35 cowpea varieties for her project in June 2008. We are also working with Dr. Jim Beaver at the University of Puerto Rico on training a CRSP student from Angola. We have been interacting with Dr. Emmanuel Prophete in Haiti and will be sending him seed of several cowpea varieties for trials he plans to conduct in there.

In Burkina Faso, we are working with AFRICARE, a NGO financed by USAID to ensure food security. Our collaborative work aims to develop new Striga resistant varieties adapted to intercropping. A collaboration with LVIA, a NGO financed by the EU and Italy, aims to train farmers for cowpea certified seed production and conservation. With Association FERT, a French NGO whose aim is to improve cowpea production in the northern part of the country, we have initiated on-farm tests of improved varieties and we are helping them to produce Certified Seed. Linkages have also been made

with five farmer organizations: "Song Taaba" at Donsin near Ouagadougou; "Six S" at Pobe Mengao; Producteurs de semences de Diouroum; Producteurs de Semences at Pobe Mengao; and Producteurs Semenciers Songd Woaga at Saria. In Senegal, collaboration was established with the extension service ANCAR in the Kaolack region and with the PADER project of EWA in the southern region of Sedhiou, for on-farm testing of the advanced breeding line ISRA-2065. EWA, ANCAR-Thiès and CPFP of Sangalkam were involved in seed production in the Mekhe and Merina regions.

Leveraged Funds

Name of PI receiving leveraged funds: Jeff Ehlers
Description of leveraged Project: Drought phenotyping for cowpea
Dollar Amount: $445,000
Funding Source: CGIAR-GCP

Name of PI receiving leveraged funds: Jeff Ehlers
Description of leveraged Project: Improve tropical legumes for Africa
Dollar Amount: $1,952,008
Funding Source: CGIAR-GCP

Name of PI receiving leveraged funds: Phillip Roberts
Description of leveraged Project: Blackeye cowpea varietal improvement
Dollar Amount: $19,900
Funding Source: CDBAB

Name of PI receiving leveraged funds: Phillip Roberts
Description of leveraged Project: Cowpea collection aphid and nematode resistance screening
Dollar Amount: $16,001
Funding Source: USDA

Name of PI receiving leveraged funds: Ndiaga Cisse
Description of leveraged Project: Cowpea Foundation Seed production
Dollar Amount: $2,500
Funding Source: RESOPP-EWA

List of Scholarly Activities and Accomplishments

Dr. Issa Drabo, INERA, Burkina Faso, was awarded on October 5, 2008 "Chevalier de l'Ordre des Palmes Academiques" for his outstanding work on cowpea in Burkina Faso by the Minister of Higher Education and Research on behalf of the Chief of State.

Dr. Jeff Ehlers, UC-Riverside, was awarded the UC-Riverside campus "Distinguished Research Award (Non-Senate) for 2007-2008" in recognition of his research work on cowpea genetic improvement.

Contribution of Project to Target USAID Performance Indicators

No information provided.

Contribution to Gender Equity Goal

Among the target beneficiaries of the project work, the activities in Burkina Faso and Senegal resulted in eight producer/community based organizations being recipients of technical assistance during the report period, which are comprised of women and men. More specifically, four women organizations received technical assistance in Senegal and Burkina Faso, as planned. The technical assistance was focused on seed system processes under Objective 2, for growing, harvest handling and storing cowpea planting seed.

Progress Report on Activities Funded Through Supplemental Funds

During the reporting period, supplemental funds were approved through the CRSP Technical Committee and Director for Capacity Building in the three Host Country partner Institutions. The approvals were made in support of the cowpea breeding and genetic improvement programs as follows:

1. ISRA, Senegal: $30,000 to the Institut Senegalais de Recherches Agricole (ISRA), Bambey Research Station, in support of the purchase of a vehicle that will enhance the capacity of ISRA's cowpea breeding program to serve the needs of stakeholders of cowpea value chains in Senegal.

2. INERA, Burkina Faso: $11,000 to the Institut de l'Environnement et du Recherches Agricoles (INERA) in support of vehicle repair, the purchase of a weather station and training that will enhance the capacity of INERA's cowpea breeding program to serve the needs of stakeholders of cowpea value chains in Burkina Faso.

3. IIA, Angola: $33,600 to the Instituto de Investigacao Agronomica (IIA), Huambo Research Station, in support of the purchase of a vehicle and laboratory equipment that will enhance IIA's research capacity to serve the stakeholders of bean and cowpea value chains in Angola.

The contract for these supplemental awards were not processed during the reporting period, and will be reported on for progress during the October 1, 2008 to September 30, 2009 year under the current workplan period.

Tables/Figures Cited in the Report

Table 3: Crosses (High x High) made with Burkina Faso breeding lines.

Recurrent parent	Traits being introgressed	Donor parents
KVx 745-11P	Medium seed size white and rough	KVx 414-22-2 derived lines and KVx 775-33-2
KVx 396-4-5-2D	Striga resistance and seed size	Kvx 414-22-2 derived lines and KVx 775-33-2
KVx775-33-2	Increased seed size	Montiero
KVx 414-22-2	Increased seed size Striga and virus resistance	KVx 414-22-2 derived lines and Montiero
KVx 414-22-2	Increesed seed size and virus resistance	KVx 775-33-2
KVx 771-10	Striga and insect resistance	IT86D-716 and Moussa Local
KVx 775-33-2	Virulent race of Striga resistance	IT93K-693-2

Table 4. Senegal varieties being improved by introgression of specific traits by backcrossing.

Recurrent Parent Line	Trait donor (non-recurrent) parent	Institution	Trait being introgressed
Yacine	IT93K-503-1	ISRA	Macrophomena
Yacine	58-77	ISRA	Flower thrips resistance
Yacine	SuVita 2 (substituted IT90K-76)	ISRA	Striga
Mouride	Montiero derived line	ISRA	Large grain
Melakh	IT97K-499-39	ISRA	Striga resistance
Melakh	UCR 03-11-747	ISRA	Green grain

Table 5. California blackeye lines being improved by introgression of specific traits using backcrossing at UCR. BC1 to BC6 lines have been generated by 2008 and previous crosses.

Recurrent Parent Line	Trait donor (non-recurrent) parent	Trait being introgressed	Generation
CB5	CB27	Fusarium wilt	BC2F5
CB46	UCR 03-11-747	Green grain	BC4F5
CB46	IT84S-2049	Root-knot nematodes	BC6F6
CB46	Montiero (Brazil)	Large grain size	BC3F6
CB46	Bambey 21(Senegal)	All-white grain	BC4F6
CB46	IT97K-556-6 & UCR 779	Aphid resistance	BC1F4
CB46	IT93K-2046	Lygus resistance	BC3F6

Table 6. List of crosses made and advanced to F2 generation that will provide progenies for selection of drought and pest tolerant cultivars.

Cross	Type	Current Status
SuVita2/Mouride	Elite Drought Tol. x Elite Drought Tol.	F2 – F3 in greenhouse now
IT93K-503-1/IT84S-2246	Elite Drought Tol. x Elite Drought Tol.	F2 – F3 in greenhouse now
Mouride /IT84S-2246	Elite Drought Tol. x Elite Drought Tol.	F2 – F3 in greenhouse now
IT97K-499-39/IT93K-503-1	Elite Drought Tol. x Elite Drought Tol.	F2 – F3 in greenhouse now
IT97K-503-1/IT97K-556-6	Elite Drought Tol. x Elite Drought Tol.	F2 – F3 in greenhouse now
Mouride/Apagbaala	Elite Drought x Elite Heat Tolerant	F2 – F3 in field at Coachella now
KVx61-1/Mouride	Elite x Elite Drought Tolerant	F2 – F3 in field at Coachella now
IT93K-503-1/UCR 779	Elite Drought Tolerant x Drought Tolerant and aphid resistant landrace	F2 – F3 in field at Coachella now
Apagbaala/IT82E-18	Elite Heat Tolerant x Elite	F2 – F3 in field at Coachella now
IT97K-819-45/Ein El Ghazal	Elite x Elite Drought Tolerant	F2 – F3 in field at Coachella now
Ein El Ghazal/KVx544-6-151	Elite Drought Tolerant x Elite	F2 – F3 in field at Coachella now
IT98K-558-1/Mouride	Elite x Elite Drought Tolerant	F2 – F3 in field at Coachella now
Apagbaala/IT98K-558-1	Elite Heat Tolerant x Elite	F2 – F3 in field at Coachella now
IT95K-1479/Mouride	Elite x Elite Drought Tolerant	F2 – F3 in field at Coachella now

Literature Cited

No information provided.

Capacity Building Activities: P1-UCR-1

Degree Training:

Student #1

First and Other Given Names:	Manuel
Last Name:	Costa
Citizenship:	Angola
Gender:	Male
Degree:	M.S.
Discipline:	Plant Breeding/Genetics/Plant Pathology
Host Country Institution to Benefit from Training:	Angola
Training Location:	University of Puerto Rico
Supervising CRSP PI:	Roberts, Phillip
Start Date:	10/08
Project Completion Date:	09/10
Training Status:	
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Student #2

First and Other Given Names: TBD
Last Name: TBD
Citizenship: African
Gender: Female
Degree: Ph.D.
Discipline: Plant Breeding/Genetics/Plant Pathology
Host Country Institution to Benefit from Training:
Training Location: University of Ghana, Legon and UCR
Supervising CRSP PI: Roberts, Phillip
Start Date: 10/08
Project Completion Date: 10/12
Training Status:
Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Student #3

First and Other Given Names:	Antonio
Last Name:	David
Citizenship:	Angola
Gender:	Male
Degree:	M.S.
Discipline:	Plant Breeding
Host Country Institution to Benefit from Training:	Angola
Training Location:	UPR
Supervising CRSP PI:	Roberts, Phillip
Start Date:	04/09
Project Completion Date:	06/11
Training Status:	Delayed
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: ı Cowpea Breeding to Overcome Critical Production Constraints in Africa and

	Abbreviated name of institutions											
	UCR			ISRA			INERA			IIA		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *
	(Tick mark the Yes or No column for identified benchmarks by institution)											
Objective 1 Breeding												
Varietal identification and release												
Germplasm assembly and seed increase										x		x
Germplasm Screening												
Varietal candidate screening - Angola												
Germplasm Development												
Cross Improved varieties	x	x										
Make BC1F1 and BC2F1												
Inbreed BC2F1 to BC2F2												
Make F1 elite x elite	x	x		x	x		x	x				
Advance F1 To F2,												
Develop F3 lines												
Objective 2 -Improve Seed Systems												
Breeder's Seed Production				x	x		x	x				
Foundation Seed Production												
Certified Seed Producer Training												
Assess seed system needs - Angola												
Objective 3 - Training												
MS Training (Breeding) - Angola (Univ. PR) started	x		x									
PhD Training (Breeding - HPR) - started												
Training in MAS with SNP-based markers												
Breeding Guide												

Name of the PI reporting on benchmarks by institution	P. A. Roberts	N. Cisse	I. Drabo	A. Chicapa

Name of the U.S. Lead PI submitting this Report to the MO

Philip A. Roberts

Signature

9/30/08
Date

* *Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 – September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Modern Cowpea Breeding to Overcome Critical Production Constraints in Africa and the US.
Lead U.S. PI and University: Philip A. Roberts, University of California, Riverside
Host Country(s): Angola, Burkina Faso, Senegal

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	0	0	1	
Number of men	0	0	1	
Short-term Training: Number of individuals who have received short-term training				
Number of women	0	0	3	
Number of men	0	0	4	
Technologies and Policies				
Number of technologies and management practices under research	1	2	13	
Number of technologies and management practices under field testing	5	5	5	
Number of *technologies* and management practices made available for transfer			5	
Number of policy studies undertaken	0	0	0	
Beneficiaries:				
Number of rural households benefiting directly	0	0	>2,000	
Number of agricultural firms/enterprises benefiting	0	0	8	
Number of producer and/or community-based organizations receiving technical assistance	8	7	10	
Number of women organizations receiving technical assistance	4	4	6	
Number of HC partner organizations/institutions benefiting	3	4	3	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	0	0	>11,600	

Biological Foundations for Management of Field Insect Pests of Cowpea in Africa

Principle Investigators

Barry Pittendrigh, University of Illinois at Urbana-Champaign, USA
Ibrahim Baoua, INRAN, Niger
Clémentine Dabiré, INERA, Burkina Faso
Mohammad Ishiyaku, IAR, Nigeria

Collaboratoring Scientists

Jeremy McNiel, UWO, Canada
David Onstad, UIUC, USA
Niang Malick Ba, INERA, Burkina Faso
Larry Murdock, Purdue, USA
William Muir, Purdue, USA
Joseph Huesing, Monsanto, USA

Abstract of Research Achievements and Impacts

We have established detailed experimental protocols for the (1) light trapping project, (2) our field experiments for both the study of the larvae Maruca vitrata and other pest insects of cowpea, and (3) scouting procedures for pests of cowpeas on wild alternative hosts. These protocols were established during a three-day regional planning meeting held in Ouagadougou (June 22-24, 2008). The light trapping, scouting, and field experiments were carried out during this past six months of the project in accordance with our research plan. Additionally, Dr. Pittendrigh has met with representatives at both the USAID missions in Mali and Nigeria to discuss our CRSP project. We continued to discover microsatellites useful in defining M. vitrata populations and collected the necessary materials and data towards understanding these populations. Farmer field schools and our first-year outreach activities were performed, in keeping with our original goals, and we are continuing to develop extension materials for the second year of the project. These experimental research activities and farmer field schools have (and will continue to) lay the foundation for the development and deployment of IPM strategies for the management of pest insects on cowpea crops in Burkina Faso, Niger, and Niger.

Project Problem Statement and Justification

Field and storage insect pests are the most severe biotic constraints for cowpea production. Insect-resistant cultivars have the potential to resolve some of the pest problems like root-knot nematode, but the lack of cultivars that resist major insect pests like legume pod borer, bruchids, and pod sucking bugs cannot be filled by conventional breeding because attempts to find genes conferring resistance in the cowpea genome to these pests have failed so far. *Thus, farmers often resort to use (and misuse) of neurotoxic pesticides to control cowpea insect pests with, in some unfortunate cases, dire consequences to their health, the health of their families, and the end users of those who purchase the cowpeas*. Thus, there is a need to develop alternative strategies for control of insect pests of cowpea, in order to reduce the levels of pesticides used on cowpea crops.

Several major strategies have been taken in the developed world to reduce the use of neurotoxic pesticide sprays in the field and on the stored seeds. First, biotechnology has offered us new tools to produce transgenic plants carrying insect resistance traits. Insecticidal proteins like those produced by *Bacillus thuringiensis (Bt)* specifically target the insect pests that actually feed on the plant. Second, Integrated Pest Management (IPM) plans have been developed to control insect pests using alternative control methodologies, including, but not limited to, host-plant resistance traits, cultural practices, biological control agents, and low level chemical use. However, regardless of which strategy prevails for insect control, all of these strategies require an in-depth understanding of the biology of the pest insects and how they interact with their environment.

The major pests of cowpea in the field in northern Nigeria, Niger, and Burkina Faso include: (i) the legume pod borer, *Maruca vitrata* Fabricius; (ii-iii) the coreid pod-bugs, *Clavigralla tomentosicollis* Stal and *Anoplocnemis curvipes* (F.); (iv) the groundnut aphid, *Aphis craccivora* Koch; and, (v-vi) thrips, *Megalurothrips sjostedti* Trybom and *Sericothrips occipitalis* Hood. A limited amount of work has been done to understand these insect pests in the areas we propose to work. Also, there are few alternatives to pesticide sprays for many of these pest species. Two notable exceptions to this situation exist. The first is *M. vitrata,* where a potential biotechnology-based pest control solution exists. Transgenic cowpea expressing the *Bt*-protein Cry1Ab, effective against *M. vitrata* already exists, however, these plants are unlikely to be available for use by African farmers during the current CRSP funding cycle. However, before transgenic *Bt*-cowpea can be released there will be a need for an insect resistance management (IRM) plan. Although not the primary focus of the current project, our studies will ultimately provide the necessary data for the eventual development of an IRM plan for *Bt*-cowpea. The second pest of cowpea, where a potentially new strategy for insect control exists, are thrip-resistant cultivars that have been developed by Drs. Phillip Roberts and Jeff Ehlers of University of California at Riverside (UC-R) in conjunction with Drs. Drabo and Dabire of INERA (*e.g.*, variety 58-77). We will work with the aforementioned investigators, to investigate the interactions between thrip-resistant cowpeas and trips in field experiments in Northern Nigeria, Niger, and Burkina Faso.

Although transgenic plants, and traditional plant breeding for insect resistant varieties are potentially effective methods for controlling at least two pests of cowpeas, a better understanding of pest populations is needed in order to integrate these, and other, pest control options into an overall integrative pest management (IPM) plan to maximize cowpea production in the field. IPM refers to a pest control strategy where a variety of complementary approaches are used to minimize the negative effects of pests on a given crop or cropping system. Before we begin to develop IPM strategies, we must understand the important life-history parameters of these pest insects in relationship to their environment. Critical life-history parameters include, but are not limited to, the following. (1) When and where do the pest insects occur? (2) What do the pest insects live on beyond just cultivated cowpeas? (3) What organisms regulate the populations of the insects that attack cowpea? (4) Are there parameters in the field that can be altered that will reduce the negative impacts that these insect pests have on cowpea? (5) Where sprayed pesticides are the only option, or a necessary component of an IPM program, how can their use be minimized while still achieving effective pest control? Regardless if biological control, insect resistant varieties, or transgenic plants, limited pesticide sprays, or a combination of these approaches are ultimately used, this project will provide a scientific foundation for such strategies.

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: *Light Trapping of Maruca and Microsatellite Markers*
This activity will build both (i) institutional infrastructures to monitor *Maruca* (ii) as well as a better understanding of the problems of this pest within the host counties. Although our efforts are not specifically focused on *Bt* cowpea, this work will lay the basis for the development of an IRM plan for *Bt* cowpea, as well as potentially providing the basis for other IPM-based pest control strategies.

Approaches and Methods: Light trapping will occur throughout the 18 months at the existing locations: (i) in Niger the current locations is Maradi; (ii) in Nigeria the existing location is Zaria; and, (iii) in Burkina Faso the existing locations are Farako-ba, Kamboinsé, and Fada N'Gourma. The site at Pobe in Burkina Faso will not be used due to high fuel costs associated with the generator. Instead we will build a new light trap at Dori, where the light trap can be plugged into a main electricity source. In Niger we will also added a location at Kornaka and move the light trap at Niamey to Gaya. In Nigeria additional traps will be stationed at Kadawa and Minjbir. Adults will be monitored and collected from the light traps on a daily basis. Adults will be sent to UIUC through a courier service for microsatellite analysis. The aforementioned work will be the responsibility of the host country P.I.'s.

The microsatellite analysis will be performed by Dr. Weilin Sun, in Dr. Pittendrigh's laboratory, over the last 1 year of the 18-month budget period (and for one more year of the 2.5 year grant based on the availability of funds).

Results, Achievements and Outputs of Research:
Light trapping was performed at all the locations where previous light traps existed and new light traps have been ordered for the additional locations. In addition to this Dr. Baoua is developing a series of new, much lower cost, light traps that we hope to be able to use in future experiments. These light traps may be able to give us more detailed information on M. vitrata's biology. M. vitrata populations were monitored and the data is being put in excel files for analysis. A manuscript laying the groundwork for this project has already been submitted to Entomologia Experimentalis et Applicata for peer review.

A second microsatellite library was made and we are continuing to discover further microsatellites that will make our analysis more robust.

Objective 2: This activity will provide the basis for a better understanding of the problems of pest insects of cowpeas within the host countries. It will also allow for cross training in pest insect biology across the three host countries. Although our efforts are not specifically focused on *Bt* cowpea, this work will lay the basis for the development of an IRM plan for *Bt* cowpea, as well as potentially providing the basis for other IPM-based pest control strategies for both *Maruca* and other pest insects of cowpea.

Approaches and Methods:
The data sharing from our preliminary work and the experimental design for the field studies on the insect pests of cultivated cowpeas will be completed in the first six month budget period. Based on these experimental plans we will study the presence and detailed life-history of the five major pests of cowpea (in the field and where necessary in the laboratory). This will be achieved through the use of randomized complete block design experiments using multiple lines of cowpea and alternative host plants. In Burkina Faso, Dr. Dabire will have one graduate student in working on the pests of cultivated cowpea. All experimental designs will be checked with our statistician (Dr. William Muir of Purdue University) to ensure proper experimental design and analysis of the datasets. Planting for these experiments will occur in the summer of 2008. Data collection will occur upwards of into November/December of 2008. The data will be tabulated, shared with the group, and analyzed. Another round of planting will occur in the summer of 2009, however, the experiments will be completed beyond the 18-month budget period.

Results, Achievements and Outputs of Research:
A mini-conference including the African collaborators as wells Drs. Pittendrigh, Bello, and McNeil was held in Ouagadougou (i) to share data from our preliminary work (ii) as well as to set the stage for experimental design for this specific aim. Dr. Bello also attended this conference, however, as she was not officially a co-P.I. on the project at the time, she attended this conference at her own personal expense. Additionally, Dr. Pittendrigh leveraged funds from his endowment in order to bring a representative from T4Global (an NGO) to the meeting to explain the use of solar powered MP3 players and learning strategies to target audiences that are illiterate. The experimental design established at this conference was checked by Dr. William Muir and approved. The experiments were set up and data has been collected, and is currently being placed in a format that will ultimately be used for analysis towards a peer review manuscript. In Burkina Faso a graduate student working under the direction of Dr. Dabire participated in these experiments. The Ouagadougou conference also allowed us the opportunity to move forward several manuscripts that have (Ba et al., submitted) and will result from both our current and previous CRSP projects.

Objective 3: This activity will provide the basis for a better understanding of the problems of pest insects of cowpeas within the host counties both during the growing season and when cowpea is not in season. Although our efforts are not specifically focused on *Bt* cowpea, this work will lay the basis for the

development of a refuge system for *Bt* cowpea, as well as potentially providing the basis for other IPM-based pest control strategies for both *Maruca* and other pest insects of cowpea.

Approaches and Methods: A standardized scouting plan will be established within the first six months of the project. Scouting of pests of cowpea on alternative host plants will occur both during and outside of the cowpea-growing season. The frequency and distances of the scouting trips will be dependent on the costs of transportation (*e.g.,* fuel prices). However, no fewer than one scouting trip will occur per country per six-month budget period. Every effort will be made to maximize the amount of scouting data in relationship to the resources available.

Surveys of wild alternative hosts around and near cowpea fields will be designed in the first six months of the project. The experiments will be performed in each country during the cowpea-growing season. Briefly, farmers' fields will be surveyed for the numbers of insects on cowpeas in relationship to any nearby wild alternative hosts (or the lack of alternative hosts will be documented). In the case of *Maruca*, this will provide the basis for the estimated wild refuge potential for an IRM plan for *Bt* cowpea.

Results, Achievements and Outputs of Research:
A scouting plan has been established and a minimum of one scouting trip has occurred in each country. Our data to date, for example, in Burkina Faso suggests that M. vitrata lives on wild alterative hosts in the off-season in the south, and does not occur in the northern region of the country. We are currently in the process of summarizing the data collected on wild alternative hosts for the pests of cowpeas in each of the host countries.

Explanation for Changes
No significant changes occurred in our workplan.

Networking and Linkages with Stakeholders
We will continue to work with cowpea growers associations and farmer field schools to develop and disseminate information necessary for IPM strategies for the control of insects that are pests of cowpeas. Dr. Bello will be working with our African development of MP3

Leveraged Funds

Name of PI receiving leveraged funds: Barry Pittendrigh
Description of leveraged Project: Summer salary paid from UIUC
Dollar Amount: $25,550
Funding Source: UIUC

Name of PI receiving leveraged funds: Barry Pittendrigh
Description of leveraged Project: Endowment monies used towards extension development
Dollar Amount: $4,000
Funding Source: UIUC

Name of PI receiving leveraged funds: Barry Pittendrigh
Description of leveraged Project: Funds for Dr. Bravo to travel to planning meeting
Dollar Amount: $3,500
Funding Source: Private

List of Scholarly Activities and Accomplishments
N/A

Contribution of Project to Target USAID Performance Indicators
No information provided.

Contribution to Gender Equity Goal

Our farmer field schools contained on average approximately 50% females. We are also working with a host country scientist who is female. We have added Dr. Bello (a female) to our project for the development of extension materials.

Progress Report on Activities Funded Through Supplemental Funds

We recently received supplemental funding for work with Dr. Tamo at IITA in Benin and with Mr. Mamadou Ousmane Ndiaye. We are currently in the process of establishing the necessary sub-contracts to initiate the work. For the extenion work with Mr. Ndiaye we are currently writing a concept manuscript for the basis of the extension strategy we will use in Mali. The work in Dr. Tamo's laboratory with biological control agents for M. vitrata have already been initiated.

Tables/Figures Cited in the Report
N/A

Literature Cited

Ba, M., C. L. Binso Dabire, A. Sanon, V. M. Margam, J. McNeil, L. L. Murdock, and B. R. Pittendrigh. Seasonal and regional distribution of the cowpea pod borer, Maruca vitrata Fabricius (Lepidoptera: Crambidae), in Burkina Faso. Entomologia Experimentalis et Applicata. Submitted.

Capacity Building Activities: P1-UIUC-1

Degree Training:

Student #1

First and Other Given Names:	Traore
Last Name:	Fousseni
Citizenship:	Burkina Faso
Gender:	Male
Degree:	M.S.
Discipline:	Entomology
Host Country Institution to Benefit from Training:	INERA
Training Location:	University of Ouagadougou
Supervising CRSP PI:	Dabiré, Clémentine
Start Date:	09/08
Project Completion Date:	08/10
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Short-term Training:

Type of Training: 1) Dr. Ba will visit Dr. Pittendrigh's lab. 2) Farmer field schools

Description of training activity: Microsatellite and computational modeling (UIUC)

Status of this activity:

Reason if training activity not completed as planned:

When did the activity occur?:

Location: UIUC

Who benefited from this activity?: INERA and our overall network of African researchers

Number of Beneficiaries: 61

Male:

Female:

Total:

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 – September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: **Biological Foundations for Management of Field Insect Pests of Cowpea in Af**

	Abbreviated name of institutions											
	Pittendrigh UIUC			Dabire INERA			Baoua INRAN			Ishiyaku IAR		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	**10/1/08**	**Y**	**N ***	**10/1/08**	**Y**	**N ***	**10/1/08**	**Y**	**N ***	**10/1/08**	**Y**	**N ***
	(Tick mark the Yes or No column for identified benchmarks by institution)											
Objective 1 - Light Trapping and Microsatellites												
Run existing light traps				X	X		X	X		X	X	
Order new light traps				X	X		X	X		X	X	
Ship Maruca samples to UIUC												
Microsatellite work (collect data)												
Pittendrigh visits collaborators												
Objective 2 - Insect Pests on Cultivated Cowpeas												
Share Previous data	X	X		X	X		X	X		X	X	
Experimental Design	X	X		X	X		X	X		X	x	
Planting				X	X		X	X		X	X	
Data Recording												
Data Sharing												
Objective 3 - Survey Wild Alternative host plants (in and off season)												
Scouting for Wild Alt Host Plants				X	X		X	X		X	X	
Experimental Design for Survey	X	X		X	X		X	X		X	X	
Survey fields for insect pests												
Objective 4 Farmer Field School and General Training												
Train in insect biology												
IPM control techniques												
Graduate student starts at UIUC												
Malik Ba -- Short term training												
Graduate student in BF				X	X							

Name of the PI reporting on benchmarks by institution	**Pittendrigh**	**Dabire**	**Baoua**	**Ishiyaku**

Name of the U.S. Lead PI submitting this Report to the MO

Dr. Barry Robert Pittendrigh, University of Illinois

Signature **Signed October 1, 2008**

** Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 – September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title:
Lead U.S. PI and University: Barry Pittendrigh, University of Ilinois
Host Country(s): Burkina Faso, Niger, Nigeria

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	0		1	
Number of men	0	1	1	
Short-term Training: Number of individuals who have received short-term training				
Number of women	60	>60	60	
Number of men	60	>60	60	
Technologies and Policies				
Number of technologies and management practices under research	3	3	3	
Number of technologies and management practices under field testing	3	3	3	
Number of technologies and management practices made available for transfer	N/A	N/A	2	
Number of policy studies undertaken	N/A	M/A	N/A	
Beneficiaries:				
Number of rural households benefiting directly	120	>120	120	
Number of agricultural firms/enterprises benefiting	N/A	N/A	N/A	
Number of producer and/or community-based organizations receiving technical assistance	6	>6	6	
Number of women organizations receiving technical assistance	3	>3	3	
Number of HC partner organizations/institutions benefiting	6	>6	6	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	N/A	N/A	5000	

Development, Testing and Dissemination of Genetically Improved Bean Cultivars for Central America, the Caribbean and Angola

Principle Investigators

James Beaver, University of Puerto Rico, Puerto Rico
Juan Carlos Rosas, EAP, Honduras
Timothy Porch, USDA-ARS, U.S.
António Chicapa Dovala, IIA, Angola
Emmanuel Prophete, CRDA, Haiti

Abstract of Research Achievements and Impacts

Significant progress was made in initiating research activities. Breeding lines previously developed with funding from the Bean/Cowpea CRSP were tested and advanced a generation during the past six months. Small red and black bean regional performance trials were distributed to collaborators in Central America and Haiti. A web blight performance trial was also distributed to collaborators. Andean bean breeding lines and other promising germplasm were sent to Angola and Rwanda for evaluation. Two sets of on-farm validation trials are being conducted in Honduras. A validation trial known as "Drought and low fertility tolerant on-farm bean trials" (PASEBAF) includes drought, low fertility tolerant lines developed with support from the Bean/Cowpea CRSP. The Agrosalud trial includes small red lines with greater mineral content (iron and zinc) developed in collaboration with CIAT and INTA/Nicaragua. It is expected that during 2009 at least one line from each trial will be released as a cultivar in Honduras and Nicaragua. The small red bean cultivars "CENTA Nahuat" and "CENTA CPC" were released in El Salvador on August 2008. Both cultivars were developed with support from the Bean/Cowpea CRSP. Validation trials were conducted with support from the Dry Grain Pulses CRSP. Certified seed of small red cultivars developed by the project was produced and distributed by governmental bean seed and input distribution programs in El Salvador, Honduras and Nicaragua. These seed programs have benefited more than 200,000 farmers in Central America. The multiple disease resistant white bean cultivar 'Verano' was developed and jointly released by the University of Puerto Rico and the USDA-ARS Tropical Agriculture Research Station. Greenhouse experiments conducted at Zamorano identified bean lines with greater nodulation scores, root, shoot and total dry matter accumulation. In Puerto Rico, the bean breeding lines VAX 3, PR0443-151 and RBF 19-63 produced mean seed yields > 1,500 kg in the –N plots. These mean seed yields were significantly greater than the check varieties Amadeus 77 and Salagnac 90A. Seed of lines, which are expected to segregate for resistance and susceptibility to ashy stem blight, were planted in Puerto Rico in a field trial that was inoculated with the pathogen. Phenotypic data will be used to identify molecular markers for resistance genes. Seed of landrace varieties of Lima beans were collected in Puerto Rico and Haiti.

Project Problem Statement and Justification

Common bean (*Phaseolus vulgaris* L.) is an important source of protein for low income families in Central America, the Caribbean and Angola. Increased or more stable bean yield can improve the diet and provide a reliable source of income for small-scale farm families in these countries. An increased supply of beans should also benefit the urban consumer of beans.

Planned Project Activities for April 1, 2008 - September 30, 2009

Objective 1: Development, release and dissemination of improved bean cultivars for Central America, the Caribbean and Angola.

Approaches and Methods: Plant breeders will focus on the combination of disease (BGYMV, BCMNV, rust, common bacterial blight, anthracnose and angular leaf spot) resistance with enhanced resistance to pests (bruchid, leafhopper) and greater tolerance to abiotic stress (drought, low soil fertility, high temperature). Elite bean breeding lines with multiple disease resistance have already been crossed with sources of resistance to pests or tolerance to abiotic stress. Bean lines will be screened for the selected traits each generation in environments that are most likely to provide the desired abiotic or biotic stress. This can be most easily achieved through collaboration among Dry Grain Pulse CRSP scientists and the regional bean research network in Central America and the Caribbean. Regional performance trials for black, small red, red mottled and light red kidney bean lines will be conducted in collaboration with national bean research programs in Latin America and the Caribbean.

Basic seed stocks of bean varieties developed and released by the project will be multiplied and small lots of seed will be distributed to farmers in Latin America and the Caribbean for testing in on-farm trials. Performance of the varieties in the on-farm trials also provides bean breeders with valuable feedback concerning the direction of their research. The project will also produce basic seed stocks of the most promising bean breeding lines and make seed available to the national bean research programs and NGO's involved in the multiplication and dissemination of improved seed.

The project will initiate collaborative research with Mr.Antonio Chicapa Dovala, Head of the Legume Program of the Instituto de Investigacão Agronómica in Angola. Promising bean breeding lines from Central America, the Caribbean and the U.S., primarily of medium-sized market classes, will be provided to the Angolan bean research program for evaluation for local adaptation and consumer acceptance.

Results, Achievements and Outputs of Research:

Development of breeding populations

More than 20 small red and black bean breeding populations were developed during the past six months. Parental materials used in the crosses to develop these populations included breeding lines, improved cultivars and landraces from Honduras, El Salvador, Guatemala and Nicaragua, and the bean breeding programs of the UPR and CIAT. The emphasis on these crosses was to combine multiple disease resistance, tolerance to abiotic stress and commercially desirable grain quality. Some of these populations were developed for adaptation to the highlands of Honduras, Guatemala and Haiti. During this period of funding, these populations were advanced to the F_2 generation and are ready for F_3 family testing during the 2008 'postrera' growing season.

Early generation populations have been developed at the University of Puerto Rico from crosses among sources of disease (BGYM, BCMNV, common blight, rust and web blight), pest (leafhopper and bruchid) resistance and tolerance to low N soils. Individual plants will be selected in F_2 and F_3 generations based on agronomic characteristics and seed type. Lines will be screened in later generations for disease and pest resistance and tolerance to low N soils.

Evaluation of breeding populations

More than 3,000 breeding lines previously developed with funding from the Bean/Cowpea CRSP were tested and advanced in Honduras during the past six months with support from Dry Grain Pulses CRSP. Breeding materials under field evaluation included 48 F_7 families from 5 populations (breeding lines with high levels of iron x elite small reds and black bean lines), 69 F_8 families from eight populations [triple and double crosses of drought and angular leaf spot (ALS) resistant lines], 149 F_8 lines from 21 populations (from the second cycle of recurrent selection for drought tolerance), 223 F_5 families from seven populations (landrace x improved lines or cultivars) for Participatory Plant Breeding (PPB) activities in Honduras, 1066 F_3 families from 23 populations (landrace x improved lines or cultivar, improved cultivar x line) for conventional and PPB activities in Nicaragua, El Salvador, Honduras and Costa Rica, 121 F_7 families from 19 populations (from the second cycle of recurrent selection for

resistance to web blight), 39 F_5 and F_6 lines (ALS Andean x Mesoamerican resistant to ALS), 151 F_4 families resistant to ALS (triple crosses of improved cultivar x F_1 ALS Andean x Mesoamerican), 71 F_7 families from five populations resistant to rust (improved cultivar or line x multiple genes rust source), 491 F_3 families from 12 populations (combinations of improved cultivar x landrace, improved cultivar x ALS, improved cultivar x drought and high iron x ALS) for El Salvador, Honduras and Nicaragua, , 23 BC_1S_4 families (drought/drought/improved cultivar), 124 F_6 families from 16 populations for increase nutritional value (improved x source of high iron and zinc), and 131 F_6 families and 595 F_3 families developed by S. Beebe at CIAT (drought, BGYMV and seed quality for collaboration under the Red SICTA Project).

Regional performance trials
During the past six months, Zamorano distributed 16 small red and small black adaptation nurseries (VIDAC) and 18 yield and adaptation trials (ECAR) to all five Central American countries and to Haiti. The majority of the advanced lines included in these regional nurseries and trials were developed by Zamorano and UPR, and in collaborations with CIAT and national bean research (NBR) programs. Zamorano has been responsible since 1996 for the development and distribution of these nurseries and trials to members of the regional Bean Research Network.

Seven advanced lines trial including 76 web blight resistant lines and four checks (ERMUS), were distributed for regional testing to collaborators in Central America, Puerto Rico and Haiti. The resistant lines included in this trial were selected from populations derived from crosses between the cultivar Tio Canela x VAX 6, crosses from a second cycle of recurrent selection program, and from interspecific hybridizations with a *P. coccineus* resistant accession. Some of the lines also have resistance to common bacterial blight and Bean Golden Yellow Mosaic Virus. The most promising lines will be considered for release as cultivars or breeding lines.

Thirty four lines including the 12 ALS differentials, 18 small red and black lines and cultivars and four cultivated *P. coccineus* accessions from Honduras were sent to Angola for testing. In addition, 50 small red and black bean cultivars and promising lines were sent to Julie G. Lauren, Cornell University, for testing in Kenya, as part of our Dry Pulses CRSP collaboration with Jonathan Lynch, Penn State University.

Seed for regional performance trials for Ecuador, Angola and Rwanda were prepared at the University of Puerto Rico. Entries in the trials included lines from Michigan State University, the University of Puerto Rico, USDA-ARS Tropical Agriculture Research Station, Zamorano and INIAP. U.S. and HC researchers plan to evaluate the performance of the lines in the nurseries in Angola during an upcoming visit. The information from these trials will be valuable to detect the most important biotic and abiotic constraints and to identify bean lines that might serve as valuable parents in a breeding program for Angola.

On-farm validation of promising breeding lines
Two on-farm validation trials are being conducted in collaboration with the National Bean Research program, associations of Local Agricultural Research Committee (CIAL), NGOs and other extension organizations in Honduras and Nicaragua. The validation trial known as "Drought and low fertility tolerant on-farm bean trials" (PASEBAF) includes drought, low fertility tolerant lines developed with support from the Bean/Cowpea CRSP. The Agrosalud trial includes small red lines with greater mineral content (iron and zinc) developed in collaboration with CIAT and INTA/Nicaragua. It is expected that during 2009 at least one line from each trial will be released as a cultivar in Honduras and Nicaragua. The PASEBAF trial is supported by IICA/COSUDE and the Agrosalud trial by CIAT/CIDA. The same trials have been distributed for on-farm validation in El Salvador and Costa Rica.

Ten of the most promising small red improved cultivars and lines for Central America, developed under the Bean/Cowpea CRSP, were sent to our HC collaborator in Guatemala (J.C. Villatoro), for testing in the most important bean production lowland regions, such as Peten and Jutiapa, where small red bean production for export has increased and cultivars with higher yield potential and greater disease resistance cultivars are needed.

A set of 15 small red lines of the 'Rojo de Seda' market class was provided to the agricultural division of the Lafise Bank for field and consumer validation trials in Nicaragua. The bank has expressed interest on producing certified seed of at least one of the lines. The bank provides seed and other inputs to small farmers to produce beans that are exported to the U.S. If an agreement is reached between Zamorano and Lafise, foundation and registered seed will be produced at Zamorano, and certified seed and commercial beans with farmers identified by the bank.

Release of cultivars and seed multiplication
The small red bean cultivars "CENTA Nahuat" and "CENTA CPC" were released in El Salvador on August 2008. Both cultivars were developed with support from the Bean/Cowpea CRSP Project, but part of the seed increase, validation trials and release process were conducted under the current Dry Pulses CRSP.

As in previous years, certified seed of small red cultivars developed by the project was produced and distributed by governmental bean seed and input distribution programs in El Salvador, Honduras and Nicaragua. These programs have benefited more than 200,000 farmers in Central America.
The multiple disease resistant white bean cultivar 'Verano' was developed and jointly released by the University of Puerto Rico and the USDA-ARS Tropical Agriculture Research Station (*J. of Plant Registrations*. 2:187-189). Verano combines resistance to Bean Golden Mosaic Virus, Bean Common Mosaic Virus and common bacterial blight. Seed of Verano is currently produced and sold to farmers by the Seed Program of the University of Puerto Rico.

The University of Puerto Rico has developed red mottled bean lines that combine resistance to Bean Golden Mosaic Yellow Virus, Bean Common Mosaic Virus, Bean Common Mosaic Necrotic Virus and common bacterial blight. Seed of these lines will be increased in Puerto Rico so that on-farm trials can be conducted next year in Haiti.

The University of Puerto Rico, the University of Nebraska, the USDA-ARS Tropical Agriculture Research Station and IDIAF have developed a tropically-adapted pinto bean line that has resistance to Bean Golden Yellow Mosaic Virus, Bean Common Mosaic Virus, Bean Common Mosaic Necrotic Virus and rust. This breeding line may be of potential benefit to countries such as Haiti and Angola where pinto beans are consumed.

The University of Puerto Rico and the USDA-ARS Tropical Agriculture Research Station developed a high-yielding, light red kidney bean line with resistance to common bacterial blight and Bean Common Mosaic Virus. This line is being considered for release in Puerto Rico.

Objective 2: Selection of beans for adaptation to low N soils.

Approaches and Methods: Inadequate soil nitrogen is a frequent yield constraint for common beans in the Tropics. The use of nitrogen fertilizers increase production costs and, in some intensive bean production systems, can contribute to groundwater contamination. Researchers have pointed out the need to develop integrated soil nutrient management practices for beans that would combine biological nitrogen fixation with limited use of fertilizers, sustainable crop management practices, and the

development of crop varieties better adapted to low fertility soils. Bean varieties with greater efficiency in the utilization of nitrogen should have enhanced biological nitrogen fixation capacity, root traits such as greater root hair density that contribute to tolerance to low soil P, and healthy root systems that can take advantage of available soil nitrogen and other nutrients.

Recurrent selection (RS) has proven to be useful in the selection of quantitatively inherited traits such as web blight resistance and tolerance to low soil P. We propose to conduct one cycle of recurrent selection to develop Mesoamerican and Andean breeding lines with greater adaptation to low soil N. A second cycle of RS would be conducted if the project is extended beyond the initial 30 months of funding. Preliminary screening conducted in Honduras and Puerto Rico has identified disease resistant bean breeding lines that could be used to form the base population for recurrent selection. A few elite small red bean breeding lines from Zamorano were found to have good biological nitrogen fixation when evaluated in field trials in Minnesota (Peter Graham, personal communication). The root rot resistant black bean line PR0443-151 from Puerto Rico and CIAT bean breeding lines A 774 and VAX 3 have performed well in a low N soil in Puerto Rico. During the past five years, the Zamorano bean breeding program and Dr. Jonathan Lynch have collaborated in the development of small red and black bean breeding lines with greater tolerance to low P soils and drought. Some of these lines also have better yield under low N soils due to increased nodulation by resident rhizobia. Zamorano has experience conducting strain selection and inoculation studies, maintains a collection of bean rhizobia and has the expertise needed to conduct the multifaceted research related to biological nitrogen fixation. Black bean lines developed at the University of Puerto Rico with enhanced levels of root rot resistance, will serve as a source of root rot resistance. In the proposed project, breeding lines will be evaluated in the F_3 and F_4 generations in replicated field trials. The field trials will receive low levels (20 kg/ha) of N fertilizer. The bean lines will be inoculated with recommended bean *Rhizobium* strains to create conditions favorable for biological nitrogen fixation. Dr. Tim Porch will evaluate the F_4 generation for root rot resistance in a field maintained specifically for root rot screening and selection. The most promising F_5 lines will be screened using molecular markers for disease resistance and traits associated with tolerance to low P soils. The most promising lines from each cycle of recurrent selection will be included as entries in regional performance trials in Central America and the Caribbean.

Results, Achievements and Outputs of Research: Three greenhouse trials were conducted in Honduras to identify lines with higher performance under low N conditions, by expressing greater nodulation and N fixation along with other mechanisms which allow beans to have greater accumulation of dry matter and seed yield under low N. The trials were conducted using soil: sand substrates that have low organic matter and N content, conditions which normally produces symptoms of N deficiency and low yield in most bean genotypes. The first trial included a screening of 180 bean accessions from the working collection of Zamorano breeding program under inoculation with a mixture of two *Rhizobium* strains, CR 477 (*R. etli*) y CIAT 899 (*R. tropici*). The plants were grown in a soil: sand (1:1) substrate low in organic matter (1.24%) and N (0.06%). Significant variation for nodulation using a 1 to 9 scale (1= none or very few, small nodule; 9= maximum number of large nodules), root, shoot and total dry weight (DW), and root/shoot ratio were observed between genotypes. The cultivars and lines with higher nodulation scores also had greater root, shoot and total DW and the lowest root/shoot ratio.

The 35 accessions with the highest nodulation scores and total plant DW, and five accessions with poor performance in the previous trial, were included in a second trial, to test their performance under *Rhizobium* inoculation by two individual strains (CIAT 899 and CR 477) and treatments of added or no added nitrogen, using a nutrient solution with 0 or 70 ppm N, respectively. The soil: sand (1:3) substrate was quite low in organic matter (0.86%) and N (0.04%). Significant differences were observed in nodulation, root, shoot and total DW among treatments and genotypes, but not for the T x G interaction. Greater nodulation were observed in the inoculation treatment than the treatments with or without added N. Larger root, shoot and total plant DW were found in the added N treatment. Although T X G

interaction was not significant, there were some genotypes that had better nodulation by the *Rhizobium* strain CIAT 899 and other accessions that had better nodulation with the CR 477 strain. These results suggest that some strain x genotype interactions are more effective than others under low N.

The third trial included the 25 accessions with the higher nodulation and total plant DW from the first trial: These lines were inoculated with a mixture of *Rhizobium* strains CIAT 899 and CR 477 and grown in a soil: sand (1:2) substrate low in organic matter (1.41%) and N (0.07%). The best nodulation was observed in the *Rhizobium* inoculated treatment without N; and the greatest root, shoot and total plant DW were observed in the added N treatments, and both were superior to the without inoculation and no added N treatment. Significant differences were observed between genotypes for all variables; nodule DW ranged from 225 to 477 mg/pl and total plant DW from 3.2 to 5.4 g/pl. The genotypes with higher nodulation have almost twice nodule DW and 50% greater plant DW, than those with lower nodulation.

A group of bean breeding lines, previously screened in two field trials for tolerance to low soil fertility, were planted at the Isabela Substation in January 2008 (Table 1). A split pot arrangement of a RCB design was used to test the lines at three levels of fertilization [(+N,+P), -P and –N]. Nitrogen proved to be the most limiting soil nutrient in the trial with most lines producing significantly lower seed yields in the –N fertilizer plots. Nevertheless, several lines were identified that had mean seed yields > 1,000 kg/ha in the –N plots. VAX 3, PR0443-151 and RBF 19-63 had mean seed yields > 1,500 kg in the –N plots. These mean seed yields were significantly greater than the check varieties Amadeus 77 (699 kg/ha) and Salagnac 90A (831 kg/ha). These trials are part of the M.S. thesis research of Haitian graduate student Ronald Dorcinvil. He is currently using Whin-Rhizo to study the root characteristics of some of the lines that performed well in the – N fertilizer plots. Mr. Dorcinvil expects to complete requirements for a M.S. degree during the upcoming year.

Table 1. Performance of bean breeding lines planted at the Isabela Substation in January, 2008 at different levels of fertilization.

Line	Fertilizer treatment		
	+N, +P	- P	- N
	Seed yield (kg/ha)		
VAX 3	1929 a	2227 a	1880 a
PR0443-151	2544 a	2821 a	1707 b
RBF 19-63	1686 a	1958 a	1511 a
Verano	2078 a	2128 a	1337 b
IBC 309-23	2184 a	2183 a	1258 b
IBC 308-15	2169 a	2069 a	1192 b
A774	2162 a	2464 a	1167 b
MER2226-28	2205 a	1872 a	1102 b
Amadeus 77 (check)	2777 a	2289 a	699 b
Salagnac 90 (check)	1198 a	1429 a	831 a

The most promising sources of tolerance to low N were crossed in Puerto Rico with breeding lines with multiple disease resistance. During the upcoming year progeny from these crosses will be screened for both disease resistance and tolerance to low N soils. The most promising breeding lines from these populations ultimately will be evaluated in Central America and Haiti in regional performance trials.

Superior bean genotypes selected from the field studies conducted in low N soils at Isabela, Puerto Rico, and from the greenhouse studies at Zamorano, will be used to initiate the first hybridization cycle of a recurrent selection program to develop cultivars with greater efficiency for low N production conditions.

Objective 3: Develop molecular markers for disease resistance genes.

Approaches and Methods: Marker-assisted selection has proven to be a very useful tool for bean breeders. Unfortunately, molecular markers are not available for some important genes and the use of other molecular markers is often limited to either the Andean or Middle American gene pools. The development of new molecular markers for valuable traits or markers with greater versatility would benefit the entire bean research community.

Resistance to charcoal rot caused by *Macrophomina phaseolina* has been reported to be associated with drought tolerance and it has been recommended that breeding for terminal drought tolerance should include breeding for resistance to charcoal rot. The charcoal rot resistance in the breeding line BAT 477 was found to be controlled by two dominant complementary genes. The RAPD $B386_{900}$ has been reported to be linked in coupling with one of the resistance genes (*Mp-1*) whereas $B459_{1600}$ was reported to be linked in repulsion with the other resistance gene (*Mp-2*). The utility of these markers has not been confirmed because the presence of the markers has not been surveyed in susceptible lines and in other sources of resistance to charcoal rot. The Dry Grain Pulse CRSP project will evaluate the usefulness of the putative molecular markers. If proven to be useful, Dr. Tim Porch will convert these RAPD markers to SCAR markers. If the putative RAPD markers are proven to be ineffective, recombinant inbred lines will be developed from crosses between BAT 477 and susceptible bean lines to attempt to identify new molecular markers for the charcoal rot resistance genes using bulk segregant analysis (BSA).

Although marker-assisted selection is routinely used by some breeding programs, it is currently used by only a few programs in Latin America and the Caribbean. The molecular marker lab at Zamorano will assist other bean research programs in the region in the use of this new technology by providing informal training and assistance in screening elite bean breeding lines and in the application of any new molecular markers developed by this project.

Results, Achievements and Outputs of Research: The RAPD markers previously reported to be linked to genes for charcoal rot were screened with a set of susceptible and resistant genotypes. Seven susceptible genotypes, ICA Pijao, Sanilac, Pinto Villa, Rio Tibagi, DOR 364, Morales, Tapatio, and eight resistant genotypes, A 300, Tacana, SEA 5, TLP 19, BAT 477, Tio Canela, G 5059, and XAN 176, were tested. RAPD $B386_{900}$ (coupling) was not amplified in BAT 477 nor in other resistant genotypes, while $B459_{1600}$ (repulsion) was not amplified in any susceptible genotypes. Bands of other sizes were amplified with each RAPD marker but were not associated with resistance. The PCR cocktail and PCR amplification conditions were then modified in order to optimize amplification and to reproduce the reported bands, but they were not reproducible. Consultation with another group working with *Macrophomina phaseolina* in common bean confirmed that $B386_{900}$ and $B459_{1600}$ do not have utility for charcoal rot (Mayek, pers. comm.).

Because the putative RAPD markers were proven to be ineffective, recombinant inbred lines (RILs) from crosses between BAT 477 and susceptible bean lines were pursued for the development of novel markers. Seed of RILs from the cross DOR 364 x BAT 477, which are expected to segregate for resistance and susceptibility to ashy stem blight, were obtained from CIAT by Dr. Tim Porch. In September 2008, these lines were planted at Isabela, Puerto Rico in a replicated field trial that was inoculated with the pathogen. The disease reactions of the RILs will be used to initiate the search for molecular markers for resistance to ashy stem blight using bulk segregant analysis (BSA)

Objective 4: Evaluation of other dry pulse crops for Central America and the Caribbean.

Approaches and Methods: The Lima bean (*Phaseolus lunatus* L.) is a heat and drought tolerant dry grain pulse crop that is produced and consumed throughout the Caribbean. Most landrace varieties are indeterminate, short day plants that produce pods during the dry season when there is often a scarcity of common beans. Because Lima beans grow well in fence rows or on walls, the crop is well suited for urban agriculture. Lima bean landraces have been cultivated in the Caribbean during the past 500 years and may have acquired unique traits of economic value. At present, the USDA and CIAT bean germplasm collections contain very few accessions from the region. The germplasm collections currently have 2 accessions from Haiti, ≤ 3 accessions from Puerto Rico and no accessions from the Dominican Republic. We plan to collect and characterize the agronomic traits of at least 30 Lima bean landrace varieties from Puerto Rico and Haiti. Passport data will be collected so that the germplasm can be included in the CIAT and USDA germplasm collections. Seed of superior Lima bean accessions will be increased for further evaluation and possible release in the country of origin.

Cowpeas [*Vigna unguiculata* (L.) Walp] are produced on a limited scale in the Caribbean. Ing. Emmanuel Prophete has expressed interest in evaluating promising cowpea breeding lines from the University of California, Riverside and IITA. The Dry Grain Pulse CRSP project will serve as a facilitator in obtaining cowpea breeding lines for testing in Haiti. The project will also attempt to identify research programs in Central America that might be interested in evaluating cowpea breeding lines. Zamorano will conduct preliminary evaluations of cowpea lines and will provide seed of the best adapted lines to other programs and organizations interested in this crop. Potential areas of adoption of new cowpea lines are the semi-arid regions in northern Nicaragua and southern Honduras where the crop is used as an alternative to common beans during the 'postrera' season. We also plan to collaborate with the University of California, Riverside Dry Grain Pulse CRSP in Angola in the evaluation of beans, cowpeas and other grain legumes, such as Lima beans or pigeonpeas.

Results, Achievements and Outputs of Research: Seed of landrace varieties of Lima beans were collected in Puerto Rico and Haiti. Variability in seed type, days to maturity and leaf type were observed among the 16 landrace varieties collected in Puerto Rico. During the upcoming year, the varieties will be planted in Haiti and Puerto Rico to multiply seed and to observe their performance. Once sufficient seed has been produced, the varieties will be sent to the USDA and CIAT bean germplasm collections. A few of the most promising landrace varieties will be considered for release in Haiti and Puerto Rico.

Photoperiod sensitive cowpea lines from the University of California, Riverside (PI-UCR-1 project) were evaluated at Isabela, Puerto Rico (18º N latitude). When the lines were planted in January (± 11 h photoperiod), the plants were relatively early in maturity. On the other hand, the lines were very late in maturity and produced a large amount of biomass when planted in June (± 13 h photoperiod). This photoperiod sensitivity permits the production of seed of the cowpea lines during the winter months. During the summer months, the cowpeas can be used for forage production or as a green manure. Due to the high price of imported grain, cattle and small ruminant producers in the Caribbean are increasingly interested in sources of locally-produced forage.

Explanation for Changes

Monica Mbui and Antonio David will delay initiation of graduate studies at the University of Puerto Rico, Mayaguez Campus until August 2009. It was not possible to complete the paperwork required for admission in January 2009 before the deadline.

Due to the severe damage to crops in Haiti caused by recent flooding, it may be necessary to use some Dry Pulse CRSP funds to purchase seed of adapted bean varieties for seed multiplication by the project in Haiti.

Networking Activities with Stakeholders

Collaborative research has been a key element in the success of the small red bean breeding activities in Central America. The Dry Grain Pulse CRSP project will build upon these achievements by placing greater emphasis on the improvement of black bean lines. This collaboration will enhance the impact of the Dry Grain Pulse CRSP project research in Guatemala and Haiti where the black bean is the preferred seed type. Mr. Emmanuel Prophete and the recent Bean/Cowpea CRSP trainees from Haiti, Gasner Demosthenes and Ronald Dorcinvil, speak Spanish, which will facilitate communication with other bean researchers in Central America and the Caribbean. The proposed Dry Grain Pulse CRSP project will collaborate with the bean research network in Central America and the Caribbean in the evaluation of bean lines and the multiplication of basic seed stocks of recently released cultivars. Dr. Rosas will coordinate regional performance trials for black and small red beans in Central America and the Caribbean. At least 25% of the funds assigned to the Escuela Agrícola Panamericana will be used to support activities of national bean research programs in Central America. James Beaver will coordinate the evaluation of red mottled and light red kidney bean regional performance trials in the Caribbean and will provide seed of these seed types to collaborators in Ecuador and Africa. Dr. Tim Porch will collaborate with Mr. Antonio Chicapa Dovala in the evaluation of bean lines in Angola. Ing. Emmanuel Prophete will be responsible for the evaluation and on-farm testing of black, white and red mottled bean lines in Haiti. The project will also collaborate with NGO's and participatory plant breeding programs in Central America and the Caribbean to promote the dissemination and adoption of bean cultivars. As project personnel learn more about the bean subsector and ongoing research and extension activities in Angola, opportunities for greater collaboration will be pursued. For example, formal or informal training activities with Augostinho Neto University in Huambo, Angola could be developed. Dr. Porch has communicated with CIAT bean scientists and Dr. Rowland Chirwa to identify opportunities for collaboration with the SABRN bean research network. He has also communicated with Mr. Kennedy Muimui of the ZARI bean research program to determine if Dry Grains Pulse CRSP activities in Angola can benefit bean research in Zambia.

Leveraged Funds

Name of PI receiving leveraged funds: Juan Carlos Rosas

Description of leveraged Project: Development and testing of drought/low fertility tolerant lines in Nicaragua and Honduras

Dollar Amount: $240,000

Funding Source: Red SICTA

Name of PI receiving leveraged funds: Juan Carlos Rosas

Description of leveraged Project: Improvement of farmer bean and maize cultivars thru participatory plant breeding

Dollar Amount: $30,000

Funding Source: Norway DF

Name of PI receiving leveraged funds: James Beaver

Description of leveraged Project: Research assistantship for Ronald Dorcinvil

Dollar Amount: $15,000

Funding Source: Mycogen

List of Scholarly Activities and Accomplishments

The President of El Salvador, Elías Antonio Saca, participated in an official ceremony where seed (10 kg sacks) of small red bean varieties CENTA Pipil, CENTA San Andrés e INTA Rojo were distributed to farmers. The program has distributed approximately 30,000 hwt of seed to 120,000 farmers in El Salvador. The contribution of the Bean/Cowpea and Dry Grain Pulse CRSPs were recognized at the ceremony.
(http://www.mag.gob.sv/main/index.php?id=1066&mostrar=full&secc=98&nivel=&tabs=4&pivote=1&ids=97)

Contribution of Project to Target USAID Performance Indicators

All of the host countries participating in this Dry Grain Pulse CRSP project are USAID-eligible countries. Increased or more stable bean yields contribute to economic growth and improve the lives of the families who produce the crop. A more reliable supply of staple crops such as beans fosters stability in the Latin American and Caribbean region. With the advent of CAFTA, increased opportunities exist to link bean markets within the region and to export beans to niche markets in the U.S. Because Central America is one of the Centers of Domestication of the common bean, collaboration with bean research programs in LAC provides U.S. bean breeding programs with greater access to bean germplasm having traits of potential economic value. Disease pressure is often more severe in LAC, which permits the development of bean lines having greater levels of disease resistance. Bean research in Central America and the Caribbean helps to identify emerging bean diseases and permits researchers to respond more rapidly and effectively when new diseases threaten bean production in the U.S. All of the abovementioned activities support U.S. foreign policy in Latin America and the Caribbean
(http://www.usaid.gov/locations/latin_america_caribbean/issues/trade_issue.html).

The development of bean cultivars for Angola with enhanced levels of resistance to biotic and abiotic constraints contributes directly to the Presidential Initiative to End Hunger in Africa (IEHA) (http://www.usaid.gov/locations/sub-saharan_africa/initiatives/ieha.html). The proposed research provides the innovations needed to reduce vulnerabilities and risks of bean producers in Angola. The proposed Dry Grain Pulse CRSP project will establish collaborative research and training activities among U.S., LAC and Angolan bean research institutions that is in accord with the IEHA science and technology strategy.

This project addresses two of the four global themes of the Dry Grain Pulse CRSP. The development and release of bean cultivars with enhanced disease resistance and greater tolerance to abiotic stress should reduce production costs and reduce risk for bean producers in Central America, the Caribbean and Angola. Lines with resistance to bean diseases, such as rust, should also be useful germplasm for U.S. bean breeding programs. Disease and pest resistance are key components in effective crop management systems. Bean breeding lines developed by the project will be screened for tolerance to drought and low soil fertility. Bruchid resistance should improve the quality of bean seed.

Participatory plant breeding methods and multiplication of basic stocks on underutilized research stations should result in more sustainable seed production and distribution systems. The project will use informal training and web sites to strengthen the capacity of the bean research programs in Central America, the Caribbean and Angola

Contribution to Gender Equity Goal

1. Dr. Consuelo Estevez will provide training in plant pathology research techniques at a workshop to he held in Angola in November 2008. She will also participate in the workshop to be held in Honduras in August 2009. The workshops in Angola and Honduras are expected to include several female trainees.

2. Two female technicians from El Salvador received short-term training in bean research techniques at Zamorano.

3. The participatory plant breeding techniques used in Honduras solicit the opinion of both men and women concerning the potential value of bean breeding lines.

4. Monica Mbui was chosen by the IIA in Angola to receive M.S. degree training in plant breeding at the UPR.

Progress Report on Activities Funded Through Supplemental Funds

Not Applicable

Tables/Figures Cited in the Report

None

Capacity Building Activities: P1-UPR-1

Degree Training:

Student #1

First and Other Given Names:	Ronald
Last Name:	Dorcinvil
Citizenship:	Haiti
Gender:	Male
Degree:	M.S.
Discipline:	Soil Sciences
Host Country Institution to Benefit from Training:	Haiti
Training Location:	University of Puerto Rico
Supervising CRSP PI:	Beaver, James
Start Date:	08/06
Project Completion Date:	05/09
Training Status:	Active
Type of CRSP Support (full, partial or indirect):	Partial (Category 2b)

Student #2

First and Other Given Names:	Monica
Last Name:	Mbui
Citizenship:	Angolan
Gender:	Female
Degree:	M.S.
Discipline:	Plant breeding
Host Country Institution to Benefit from Training:	IIA, Angola
Training Location:	University of Puerto Rico
Supervising CRSP PI:	Beaver, James
Start Date:	08/09
Project Completion Date:	08/11
Training Status:	Pending
Type of CRSP Support (full, partial or indirect):	Full (Category 1)

Short-term Training:

Type of Training: Informal training of bean research personnel in Angola

Description of training activity: Tim Porch, Juan Carlos Rosas and James Beaver will travel to Angola to provide short-term training to bean research personnel in Angola on research techniques used to screen bean lines for resistance to biotic and abiotic constraints. Dr. Rosas will share his experience using participatory plant breeding techniques in Central America to promote the adoption of bean cultivars.

Status of this activity:

Reason if training activity not completed as planned:

When did the activity occur?:

Location: Huambo, Angola

Who benefited from this activity?: Pulse crop researchers and staff

Number of Beneficiaries: 15

Male:

Female:

Total:

Type of Training: Informal training of Salvadoran researcher

Description of training activity: Aldemaro Clara and Aura Morales de Borja, technicians from the bean research program in El Salvador ,received short-term training at Zamorano dealing with bean research techniques. The goal of the training is to increase the research capacity of the bean program in El Salvador

Status of this activity: Completed as planned

Reason if training activity not completed as planned:

When did the activity occur?: August 2008

Location: Zamorano

Who benefited from this activity?: The CENTA bean research program in El Salvador

Number of Beneficiaries: 2

Male:

Female: 2

Total: 2

Type of Training: Bean breeding workshop for Central American and Caribbean bean researchers.

Description of training activity: The workshop will discuss recent advances in bean breeding and review standard techniques used to screen beans for resistance to biotic and abiotic stresses. The testing and validation bean lines will be discussed.

Status of this activity:

Reason if training activity not completed as planned:

When did the activity occur?:

Location: Zamorano

Who benefited from this activity?: Not specified

Number of Beneficiaries: 15

Male:

Female:

Total:

Dry Grain Pulses CRSP
Report on the Achievement of "Semi-Annual Indicators of Progress"
(For the Period: April 1, 2008 -- September 30, 2008)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2008

Project Title: **Development, Testing and Dissemination of Genetically Improved Bean Cultivars for Central America, the Caribbean and Angola**

Provide abbreviated name of institutions in columns below

	UPR			USDA			EAP			IIA			Haiti		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Benchmark Indicators by Objectives	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *	10/1/08	Y	N *
(Tick mark the Yes or No column for identified benchmarks by institution)															
Objective 1: Development, release and dissemination of improved bean cultivars.															
Germplasm acquired for key abiotic and biotic stress factors of Angola				X	Y					X	Y				
Germplasm tested in Angola															
Breeding populations developed	X	Y					X	Y							
Breeding populations tested							X	Y					X	Y	
Advanced trials conducted							X	Y					X	Y	
Promising lines validated on farm							X	Y							
Cultivar released							X	Y							
Objective 2: Selection of beans for adaptation to low N soils.															
Complete field and greenhouse evaluations to identify most promising sources of BNF germplasm	X	Y					X	Y							
Complete crosses for the first cycle of recurrent selection for enhanced BNF															
Harvest F2 seed for the first cycle of recurrent selection															
Objective 3: Develop molecular markers for disease resistance genes.															
Sources of ashy stem blight resistance acquired				X	Y										
Existing RAPD markers tested															
Effectiveness of RAPD markers in acquired germplasm determined															
RAPD products cloned and sequenced															
SCAR markers designed and initially tested															
Objective 4: Evaluation of other pulse crops for Central America and the Caribbean															
Complete collection of P. lunatus													X	Y	
Complete first year of field testing of cowpeas in PR, Haiti, and Central America															
Characterize the phenological, morphological, and agronomic traits of P. lunatus (Haiti, PR)															
Objective 5: Increase the capacity, effectiveness and sustainability of agricultural research institutions that serve the															
M.S. training of Ronald Dorcinvil completed															
M.S. training of Luzia J. Baptista	X		N	X	N										
Informal training in Angola in bean research techniques															
Informal training in Honduras in bean research techniques							X	Y							
Workshop in Central America in bean research techniques and the discussion of a new strategy for the development and dissemination of bean cultivars															

Name of the PI reporting on benchmarks by institution	J. Beaver; T. Porch; J..C. Rosas; A. Dovala; E. Prophete
Name of the U.S. Lead PI submitting this Report to the MO	J. Beaver

Tonya Beaver — Signature
30 September 2008 — Date

** Please provide an explanation for not achieving the benchmark indicators on a separate sheet.*

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(April 1, 2008 – September 30, 2009)

PERFORMANCE INDICATORS/TARGETS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: Development, Testing and Dissemination of Genetically Improved Bean Cultivars for Central America, the Caribbean and Southern Africa.
Lead U.S. PI and University: James S. Beaver, University of Puerto Rico
Host Country(s): Angola

Output Indicators	2008 Target (Apr 1-Sept 30, 2008)	2008 Actual (Apr 1-Sept 30, 2008)	2009 Target (Oct 1 2008-Sept 30, 2009)	2009 Actual (Oct 1 2008-Sept 30, 2009)
Degree Training: Number of individuals who have received degree training				
Number of women	0	0	2	
Number of men	1	0	1	
Short-term Training: Number of individuals who have received short-term training				
Number of women	0	0	21	
Number of men	0	0	10	
Technologies and Policies				
Number of technologies and management practices under research	3	3	3	
Number of technologies and management practices under field testing	2	2	2	
Number of technologies and management practices made available for transfer	0	0	1	
Number of policy studies undertaken	0	0	0	
		0		
Beneficiaries:				
Number of rural households benefiting directly	0	0	140	
Number of agricultural firms/enterprises benefiting	0	0	2	
Number of producer and/or community-based organizations receiving technical assistance	0	0	8	
Number of women organizations receiving technical assistance	0	0	1	
Number of HC partner organizations/institutions benefiting	0	0	6	
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	0	0	2,000	

Institutional Capacity Building Activities Conducted by the Pulse CRSP in FY 08: Summary Report

The Dry Grain Pulses CRSP seeks to build host country institutions' capacity building through three mechanisms—support for long-term degree training, short-term non-degree training and purchase of equipments. The status of activities planned and undertaken under these three categories of capacity building activities is included under the progress report of each project. Here we provide a summary picture of these activities for the whole CRSP program.

Degree training

All Pulse CRSP degree training is closely linked to research activities and aligned with CRSP project research objectives. The degree training is done under the supervision of CRSP principal investigators and forms an integral part of the annual workplans of each project. In FY 08—its first year of implementation, the Pulse CRSP continued the tradition of its predecessor CRSP of strong commitment to human resource development by including an average of two to three degree training activities in each project. Annex 1 provides a summary status of degree trainees as of the end of FY 2008. A total of 22 trainees were included in the workplan. But due to delays in project implementation and unforeseen problems in identifying trainees that met the university admission criteria, many projects could not start their planned degree training by Fall 2008. As a result, ten trainees were "active" by the end of FY 2008. Twelve degree training activities were either delayed or discontinued and did not occur as planned (Annex 1). A descriptive summary of the degree training activities planned and supported by the Pulse CRSP is provided in Table 1.

Table 1: Descriptive Summary of Degree Trainees as of the End of FY 08.

	No. of trainees
Training Status	
▪ Active:	10
▪ Delayed/Pending:	9
▪ Discontinued/cancelled:	3
Profile of "Active" trainees (10)	
Gender	
▪ Male	6
▪ Female	4
Region of Origin	
▪ East Africa	8
▪ Southern Africa	0
▪ West Africa	1
▪ Latin America/Caribbean	1
Degree program	
▪ M.S.	8
▪ Ph.D.	2
Training Location	
▪ U.S.	3
▪ Host countries	7

Non-Degree Training

Non-degree training and short-term training are considered important for attaining CRSP institutional capacity building goals. This includes training through organized workshops, group training, and short-term individualized training at CRSP participating institutions. Like degree training, all non-degree training is integrated with research activities and is incorporated into the annual research workplans of each research project. In FY 08, two non-degree, short-term training activities were completed by the Pulse CRSP (Table 2). These activities range from a few days training programs (e.g., workshops) in a group setting to a few weeks or months of individualized training in lab/field setting. Unquestionably, short-term training activities are essential for the CRSP to develop the necessary human resources for national agriculture research institutions and universities to address the emerging needs and opportunities for the dry grain pulses sectors in developing countries.

Table 2: Summary of Short-term Training Activities Supported by the Pulse CRSP, FY 2008

Description	Location	Time period	Beneficiaries	Number of Beneficiaries		
				Male	Female	Total
Practical training for farmers who will grow organic beans and EAP staff interested in learning about organic bean production methods.	EAP (Zamorano), Honduras	September 2008	Technicians and farmers from collaborating institutions--ARSAGRO (a farmer organization) and CIALs based in Yojoa Lake and Yorito Region	13	2	15
Short-term training at Zamorano dealing with bean research techniques. The goal of the training was to increase the research capacity of the bean program in El Salvador	EAP (Zamorano), Honduras	August 2008	Aldemaro Clara and Aura Morales de Borja, technicians from the bean research program in El Salvador	0	2	2

Equipments for Host Country Capacity Building

No activity was planned under this category of capacity building in FY 08.

Annex 1: Status of degree training planned and executed in FY 08

#	Project	Given name	Last name	Country of citizenship	Gender	Training institute	Degree	Discipline	Training status as of 10/1/08	Start date	Anticipated completion date	Type of CRSP support
1	PI-CU-1	Crispus Mugambi	Njeru	Kenya	M	Moi University	M.S.	Soil Science	Active	02/08	02/10	Full
2	PI-CU-1	Belinda Akinyi	Weya	Kenya	F	Egerton University	M.S.	Soil Science	Active	08/08	08/10	Full
3	PI-CU-1	Jane Francisca	Lusweti	Kenya	F	University of Nairobi	M.S.	Plant Protection	Active	10/07	10/09	Partial
4	PI-ISU-1	Cyrille	Syanobe	Rwanda	M	Makerere University	M.S.	Food Science & Technology	Active	08/08	08/10	Partial
5	PI-ISU-1	Gerald	Sebuwufu	Uganda	M	Iowa State University	Ph.D.	Agronomy	Active	08/08	05/12	Partial
6	PI-ISU-1	Geoffrey Arijole	Nyakuni	Uganda	M	Iowa State University	Ph.D.	Food Science & Human Nutrition	Canceled			
7	PI-ISU-1	Aisha Nakitto	Musaazi	Uganda	F	Makerere University	M.S.	Technology	Active	08/08	06/09	Partial
8	PI-ISU-1	Simon	Okiror	Uganda	M	Makerere University	M.S.	Agricultural Economics/Agribusiness	Active	08/08	06/09	Partial
9	PI-MSU-1	Gerardine	Mukeshimana	Rwanda	F	Michigan State University	Ph.D.	Plant Breeding and Genetics	Active	08/08	08/11	Full
10	PI-MSU-1	TBD	TBD	Rwanda		Michigan State University	Ph.D.	Participatory plant breeding and	Delayed			
11	PI-MSU-2	Maria da Luz	Quinhentos	Mozambique	F	Michigan State University	M.S.	Agricultural Economics	Canceled			
12	PI-MSU-2	Ana Lidia	Gungulo	Mozambique	F	University of Pretoria, South Africa	M.S.	Agricultural Economics	Delayed			
13	PI-MSU-2	Estaveo	Chaves	Angola	M	University Federal Vicosa, Brazil	M.S.	Agricultural Economics	Delayed			
14	PI-PSU-1	IIAM Scientist 1	TBD	Mozambique		Penn State	M.S.	Agronomy	Delayed			
15	PI-PSU-1	IIAM Scientist 2	TBD	Mozambique		Penn State	M.S.	Plant Nutrition	Delayed			
16	PI-UPR-1	Ronald	Dorcinvil	Haiti	M	University of Puerto Rico	M.S.	Soil Sciences	Active	08/06	05/09	Partial
17	PI-UPR-1	Monica	Mbui	Angola	F	University of Puerto Rico	M.S.	Plant breeding	Delayed			
18	PI-UCR-1	Manuel	Costa	Angola	M	University of Puerto Rico	M.S.	Breeding/Genetics/Plant	Canceled			
19	PI-UCR-1	TBD	TBD	African		Legon and UCR	Ph.D.	Breeding/Genetics/Plant	Delayed			
20	PI-UCR-1	Antonio	David	Angola	M	UPR	M.S.	Plant Breeding	Delayed			
21	PI-UIUC-1	Traore	Fousseni	Burkina Faso	M	Ouagadougou	M.S.	Entomology	Active	09/08	08/10	Full
22	PI-ISU-1	Martin	Mutambuka	Uganda	M	Iowa State University	Ph.D.	Nutrition	Delayed			

Dry Grain Pulses CRSP
FY 2008 Annual Report of the Management Office
(October 1, 2007 to September 30, 2008)

Outline:

A. Dry Grain Pulses CRSP Award to Michigan State University
B. Establishment of Projects to Achieve Program Technical Vision
C. Program Implementation
D. Management Office Activities
E. Institutional Capacity Building
F. Other Activities of the MO
G. USAID CTO Change

A. Dry Grain Pulses CRSP Award to Michigan State University

In September 2007, Michigan State University signed the contract with USAID to serve as the Management Entity for the Dry Grain Pulses CRSP. The effective start and end dates for this award are September 30, 2007 and September 29, 2012, respectively. The total estimated amount of the five-year award is $9,000,000.

Since the Management Entity (ME) and the Management Office (MO) staff for the Dry Grain Pulses CRSP are essentially the same as that for the Bean/Cowpea CRSP, the transition between the two CRSPs was relatively smooth. Regarding MO staffing, the only change involved the departure of Missy Moryc (1.0 FTE, Program Information Coordinator) and the hiring of Sarah Kittle (0.5 FTE, Secretary). This resulted in substantial salary savings for the MO.

B. Establishment to Projects Achieve Program Technical Vision

A priority of the MO was to implement the new Pulse CRSP as expeditiously as possible so as to minimize disruptions in technical and financial assistance to strategic Host Country (HC) programs. The goal was to conduct a competitive process that would result in the selection and contracting of research, training and outreach projects by April 1, 2008, six months after the start of the program. The MO is pleased to report that it effectively achieved this goal. The following outlines steps taken by the MO to constitute a new program on pulses that would both achieve the "technical vision" established for the program (see Technical Vision in the Pulse CRSP's web site; http://www.pulsecrsp.msu.edu/) while responding to the development needs of the host countries.

Expressions of Host Country Institutional Needs and Interests: The MO invited Host Country agriculture research institutions (NARS, agriculture research institutions, IARCs) in Sub-Saharan Africa and Latin America with interest in collaborating with US universities on pulse research to submit Expressions of HC Institutional Needs and Interests. By the end of October 2007, the MO had received nearly 50 submissions. These Expressions of Interest with the HC institutional contact information were posted on the new Pulse CRSP's website for ready access and review by both U.S. and developing country scientists who were seeking collaborators and preparing a proposal for Phase I of the Pulse CRSP program.

Expressions of Interest from U.S. Universities**:** The MO concurrently requested that all U.S. scientists and universities with intentions of submitting a project proposal for consideration for funding through the Pulse CRSP to also submit an Expression of Interest. A total of 38 Expressions were received and posted on the Pulse CRSPs webpage. The expectation was that U.S. scientists and their respective universities might contact one another about potential partnerships and collaboration in projects if they shared common thematic or HC interests.

Issuance of Request for Proposals (RFP):
Within one week of receiving the award from USAID (10/8/07), the MO sent out a Pre-RFP Notification through various list serves (including NASULGC list serves to Deans and to International Program Directors) to research institutions, administrators and scientists in both the U.S. and in Host Countries. After having received approval of the content in the Request For Proposals from both the CTO for the Pulse CRSP (Jiryis Oweis) and from the MSU Office of Contract and Grants, the MO issued the RFP on October 12, 2008 with a deadline for receipt of proposals by Nov 30, 07. The RFP was posted on the Pulse CRSP's web page as well as sent out electronically through the same set of list serves as the Pre-RFP Notification.

The RFP invited proposals for multi-disciplinary collaborative research, institutional capacity building and outreach projects addressing constraints of bean and cowpea value-chains for the funding period of April 1, 2008 through September, 30, 2010 (Phase I). The MO anticipated funding up to nine projects ranging from $300,000 to $450,000 each for the 30-month period. Proposed projects were to be led by a U.S. university with collaborative activities subcontracted to Host Country institutions (e.g., National Agriculture Research Systems, agricultural universities, non-governmental organizations, etc.), and IARCs in strategic countries of priority to USAID and where pulses are produced and consumed. Project proposals had to address identified priority topical areas related to the Global Themes of the Pulse CRSP:

- To reduce bean and cowpea production costs and risks for enhanced profitability and competitiveness.
- To increase the utilization of bean and cowpea grain, food products and ingredients so as to expand market opportunities and improve community health and nutrition.
- To improve the performance and sustainability of bean and cowpea value-chains, especially for the benefit of women.
- To increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors and developing countries

"Lead" universities submitting project proposals were required to provide evidence of predominant capacity to provide scientific leadership to the proposed research and training activities, a commitment to build the capacity of the partner developing country institutions, an institutional vision for contributing to the sustainable development and economic growth of the host countries in accord with the USAID Mission Strategic Objectives, and a willingness to partner with the Management Entity in the achievement of the Dry Grain Pulses CRSP's global goals.

The MO was delighted to have received a total of 27 proposals and cost applications from 18 distinct candidate lead U.S. universities. These proposals were accompanied by signed documents from the HC institutions indicating their willingness to partner in a Pulse CRSP project. Many of the proposals were also accompanied by letters of support from Economic Growth and Agriculture Officers in the USAID Missions in the respective Host Countries. The MO was also pleased with the excellent breadth of topical areas represented in the proposals received:

- Genetic improvement for increased productivity and yield stability- 5 proposals
- Integrated crop management- 5 proposals
- Mitigating effects of low soil fertility and drought 5 proposals
- Health and nutritional attributes 4 proposals
- Urban consumer access to value added pulse foods 4 proposals
- Constraints to smallholder farmer participation in markets and trade 4 proposals

Proposal Review and Project Selection:
A five-member External Advisory Panel (EAP) of experts in such areas as pulse genetics, integrated crop management, soil health, food science, human health and agriculture economics and with no conflicts of interest were convened by the MO. The EAP members requested that their identity remain anonymous so as to protect the integrity of the review process. The charge to the EAP was to assist in the review of the proposals and to advise the MO on the selection of the projects to constitute the new Pulse CRSP program. All proposals were reviewed by three persons and both qualitatively and quantitatively evaluated using the "Criteria for Evaluation of Proposals" which appeared in the RFP:

- Technical merit (50 points)
- Collaboration and capacity building (20 points)
- Contribution of outputs to development outcomes and impact (15 points)
- Contribution to USAID objectives and initiatives (10 points)
- Cost effectiveness (5 points)

On January 10-11, 2008, the MO staff and Jiryis Oweis met with the EAP in Detroit, MI, to discuss the written proposal evaluations and to receive their recommendations on projects that best meet the criteria for evaluation. Each proposal was individually discussed and a written "EAP Summary Evaluation Form" completed for each. The Summary Evaluation addressed the following:

1. Strengths of the Proposal
2. Weaknesses of the Proposal
3. Suggestions for Improvement of the Proposal

The completed EAP Summary Evaluations were sent to the lead U.S. Principal Investigator (PI) for each of the 27 proposals received.

The EAP identified three categories of project proposals for the MO's consideration: (1) high quality proposals which meet the evaluation criteria; (2) quality project proposals with a "weakness" that could readily be addressed with a revision of the proposal; (3) and project proposals that had major weaknesses that removed them from consideration for funding.

Subsequent to the EAP meeting, the Director, Associate Director and the CTO discussed the evaluations of the EAP and decided to fund eight 30-month U.S. university lead Phase I projects (see list below). These projects had received high evaluations and totaled $1,295,387.00 the amount budgeted for contracted Phase I collaborative research, outreach and training projects.

Phase I Projects (April 1, 2008 – September 30, 2010)

PI-CU-1 Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya (Lead PI: Julie Lauren, Cornell University)

PI-ISU-1 Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda (Lead PI: Robert E. Mazur, Iowa State University)

PI-MSU-1 Combining Conventional, Molecular and Farmer Participatory Breeding Approaches to Improve Andean Beans for Resistance to Biotic and Abiotic stresses (Lead PI: James Kelly, Michigan State University)

PI-MSU-2 Expanding Pulse Supply and Demand in Africa and Latin America: Identifying Constraints and New Strategies (Lead PI: Richard Bernsten, Michigan State University)

PI-PSU-1 Improving Bean Production in Drought-Prone, Low Fertility Soils of Africa and Latin America – An Integrated Approach (Lead PI: Jonathan Lynch, Pennsylvania State University)

PI-UPR-1 Development, Testing and Dissemination of Genetically Improved Bean Cultivars for Central America, the Caribbean and Angola (Lead PI: James Beaver, University of Puerto Rico)

PI-UCR-1 Modern Cowpea Breeding to Overcome Critical Production Constraints in Africa and the U.S. (Lead PI: Philip Roberts, University of California-Riverside)

PI-UlUC-1 Biological Foundations for Management of Field Insect Pests of Cowpea in Africa (Lead PI: Barry Pittendrigh, University of Illinois at Urbana-Champaign)

Desirable attributes of the portfolio of new Pulse CRSP projects are as follows:

- All projects include collaborations with an institution in a strategic country in Africa
- Two projects include activities in both Africa and Latin America while six projects focus solely on Sub-Saharan African countries
- Host Countries are situated in four regions
  West Africa- Burkina Faso, Mali, Niger, Nigeria and Senegal
  East and Central Africa- Kenya, Rwanda, and Uganda
  Southern Africa- Angola and Mozambique
  Latin America- Ecuador, Haiti, Honduras
- Two projects focus on cowpeas, two on beans, and four on multiple pulse crops (i.e., bean, cowpeas, lab lab, pigeon pea, lima bean, etc.)
- Projects address diverse priority topical areas
  Genetic improvement for increased productivity and competitiveness (3 projects)
  Integrated crop management (2 projects)
  Mitigating effects of low soil fertility and drought (1 project)
  Value addition to pulses through processing (1 project)
  Market structure and access (1 project)

A disappointment of the Management Office was that the all the proposals received addressing Theme 2, "To increase the utilization of bean and cowpea grain, food products and ingredients so as to expand market opportunities and improve community health and nutrition," had critical problems. Using the "Criteria for Evaluation," these problems dropped this set of proposals from the EAP's category 1 (high quality) to category 2 (proposals with a weakness that could be corrected). The Management Office was thus faced with two options: (1) fund only the high quality proposals even though certain priority themes in the Technical Program of the Pulse CRSP may not be effectively addressed during Phase I (April 1, 2008 – September 30, 2010), or (2) fund only selected "quality proposals" and reissue an RFP for research, training and outreach activities focused solely on Theme 2 at a later date.

Since the CTO for the Pulse CRSP thought that there was a good possibility that USAID would likely increase the FY 08 obligation to $3 million in accord with the Congressional directive, the MO decided to only fund those proposals that received the highest ratings from the reviews. To do otherwise would compromise the integrity of the competitive process. The MO's plan was to issue a second RFP during FY 08 or 09 to address Theme 2 if EGAT/USAID obligated additional funds to the program and accordingly increased the authorization ceiling of $9 million for the program. Unfortunately, USAID only obligated $2,005,000 to the Pulse CRSP in FY 08 and indicated that this provided approximately 23

months of "forward funding." The result is that the Management Office could not obligate these monies to new projects in 2008. The consequence is that there are gaps in the technical program that could not be addressed.

C. Program Implementation

Workplans and Budgets for Period April 1, 08 – September 30, 09

Key instruments/mechanisms that the MO decided to use to monitor and assess performance of projects in the Pulse CRSP include: 1) Workplans; 2) Semi-annual benchmark indicators of technical progress; 3) annual Technical Progress Reports; 4) Performance Indicators for Foreign Assistance Framework (FAF) and the Initiative to End Hunger in Africa (IEHA); and 5) project site visits. To this end, Lead PIs were asked to develop workplans and budgets for the first 18 months of the Phase I projects (April 1, 2008 – September 30, 2009) in accord with the technical visions and cost applications of the project proposals submitted and funded by the MO. The MO sent a template for the workplans and budgets to the PIs in January 08 with a deadline for submission of March 15, 08, after they had an opportunity to be discussed and vetted at the Global Principal Investigators Meeting.

Global Principal Investigators Meeting (Barcelona, Spain, February 29 – March 4, 2008):

The Management Office (MO) held a Global PI meeting less that two months after projects were selected for funding by the Dry Grain Pulses CRSP. A total of 4 PIs, two U.S. and two Host Country, were invited from each of the eight projects. In addition, representatives from CIAT (Dr. Roland Chirwa) and IITA (Dr. Bukar Ousmane) and the CTO (Jiryis Oweis) were invited and attended the meeting. The total attendance was thus 40 persons with the three MO staff.

Barcelona, Spain, was selected as the venue for this meeting because of cost and logistical reasons. Although, the MO had numerous offers from institutions to host the Global PI Meeting (e.g., Zamorano in Honduras, CIAT in Colombia, University of Pretoria in South Africa, Antalia in Turkey, and IITA in Benin), the cost of flights from Africa, LAC and the U.S. to these destinations were prohibitive. Europe thus presented the lowest travel cost for participants from all points of origin (<$1,100 per person). Moreover, the MO discovered that it would be impossible to obtain visas for all the PIs within a six week period if the meeting was to be held in an African or Latin American country or in the U.S. Since Spain has consulate offices in nearly all African and Latin American countries and U.S. citizens do not require a visa to enter Spain, the decision was made to hold the meeting in Barcelona. HC PIs were asked to obtain a Schengen Visa for Europe. This turned out to be a wise decision by the MO. This was evidenced by the 100% attendance of the Global PI Meeting and total expenditures coming in under budget.

The topics covered and activities completed during the Global PI Meeting were:

- Developed research and training workplans and budgets for the individual projects for the funding period April 1, 2008 through September 30, 2009
- Provided opportunity for PIs to meet one another, learn about the global Pulse CRSP program and to coordinate research and training activities across thematic areas, commodities and countries/ regions.
- Reviewed the USAID Foreign Assistance Framework (FAF) and Initiative to End Hunger in Africa (IEHA): Requirements for CRSP Reporting
- Addressed contractual arrangements, and financial management and reporting requirements
- Discussed institutional capacity building goals and identified training needs of Host Country institutions
- Discussed USAID country Mission relationships and Associate Awards
- Held election of PIs to Technical Management Advisory Committee (TMAC)- Jim Beaver (UPR), Ndiaga Cisse (ISRA, Senegal) and Jill Findeis (PSU)

Establishment of Sub-agreements and Fixed Price Sub-Contracts

MSU, the Management Entity, established Cost Reimbursement Sub-agreements with the "Lead" U.S. universities for the Phase I projects funded under the Dry Grain Pulses CRSP. These sub-agreements obligate funds and pass certain authority and responsibility for the completion of individual projects from the ME to the U.S. lead universities. The goal of the Management Office was to establish the sub-agreements by April 1, 2008, six months after the start of the new Pulse CRSP program.

The MO is pleased to report that it successfully sent out contracts for signature to the University of Puerto Rico, Iowa State University, Cornell University, Penn State University, the University of California Riverside, and the University of Illinois at Urbana Champaign between March 27 and April 4, 2008. Since two of the new projects were awarded to scientists at MSU, there was no need to establish contracts for these projects. The MO was disappointed, however, by the varying amounts of time required for these contracts to be negotiated and signed by the offices of contracts and grants at the respective U.S. universities. It is noteworthy that Iowa State University, Cornell University and the University of Puerto Rico expeditiously processed and signed their contracts within approximately six weeks. In contrast, three to five months were required for Penn State, the University of Illinois and the University of California-Riverside to finalize their contracts. These delays were disconcerting to the MO since it resulted in substantive delays in the start of research and training activities for the 30 month projects, especially in Host Countries. It is difficult to attribute blame to a single factor or individual for these delays. The only conclusion that the MO can make is that certain U.S. universities are slow in processing contracts for international projects either due to a lack of institutional capacity or of will.

The ME decided that "Fixed Price Contracts" would define the relationship between Host Country institutions and either the collaborating "Lead" U.S. university or the ME, MSU, in the Dry Grain Pulses CRSP. Fixed Price Contracts were viewed as being preferred since they are performance based and provide funding in installments to Host Country institutions thus ensuring adequate cash flow in support CRSP training and research activities. To implement Phase I projects, a total of 21 fixed price contracts were established with HC institutions in the Pulse CRSP. The ME (MSU) assumed responsibility for establishing the fixed price contracts with HC institutions collaborating in projects with MSU scientists (PI-MSU1-1 and PI-MSU2-1) and for the University of Puerto Rico (PI-UPR1-1). The other U.S. lead universities were contracted to set up and manage fixed price contracts with their respective collaborating HC institutions because of liability issues for compliance and performance. As of the end of 9/30/08), all fixed price contracts had been finalized except for the UCR sub-contract with IAA, Angola, and Penn State's sub-contract with IIAM, Mozambique.

Semi-Annual "Benchmark" Indicators of Progress

The MO required that each project establish Semi-Annual Benchmark Indicators to hold participant institutions accountable for technical progress. The appropriate benchmark indicators are identified by the project teams at the time that annual workplans are prepared. Benchmark indicators are established for mid-points during the implementation of project workplans (six month intervals). Completion and submission of the Benchmark Indicators form by Host Country scientists is a means by which Lead PIs can monitor technical progress toward project goals. Acceptable achievement of benchmark indicators is also necessary for authorization of the next installment of funds to the Host Country institution. Failure to submit the semi-annual report or unsatisfactory progress (without acceptable justification) towards the achievement of established benchmarks will be viewed as an indicator of contract non-performance resulting in delayed or termination of scheduled payments to that institution.

The MO is gaining experience in the use of Fixed Price Contracts with HC institutions. To date the feedback has been positive both from U.S. lead PIs and HC institutions.

Establishment of Performance Indicators for FAF and IEHA: (first due on Oct. 1 08)

In order to ensure that the MO obtains the needed information of outputs and developmental outcomes from Pulse CRSP supported activities, the MO required that project teams also establish target

Performance Indicators for each annual workplan period. The indicator categories were established by the MO in accord with USAID's:

- EGAT's Agriculture Program Standard and Custom Sector Capacity Indicators for Program Elements "Agriculture Sector Productivity" (4.5.2) and "Agriculture Enabling Environment" (4.5.1)
- IEHA Output Indicators

Again, the target Performance Indicators were established at the time of preparation of the annual workplans. The form used can be accessed at, (http://pulsecrsp.anr.msu.edu/Portals/0/docs/PERFORMANCE%20INDICATORS%20FOR%20FOREIGN%20ASSISTANCE%20FRAMEWORK.doc). The completed FY 08 Performance Indicator reports were received prior to October 1, 2008 by the MO. This provided time therefore for the MO to compile the data for the entire program and submit it to USAID in early November 2008.

Financial Management

The sub-agreements with the Lead U.S. universities stipulate financial reporting and invoicing requirements. To ensure adequate compliance and to cultivate a functional working relationship between the Pulse CRSP's Administrative Officer and the financial and contract officers at the partner Lead U.S. universities, the MO sent Ben Hassankhani for a two-day visit to each of the following:

Cornell University (August 08)
Iowa State University (August 08)
University of Illinois at Urbana Champaign (September 08)
University of Puerto Rico (October 08)
University of Puerto Rico (November 08)

The agenda for the visits by the Administrative Officer included the following:

- Communication between PI and Office of Sponsored Programs/CGA on accounting procedures for CRSP projects, negotiations on Fixed Prices contracts with HC institutions, institutional in-kind contributions, and use of information and documents on Pulse CRSP web page.
- Review of Operations and Policy Manual of the Dry Grain Pulses CRSP
- Record keeping of source documents for invoices
- Cost sharing commitment and reporting
- Preparation of Quarterly Expense Reports to the MO

The MO decided upon making the individual visits to the partner U.S. universities instead of holding a financial managers/contract officers meeting as originally proposed in the Cost Application. This was approved by USAID Office of AA and the CTO. Experience to date indicates that the personal visits have resulted in improved compliance with financial reporting requirements and communication by administrative/financial officers with the MO. The only university which remains to be visited is Penn State University.

D. Management Office Activities

Operations and Policy Manual:

The MO prepared in FY 08 an Operations and Policy Manual for the Pulse CRSP in FY 08. The primary sections in the OP Manual include:

I. Program Overview
II. Program Administrative Structure and Function
III. Program Implementation

IV. Financial Management
V. Timeline for Program Implementation
VI. Program Policies and Guidelines
VII. Participant Training
VIII. Mission Engagement
IX. Federal Guidelines

The objective of establishing an Operations and Policy Manual for the Pulse CRSP program were to:

- To provide clear information to collaborating U.S. and HC institutions regarding normative practices, operational guidelines and program policies
- To ensure program compliance with terms of USAID contract with the Management Entity, Michigan State University
- To ensure consistent and equitable decision making by the MO on administrative management issues in the implementation of the Dry Grain Pulses CRSP.

The Operations and Policy Manual was reviewed with U.S. and HC PIs, financial and contract officers at U.S. universities, and is available on the Pulse CRSP's web page, (http://www.pulsecrsp.msu.edu/.) The OP Manual is also shared with the TMAC and the Administrative Advisory Committee (the Institutional Representatives) and can be modified if justified.

Web Page for Dry Grain Pulses:
A priority of the Dry Grain Pulses CRSP was to design and put into use a new program Web Page during the first year of the new program (FY 08). Since the previous Bean/Cowpea CRSP web page was quite 'spartan' and utilitarian, the MO desired to achieve the following objectives in the new web page.

- Have an attractive and user-friendly site where participants, stakeholders, and USAID will go to access information on the Dry Grain Pulses CRSP (e.g., maps of HC sites, etc.)
- Improve the program transparency by making available program workplans, technical and performance indicator reports, Operations and Policy Manual, forms, and publications
- Provide interesting and useful information to all who might visit the site in the form of "Spotlight" articles, Announcements, Calendar, Gallery of Photos, links to relevant web sites, etc.
- Provide a mechanism for U.S. and HC PIs to electronically prepare and submit of workplans and technical progress and training reports to the MO.

The MO believes that it has achieved these objectives with the new web page (http://www.pulsecrsp.msu.edu/). In FY 08, the web page new has been used already to post the Request for Proposals, Expressions of Host Country and U.S. Institutional Interest in Participating in the Pulse CRSP, and to receive the FY 08 Workplans and Technical Progress Reports for the eight subcontracted projects.

CRSP On-Line Reporting System (CORS):
Learning from the positive experience in using the electronic submission of workplans and technical and training reports in the 2002-07 Bean/Cowpea CRSP, the MO contracted with the ANR Information Technology Services in the College of Agriculture at MSU to design a revised CRSP On-Line Reporting System (CORS). This new system, which can be accessed through the Pulse CRSP's web page, was not available for use at the time of preparation of the FY 08-09 workplans but was finished in October 08 to allow use for submission of the FY 08 Technical Progress Reports. Desirable features of the CORS are password security and access by PIs to only those documents corresponding to their own Pulse CRSP project. The password protection enables both U.S. and HC PIs to jointly view, compose, input information, and edit workplans and reports. Once workplans and reports are received and approved, the MO posts them on the web page for public viewing.

Reporting the USAID:
The MO staff spent a considerable amount of time in FY 08 responding to the following requests for program information from either the CTO in EGAT or the Project Officer in the Office of Acquisitions and Assistance, USAID/Washington. These are over and above the regular financial and technical reports that the ME is required to submit to USAID per the terms of the ME award for the Dry Grain Pulses CRSP to MSU.

- Quarterly Accrual Reports
- Monthly Pipeline Budget Reports
- Implementing Mechanism for Dry Grain Pulses CRSP; Program Element 4.5.1 Agriculture Enabling Environment
- Implementing Mechanism for Dry Grain Pulses CRSP; Program Element 4.5.2 Agriculture Sector Productivity
- Data Quality Assessment Form
- Dry Grain Pulses CRSP Attribution Report to IEHA Objectives
- Program Synopsis for FY 08
- Significant Achievements and Training Reports of Bean/Cowpea CRSP for 2007 Title XII Report
- Highlights of Scientific and Technological Contributions of Dry Grain Pulses CRSP in 2008
- Dry Grain Pulses FY 08 Report of IEHA Output Indicators
- Dry Grain Pulses FY 08 Reports on EGAT Agriculture Standard and Custom Sector Indicators (4.5.1 Agriculture Enabling Environment and 4.5.2 Agriculture Sector Productivity)
- Dry Grain Pulses Report for USAID FY 2008 Portfolio Review
- Training Success Stories for the Bean/Cowpea CRSP
- Annual CTO Performance Evaluation

Although responding to these requests with frequently only a one or two advance notification can be quite onerous, the MO has appreciated the positive disposition and assistance of the Dr. Jiryis Oweis, the CTO for the Pulse CRSP during FY 08, in completing these reporting requirements to USAID.

Program Advisory Groups:
During FY 08, the MO established three advisory groups in accord with the administrative management plan for the Dry Grain Pulses CRSP: (1) External Advisory Panel, (2) Technical Management Advisory Committee (TMAC), and (3) the Administrative Advisory Committee. The composition of these groups is as follows:

External Advisory Panel- anonymous

Technical Management Advisory Committee (TMAC)-

- James Beaver, University of Puerto Rico (PI, Chair)
- Jill Findeis, Penn State University (PI)
- Ndiaga Cisse, ISRA, Senegal (PI)
- Ousmane Coulibally, International Institute of Tropica Agriculture-Benin (Secretary)
- Douglas Maxwell, University of Wisconsin (professor emeritus)
- Steve Beebe, CIAT, Colombia
- Bob Green, Michigan Bean Commission
- Jiryis Oweis/Bahiru Duguma (CTO, USAID)

Administrative Advisory Committee (AAC) (Institutional Representatives from U.S. Universities for Phase I Projects):

- David Acker, Associate Dean for Academic and Global Programs, Iowa State University
- Deanna Behring, Director of International Programs, the Pennsylvania State University
- Donald Cooksey, Division Dean of Agriculture and Natural Resources, University of California-Riverside
- Frank Fear, Senior Associate Dean, Michigan State University
- John Fernandez Van Cleve, Dean and Director, Universidad de Puerto Rico, Mayaquez
- Rajeev P. Malik, Assistant Director of Academic Programs, Office of International Programs and Studies, University of Illinois at Urbana Champaign.
- Terry W. Tucker, Director of International Programs, Cornell University

Apart from the MO's meeting with the External Advisory Panel in January 08 to review project proposals, the MO interacted primarily with the TMAC and AAC through mailings of information and email. A conference call meeting of the TMAC was convened on August 27, 2008 to discuss the Institutional Capacity Building proposals and to advise the MO of which activities to fund. Although a face-to-face meeting of the TMAC had been budgeted for FY 08, it was decided to delay that meeting until April or May 2009 and dedicate that meeting to a review of technical progress and of FY 2010 workplans for Phase I projects.

E. Institutional Capacity Building

Institutional Capacity Building Awards:
In June 08, the MO invited the submission of "Proposals" from Phase I PIs for activities that would contribute to the enhancement of the capacity of Host Country institutions. The Pulse CRSP had budgeted $300,000 (see Cost Application of Dry Grain Pulses CRSP) in the first two years of the program (FY 08 and 09) for distribution to Host Country institutions for support of institutional capacity building initiatives. This is in recognition of the need of HC National Agriculture Research Systems (NARS) and agricultural universities to build and maintain capacities in strategic areas of research, training and outreach in order to effectively and sustainably address the challenges facing the pulse (bean, cowpea and related edible legume crops) sectors and to contribute to economic growth and food and nutritional security within their respective countries. Thus, these funds were intended to address critical needs of Host Country (HC) collaborators which exceed the budgetary limits of the current Pulse CRSP projects. Activities that were considered appropriate for inclusion in Institutional Capacity Building Proposals included: short-term training, short-term research sabbaticals, MSc degree training, visits by HC PIs to pulse research programs in other CRSP presence countries/continents, purchase of research and/or teaching equipment (>$5,000), professional development activities (e.g., participation in conferences, travel to regional networking meetings, visits to private industries, etc.), and development of computer and communication capacity.

The MO was please to receive 11 proposals from Host Country institutions. These proposals were distributed to the TMAC for review. The criteria used by the TMAC to evaluate the institutional capacity building proposals included: a) institutional justification of need; b) cost effectiveness; c) innovation; d) linkage and importance to achievement of objectives of Pulse CRSP projects; e) gender equity; and f) benefit to HC institution's capacity to serve the dry grain pulse sectors within that host country. On August 27, 08, the TMAC held a conference call and advised the MO to fund the following institutional capacity building initiative. The MO accepted the TMAC's recommendation and obligated a total of $275,620 as part of the FY 09 obligation to the sub-contractors. The balance of funds, $24,380, will be used as discretionary funds by the MO in FY 09 to address HC institutional capacity building and training needs that arise.

1. Kenya Agriculture Research Institute (KARI)- $29,100
    - Strengthening communication capacity of KARI
    - Training in use of lab instrumentation
    - Training of two M.Sc. Students
    - Partial support for exchange visits
2. Kigali Institute of Science & Technology (KIST), Rwanda- $28,182
    - Partial support for MSc. Student
    - HC PI visits to UP and SUA
    - Rapid Nutrient Analyzer, and research supplies
3. Makerere University, Uganda- $19,000
    - Research Coordinator
    - HC PI visits to UP and SUA
    - Rapid Nutrient Analyzer and research supplies
4. Institut des Sciences Agronomiques du Rwanda (ISAR)- $2,000
    - Travel expenses for Luis Butare's visit to INIAP, Ecuador
5. Institut des Sciences Agronomiques du Rwanda (ISAR)- $27,500
    - Purchase of vehicle for ISAR bean breeding program
6. Instituto de Investigacão Agronómica (IIA), Angola- $33,600
    - Vehicle for bean and cowpea breeding program
    - Precision balance and pH meter
7. Institut de l'environnment et de Recherches Agricoles (INERA), Burkina Faso- $11,000
    - Vehicle repair
    - Weather station and training
8. ISRA, Senegal- $30,000
    - Vehicle for ISRA cowpea breeding program
9. INRAN-Niger, INERA- Burkina Faso, Institute for Ag. Research- Nigeria, Institut d'Economie Rurale- Mali, and IITA-Benin- $40,238
    - Training WA scientists on production and use of biocontrol agents
    - Two Farmer Field Schools in Mali
10. Instituto de Investigacão Agronómica (IIA), Angola- $25,000
    - Repair of greenhouse
    - Purchase of autoclave
    - Purchase of microscope with camera
11. Escuela Agrícola Panamericano (Zamorano), Honduras- $30,000
    - Workshop for leaders of National Bean/Cowpea Research Programs in Central America and Ecuador on conventional and participatory breeding and use of MAS, including training on cowpea breeding

CRSP Training:
During the period April 1 to September 30, 2008, the first six months of the Phase I projects, the Pulse CRSP supported the following training.

Short Term Training: female- 90; male- 94; Total- 184
Degree Training: female- 5; male-6; Total- 11

Due to the challenges and time required to identify qualified candidates for long-term graduate- degree training, and to obtain their admission into an appropriate university, the number of Pulse CRSP long-term trainees enrolled during 2009 is expected to rise.

F. Other Activities of the Management Office

The MO was involved in a variety of other activities during FY 08 which are directly related to the global program mission of the Dry Grain Pulses CRSP and the administrative roles of the Management Office Director and Associate Director. Most noteworthy among these activities are the following.

1. Close Out of Bean/Cowpea CRSP
   While setting up the Dry Grain Pulses CRSP, including the issuance of the RFP and evaluation of the proposals, the MO was concurrently responsible for closing out the Bean/Cowpea CRSP which ended September 29, 2007. During the months of October, November and December 2007, the MO obtained Final Financial and Technical Reports from all US and HC subcontractors involved in the three Regional Projects of the Bean/Cowpea CRSP. The Final Financial and Technical Reports for the program were compiled by the MO and submitted to USAID prior to December 29, 2007 as required by the contract with USAID. The Final Technical Report is available on the Pulse CRSP's webpage. Printed hard copies of the report can be obtained from the MO.

2. UILTCB Program
   The MO of the Dry Grain Pulses CRSP continues to administer a "Pilot" USAID training program entitled "USAID Initiative for Long Term Training and Institutional Capacity Building" (UILTCB). Mywish Maredia is to be commended for her excellent leadership and management of this program. In 2008, a total of 15 degree trainees from Ghana and Zambia enrolled at U.S. universities completed their thesis research in their respective host countries and successfully defended their theses. It was with great sadness that the MO learned of the unexpected death of Ms. Christina Jalasi (M.S. degree student at Univ. of Illinois from Zambia) due to cerebral malaria upon her return to Zambia. In July 2008, the MO submitted the 6th Semi-Annual Progress Report (covering the period January 1, 2008 – June 30, 2008) to the CTO of the UILTCB Program, Ron Senykoff (EGAT/USAID), and to John Thomas (Director of the Office of Agriculture, EGAT).

   During FY 08, a new training program was initiated with the USAID Mission in Malawi. The following process was followed to implement the Malawi UILTCB program:
   - Expressions of Interest and budget proposals were received from selected U.S. universities to train a cohort of M.S. degree trainees from Malawi.
   - Degree trainee candidates from the Ministry of Food and Agriculture and Bunda College of Agriculture were interviewed (Widders attended interviews in Dec. 07), and six were selected by Mission staff and offered scholarships.
   - Admission was obtained for these students in diverse program areas at the University of Florida (UFL)
   - Students obtained J-1 visas with data entered into TraiNet
   - A contract was established between MSU and the UFL with an accompanying workplan and budget for the training
   - The cohort of six Malawi students enrolled at UFL for the Fall 2008 semester

3. CRSP Council
   Widders and Maredia participated in CRSP Council activities during the course of FY 08. Numerous conference calls were convened during the year. On July 20-22, 08, Widders attended the CRSP Council Retreat held at the Virginia Tech campus in Arlington, VA. At that meeting, Widders gave presentations on CRSP training and CRSP activities that address the global food crisis.

   Widders was also an invited speaker in a Symposium on the USAID Collaborative Research Support Programs at the ASA/CSSA Annual Meetings in New Orleans on November 5 and 6, 2007. The title of the presentation was "The CRSP Approach to Training." For the preparation of this presentation, Mywish Maredia collected training data from all nine CRSPs and conducted cost analyses of training in the Bean/Cowpea CRSP.

4. BIFAD
Widders organized and hosted a Panel on the "USAID – University Brain Trust" for the BIFAD Meetings on October 16-17, 2008 in Des Moines, Iowa, preceding the World Food Prized Conference. The Panel involved Dean Fred Cholic (Kansas State University), Dean Jeffrey Armstrong (Michigan State University), Dean Freddie Richards (Prairie View A&M University), and Director Jess Lowenberg-DeBoer (Purdue University). The panelists responded to questions presented to them regarding a USAID- U.S. university brain trust and commented on the recently released White Paper resulting from the BIFAD meeting with university Deans. The BIFAD Panel was well received and elicited considerable amount of discussion and support for the "brain trust."

5. Health and Nutritional Committee of USDBC
Widders, as the Director of the Dry Grain Pulses CRSP, serves as a member of the prestigious Health and Promotions Committee of the U.S. Dry Bean Council (USDBC). The USDBC is a private organization that represents bean/pulse growers, grain traders and processors of pulse foods and ingredients in the U.S. Because of Dr. Widders' recognized leadership role on health and nutrition issues related to dry beans, he is the only representative from the U.S. university community of the Board of this organization. The Health and Promotions Committee holds monthly conference calls to discuss research and educational initiatives. Dr. Widders assisted the USDBC to prepare and issue an RFP for a Bean Health Research Mini-Grant Program in 2008. In addition, he was invited to participate in the "Pulse Health and Nutrition Symposium" sponsored by Pulse Canada in Toronto on January 30-31, 2008. By being involved in the H&P Committee, Dr. Widders is better informed of trends and emerging issues within the pulse industry both domestically and internationally, and thus better positioned to provide technical leadership to the Dry Grain Pulses CRSP.

6. Hosted Guests
During the course of FY 08, the MO of the Dry Grain Pulses CRSP received numerous public and private sector visitors. Two distinguished guests co-hosted by the MO included Dr. Jonas Mugabe, Deputy Director of ISAR, Rwanda, a partner HC institution in the PI-MSU1-1 project, and Dr. Sam Sefa Dedah, Dean of the College of Engineering Sciences at the University of Ghana-Legon. Dr. Mugabe spent time visiting the laboratory of Dr. James Kelly and meeting with Dr. Widders to discuss Pulse CRSP project implementation issues and performance expectations including the achievement of developmental outcomes. Dr. Sefa-Dedah, as a food scientist and previous PI in the Bean/Cowpea CRSP, continues to have interest in the development of a cowpea food processing sector in Ghana and the growth of cowpea value-chains in West Africa.

7. Michigan State University Activities
Since Michigan State University is the Management Entity for the Dry Grain Pulses CRSP, the MO staff are involved in miscellaneous international program activities at MSU that bring mutual benefits to the CRSP program as well as to the academy. Examples of such involvements include the following:

- International Program Directors Roundtable- This is a group comprised of Directors of other international programs at MSU including such USAID sponsored programs as Food Security II, Partnership for Food Industry Development, PEARL- Rwanda, etc. The Roundtable, which meets twice monthly, provides Widders and Maredia an opportunity to learn about and coordinate activities with other USAID programs, and to address issues of common interest relative to international program administration and implementation at MSU.

- Graduate student advising- Both I. Widders and M. Maredia served on graduate committees of CRSP trainees at MSU including the committees of Tomo Nagai, Lara de Villa, and Wolfgang Pejuan.

- Institute of International Agriculture- Since the MO of the Dry Grain Pulses CRSP is administratively housed within the Institute of International Agriculture, College of Agriculture and Natural Resources at MSU, MO staff are expected to participate in quarterly staff meetings. During 2008, Widders, Maredia and Hassankhani were actively involved in Strategic Planning activities of IIA.

G. USAID CTO Change

Recognition of Dr. Jiryis Oweis:
The MO of the Dry Grain Pulses CRSP wants to use this opportunity to express our sincere gratitude for the assistance and guidance of Dr. Jiryis Oweis as the CTO for the Bean/Cowpea CRSP (2002-07) and the Dry Grain Pulses CRSP (2007-08). Dr. Oweis retired from USAID on September 30, 2008. He was a strong advocate of USAID – University partnerships through the CRSPs, a dedicated public servant committed to the mobilization of the capacities of U.S. universities for the betterment of the poor and food insecure in developing countries, and a loyal friend. He constantly pushed Bean/Cowpea CRSP MO staff and PIs to achieve excellence through their research and training activities plus encouraged us to never forget who we are serving through CRSP work. We are truly indebted to Dr. Jiryis Oweis for his encouragement and support during the ME recompetition and the transition between the Bean/Cowpea and Dry Grain Pulses CRSP programs. The entire CRSP community wishes Jiryis all the best as he spends more time with Anne and his grandchildren.

Welcome to Dr. Bahiru Duguma:
The MO also extends a warm welcome to Dr. Bahiru Duguma as the new CTO of the Dry Grain Pulses CRSP effective October 2008. Having studied forestry, been involved in agriculture research with the IARCs, and had diverse international program management roles in the Africa Bureau of USAID, the MO believes that Dr. Duguma's extensive experience and contacts especially in West Africa, will enable him to provide excellent technical guidance and assistance to the Pulse CRSP. We look forward to getting to know him better and working with him over the coming years.

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ACRONYMS

CIAT	Centro International de Agricultura Tropical (International Center for Tropical Agriculture), Colombia
EAP	Escuela Agricola Panamericana- Zamorano, Honduras
HC	Host Country
IAR	Institute for Agricultural Research, Nigeria
IEHA	Presidential Initiative to End Hunger in Africa
IIA	Instituto de Investigação Agronómica, Angola
IIAM	Instituto de Investigacao Agraria de Mocambique, Mozambique
INERA	Institut de l'Environment et des Recherches Agricole, Burkina Faso
INIAP	Instituto Nacional de Investigaciones Agropecuarias, Ecuador
INRAN	l'Institut National de la Recherche Agronomique du Níger, Niger
ISAR	Institute des Sciences Agronomique du Rwanda, Rwanda
ISU	Iowa State University
KARI	Kenyan Agriculture Research Institute, Kenya
KIST	Kigali Institute of Science and Technology, Rwanda
MO	Management Office
MSU	Michigan State University
NCRRI	National Crops Resources Research Institute, Uganda
PSU	The Pennsylvania State University
UCR	University of California- Riverside
UIUC	University of Illinois at Urbana Champaign
UPR	Universidad de Puerto Rico- Mayaguez
USAID	United States Agency for International Development
UWO	University of Western Ontario
VEDCO	Volunteer Efforts for Development Concerns, Uganda