

FY 2010 Workplans

October 1, 2009-September 30, 2010

**Dry Grain Pulses Collaborative
Research Support Program (CRSP)**



USAID
FROM THE AMERICAN PEOPLE

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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
IER	Institute for Rural Economics, Mali
IIA	Instituto de Investigação Agronómica, Angola
IIAM	Instituto de Investigacao Agraria de Mocambique, Mozambique
IITA	International Institute of Tropical Agriculture
INERA	Institut de l'Environnement et des Recherches Agricoles, Burkina Faso
INIAP	Instituto Nacional de Investigaciones Agropecuarias, Ecuador
INRAN	l’Institut National de la Recherche Agronomique du Niger, 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
NUR	National University of Rwanda
PSU	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

P1-CU-1

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

Principal Investigator:

Julie Lauren, Cornell University, U.S.A.

Collaborating Scientists:

Beth Medvecky, Cornell, U.S.A.

John Ojiem, KARI, Kenya

Alice Pell, Cornell, U.S.A.

Martins Odendo, KARI, Kenya

John Duxbury, Cornell, U.S.A.

Samuel Mwonga, Egerton University, Kenya

Peter Hobbs, Cornell, U.S.A.

John Okalebo, Moi University, Kenya

Rebecca Stoltzfus, Cornell, U.S.A.

John Nderitu, University of Nairobi, Kenya

Christopher Barrett, Cornell, U.S.A.

James Muthomi, University of Nairobi, Kenya

Robin Buruchara, CIAT, Uganda

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. We hypothesize that practices that promote 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.

Consumption of pulses is essential for addressing iron deficiency, anemia and stunting caused by inadequate intakes of zinc. Recent national or regional level food composition data on the mineral nutrient content of staple food products, including iron and zinc, 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 learning partnerships. Providing opportunities for current and future scientific leaders to gain experience and expertise with participatory research and development approaches also are an essential part of the education process. These experiences will help students and research scientists to understand that adoptable and sustainable technologies are those that reduce risk and effectively address farmer constraints and resource levels.

Planned Project Activities for October 1, 2009 - September 30, 2010

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.

Collaborators:

Cornell University (Ithaca, New York)

Beth Medvecky, Julie Lauren, Peter Hobbs, Alice Pell

Kenya Agricultural Research Institute (Nairobi, Kenya)

John Ojiem, Martins Odendo, David Mbakaya, Isabella Ememwa

International Center for Tropical Agriculture (Uganda)

Robin Buruchara

Approaches and Methods:

1. *In Community Farmers Meetings/Training Sessions* - KARI will organize and conduct additional meetings and trainings for farmers outside of the initial core group that we recruited and trained in FY09. Farmers invited to these meetings will be from surrounding communities in South Nandi, who have expressed an interest but were not able to participate in the FY09 program, and farmers working with new NGO partners located in Busia, Teso and Vihiga districts. Participatory approaches will be used to engage participants in understanding 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), to facilitate exchange of farmer and scientific knowledge and to demonstrate boma compost making. A special effort will be made to create awareness with new farmers at the high fertility site in Koibem about soil fertility degradation and methods to reduce it.

2. *On Farm Verification Trials* - KARI will continue support for the initial core farmers in South Nandi to test selected vigor enhancing strategies for a second Short Rains-Long Rains cycle. In addition as funding resources allow, KARI will support verification by a limited number of new farmers in South Nandi, Busia, Teso and Vihiga districts. Treatments for the verification trials will be selected by the farmers according to their interest and resources. Based on FY09 results, we expect that farmers will streamline their testing in the second year to those treatments that have produced the greatest impacts. The project will supply sufficient quantities of bean (variety: KK8) and Lablab (variety: Rongai) seed and fertilizers (TSP, Minjingu Rock Phosphate, DAP) to plant the trials at new sites. Due to limited seed supply and to encourage farmer investment in developing their own seed supplies, we will not supply bean or lablab seed to the initial core farmers, but we will supply fertilizers. KARI personnel will provide technical backstopping and follow-up with the farmers.

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.

Collaborators:

Cornell University (Ithaca, New York)

Beth Medvecky, Julie Lauren, Peter Hobbs, Chris Barrett

Kenya Agricultural Research Institute (Nairobi, Kenya)

John Ojiem, Martins Odendo, David Mbakaya, Isabella Ememwa

NGO and farmer groups

Rural Energy and Food Security Organization (REFSO),

Appropriate Rural Development Agriculture Program (ARDAP),

Avene

Approaches and Methods:

1. *Collaborations with NGO and farmer groups* - Support will be provided to 2 NGO's (REFSO, ARDAP) and a CBO (Avene Group) who will monitor their farmers' reaction and crop response to the vigor enhancing strategies in parts of Busia, Teso and Vihiga Districts of Western Province. The new partners are bulking bean and lablab seed this season and farmer testing will begin with the Short Rains season 2009-10. The results will help us to evaluate the performance of the vigor enhancing strategies in other parts of Kenya's Highlands and to confirm that these approaches are successful in different environments. In addition this initial collaboration builds the NGOs' capacity and provides a platform for scaling up in the future. REFSO and ARDAP currently serve ~ 1,800 and 5,000 households, respectively. Avene is a smaller organization, with < 50 clients, but it is part of a larger network established by Resource Kenya, a NGO focusing on soil fertility management strategies in Western Kenya.

2. *Crop performance evaluation and in season exchange visits* - New farmers will be trained to collect crop establishment and volumetric yield data (for maize, beans, lablab) from their verification trial plots. 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.

The project will continue to support farmer-to-farmer exchange visits during Short and Long Rains seasons 2009-10 for South Nandi farmers and lead farmers from the NGO groups. These visits will raise farmers' awareness about maize and grain legume productivity under varying soil fertility conditions, while encouraging farmer-to-farmer knowledge sharing. Local input suppliers will be invited to learn about farmers' fertilizer and seed needs for grain legumes. Participant feedback after each group event will be solicited and reported.

Farmer feedback from all seasonal evaluations, exchange visits, the socioeconomic survey and participating NGO group monitoring will be compiled and used to document lessons learned from the participatory process. Key findings will be incorporated into extension materials (see below).

3. *Develop and distribute project-related training materials* - Extension materials on the vigor enhancing approaches will be prepared for farmers and development workers. These will focus on: (i) grain legumes and phosphorus use; (ii) growing and managing lablab; and (iii) alternative fertilizer strategies for maize (including boma compost, organic/inorganic fertilizer mixtures and

the use of lablab as a soil amendment). The farmer-oriented instructional materials will utilize a combination of drawings and simple text, while the development workers materials will contain more text and explain points in greater detail. The materials will be made available to NGOs, CBOs, extension trainers in Kenya and through CIAT and ASARECA websites/ outreach programs.

4. *Complete socioeconomic survey and continue to monitor technology diffusion trends* - A Masters degree student at Moi University will initiate a socioeconomic survey towards the end of the Long Rains 2009 to document the initial core farmers' reaction to the tested vigor enhancement strategies including adoption trends (see FY09 Workplan). Data collection and analysis will be completed early in FY10. Farmers associated with newly recruited NGOs REFSO, ARDAP and Avene will be monitored through the end of FY10 to record perceived impacts, constraints, innovations and diffusion of the technologies to other farmers.

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

Collaborators:

Cornell University (Ithaca, New York)

Julie Lauren, Beth Medvecky, John Duxbury, Peter Hobbs

Kenya Agricultural Research Institute (Nairobi, Kenya)

John Ojiem, David Mbakaya, Maurice Mudeheri

International Center for Tropical Agriculture (Uganda)

Robin Buruchara

Egerton University (Kenya)

Samuel Mwonga

Moi University (Kenya)

Robert Okalebo

University of Nairobi (Kenya)

James Muthomi, John Nderitu

Approaches and Methods:

1. *Implement replicated experimental trials* - The replicated Main Experiment (lablab and bean in Short Rains; maize-bean intercrop in Long Rains) at 4 sites across the soil fertility gradient will be repeated in FY10 in order to obtain a second year of data. KARI will establish and oversee the management of the replicated experiments.

2. *Data collection and evaluation* - Emergence, early seedling growth, pest/disease and agronomic data will continue to be collected from the replicated experiments during FY10. Results will be shared among all collaborators at the end of each cropping season.

3. *In-season field visits and annual meeting review of results* - Site visits will be made to the replicated trials by project collaborators to assess the effectiveness and impacts of the tested

vigor enhancing strategies and to interact with farmers. Observations and comments will be reported. A second annual meeting will be held after the Long Rains 2010 to review and summarize results from the farmer and replicated experiments.

4. *Germplasm testing* - A student at Moi University will compare the agronomic, pest/disease response and phosphorus efficiency of cowpea lines obtained from the University of California Riverside at 4 sites across the soil fertility gradient during Short Rains 2009-2010. The student's Masters thesis will utilize these results combined with a similar evaluation of local cowpea germplasm during the Long Rains 2009.

Fifty lines of nutrient efficient common beans obtained from the Pennsylvania State University (PSU) project will be evaluated on the KARI Kakamega station for adaptation to Western Kenya conditions during the Long Rains 2009 season. Early vigor, growth habit, impact of diseases (root rot, mosaic virus, angular leaf spot, etc.) and pests (bean stem maggot, aphids), flowering, maturity and yield data will be recorded. Selections will be made for cultivar release purposes or as breeding parents.

5. *Nutrient analysis of grain and edible leaf samples* - Additional grain and leaf subsamples will be collected from replicated trials for mineral nutrient analysis at Cornell University. Focus will be on cowpea materials being tested by the Moi University student in the Short Rains 2009-2010.

6. *Publication preparation* - Data from the 4 replicated experiments collected over the 2 years of the project will be summarized and prepared for publication in peer reviewed journals. Preparation of these publications will occur after the end of the Long Rains 2010 season; and we expect manuscripts to be ready for submission within 6-9 months of the end of FY10.

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

Collaborators:

Cornell University (Ithaca, New York)

Julie Lauren, Beth Medvecky, John Duxbury

Kenya Agricultural Research Institute (Nairobi, Kenya)

John Ojiem, Martins Odendo, Maurice Mudeheri

Egerton University (Kenya)

Samuel Mwonga

Moi University (Kenya)

Robert Okalebo

University of Nairobi (Kenya)

James Muthomi, John Nderitu

Approaches and Methods:

1. *Implementation of student research projects* - All of the students will have finished data collection by the end of the Short Rains season (February 2010). Two students will be collecting data from additional satellite experiments established on 4 farmer fields across the soil fertility gradient - Experiment I: to evaluate the performance of cowpea germplasm; Experiment II: to assess the impact phosphorus additions in seed priming water on growth and performance of bean, cowpea and lablab. A third student will collect additional pest and disease data from the established replicated Main Experiment.
2. *Masters theses* - Five students will complete Masters theses during FY10: 3 at Moi University, 1 at University of Nairobi and 1 at Egerton. Project and HC Capacity Building program funds have been used to support these students.
3. *Sharing results at annual meeting* - Students will present results from their research projects for discussion and suggestions during the FY10 annual meeting. Results will be incorporated into the project annual report as they become available.
4. *Publications/Conference presentations* - Results from the students' research projects will be disseminated either at local conferences or submitted for publication in refereed journals. At least one journal manuscript submitted for publication or one conference presentation will have been given by each of the universities by the end of FY10.

Objective 5: Capacity Building

Degree Training:

Trainee #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)

Trainee #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)

Trainee #3

First and Other Given Names: Jane Francisca
Last Name: Lusweti
Citizenship: Kenyan
Gender: Female
Degree: M.S.
Discipline: Plant pathology & Entomology
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)

Trainee #4

First and Other Given Names: Sylvester Navuana

Last Name: Oundo

Citizenship: Kenyan

Gender: Male

Degree: M.S.

Discipline: Soil Science

Host Country Institution
to Benefit from Training:

Training Location: Moi University

Supervising CRSP PI: Okalebo, John

Start Date: 09/07

Project Completion Date: 09/10

Training Status: Active

Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #5

First and Other Given Names: Eunice Onyango

Last Name: Odero

Citizenship: Kenyan

Gender: Female

Degree: M.S.

Discipline: Socioeconomics

Host Country Institution
to Benefit from Training: KARI Kakamega

Training Location: Moi University

Supervising CRSP PI: Odendo, Martins

Start Date: 10/07

Project Completion Date: 10/09

Training Status: Pending

Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #6

First and Other Given Names: Caren

Last Name: Oloo

Citizenship: Kenyan

Gender: Female

Degree: M.S.

Discipline: Plant pathology & Entomology

Host Country Institution

to Benefit from Training: Ministry of Agriculture-Extension

Training Location: University of Nairobi

Supervising CRSP PI: Muthomi, James

Start Date: 10/08

Project Completion Date: 10/10

Training Status: Pending

Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Contribution of Project to Target USAID Performance Indicators

See Performance Indicators worksheet for FY10

Target Outputs

- 1) Identification of biophysical environments in the East African Highlands where vigor enhancing strategies will have the most impact for addressing pests and diseases of pulse crops. Target domains will be based on pest/disease incidence and severity of pulse crops across a soil degradation gradient and assessments of vigor enhancing strategies (root rot tolerant bean varieties, seed priming, phosphorus fertilizers, combining organic-inorganic fertilizers, boma compost) in providing tolerance to identified pest and disease pressures.
- 2) Identification of socio-ecological niches in the East African Highlands where lablab (variety Rongai) can be used most successfully for food, income generation, livestock feed and/or replenishing soil fertility for enhancing crop vigor. Niches will be based on the agronomic performance of lablab, smallholder farmers' choices for utilizing lablab grain/biomass and its impacts on vigor and growth of subsequent maize production across a soil fertility degradation gradient.
- 3) Multipurpose cowpea varieties identified for production of both grain and biomass for food, income and rebuilding soil fertility; that perform well under the biophysical conditions of Western Kenya and are acceptable to smallholder farmers.
- 4) Locally relevant nutrient composition database developed for lablab, cowpea and common bean (grain, leaf) grown under Western Kenya's varying soil fertility conditions to aid policy decision-making for meeting human nutrition goals through the food system.

- 5) Project-related extension materials developed and disseminated to promote adoption and aid scaling up of vigor enhancing strategies for Highland mixed farming systems based on lessons learned from participatory activities including farmer preferences, constraints, innovations, technology impacts and adoption trends.
- 6) Increased capacity of mid-career professionals from the Kenya Agricultural Research Institute and Ministry of Agriculture to address technical pulse crop production issues using participatory research approaches.

Engagement of USAID Field Mission(s)

- 1-2 courtesy visits to Agriculture Office during FY10
- Invite Agriculture Officer for a project site visit

Networking Activities with Stakeholders

- Collaborations with NGO/farmer groups REFSO, ARDEP and Avene were developed in FY09. Trainings, facilitation and technical backstopping on the improved pulse productivity strategies will continue in FY10 in an effort to build capacity in these NGOs and provide a platform for scaling up.
- As a result of the project, farmers are expressing interest in TSP fertilizers for their pulse crops. During FY10, stockists (local input suppliers) will be invited to attend exchange visits to create awareness and exchange ideas about vigor enhancing strategies, thereby stimulating opportunities for increased sales and expanded inventory in response to farmers demands.

Leveraging of CRSP Resources

Existing projects lead by co-PIs of this project will allow us to leverage travel funds during the project period. The projects are the SANREM CRSP (Sponsor: USAID, through Sept 2009); Global Livestock CRSP (Sponsor: USAID, through Dec 2011); and Building Farmer's Capacity and Marketing Skills (Sponsor: Anonymous donor and Catholic Relief Services through August 2009).

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

PERFORMANCE INDICATORS
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	2010 Target	2010 Actual
(October 1 2009-Sept 30, 2010)		
Degree Training: Number of individuals enrolled in degree training		
Number of women	4	
Number of men	2	
Short-term Training: Number of individuals who received short-term training		
Number of women	100	
Number of men	50	
Technologies and Policies		
Number of technologies and management practices under research	2	
Number of technologies and management practices under field testing	9	
Number of technologies and management practices made available for transfer	9	
Number of policy studies undertaken	0	
Beneficiaries:		
Number of rural households benefiting directly	150	
Number of agricultural firms/enterprises benefiting	1	
Number of producer and/or community-based organizations receiving technical assistance	4	
Number of women organizations receiving technical assistance	1	
Number of HC partner organizations/institutions benefiting	4	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	20	

Dry Grain Pulses CRSP (10/1/09-9/30/10)

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

	Third period (12 months) 10/01/09 - 09/30/10					
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name:	Cornell		KARI			
a. Personnel Cost						
Salaries	\$28,327.62		\$3,419.52			
Fringe Benefit	\$13,483.95		\$0.00			
b. Travel	\$13,800.00		\$18,458.50			
c. Equipment (\$5000 Plus)	\$0.00		\$0.00			
d. Supplies	\$400.00		\$6,013.28			
e. Training						
Degree			\$16,071.97			
Non-Degree			\$0.00			
f. Other	\$5,040.00		\$0.00			
g. Total Direct Cost	\$61,051.57	\$0.00	\$43,963.27	\$0.00	\$0.00	\$0.00
h. Indirect Cost	\$32,967.85		\$4,398.33			
i. Indirect Cost on Subcontracts (First \$25000)	\$0.00					
j. Total Indirect Cost	\$32,967.85	\$0.00	\$4,398.33	\$0.00	\$0.00	\$0.00
Total	\$94,019.42	\$0.00	\$48,359.60	\$0.00	\$0.00	\$0.00
Grand Total			\$142,379.02			

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	\$61,052.57	58.14%
Total direct cost budgeted for H.C institution(s)	\$43,963.27	41.86%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind			\$22,340.00				\$ 22,340.00
Cash	\$16,217.00		\$10,634.00				\$ 26,851.00
Total	\$ 16,217.00	\$ -	\$ 32,974.00	\$ -	\$ -	\$ -	\$ 49,191.00
Attribution to IEHA Objectives							
Percentage of effort	60.00%		49.89%				56.57%
Amount corresponding to effort	\$56,411.65	\$0.00	\$24,126.60	\$0.00	\$0.00	\$0.00	\$80,538.26
Attribution to Capacity Building (Theme "D")							
Percentage of effort	40.00%		50.11%				43.43%
Amount corresponding to effort	\$37,607.77	\$0.00	\$24,233.00	\$0.00	\$0.00	\$0.00	\$61,840.76

Name of PI and Institution affiliation: Dr. Julie G. Lauren, Cornell University

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

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

Identify Benchmark Indicators by Objectives	Abbreviated name of institutions											
	Cornell	KARI										
	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10

Objective 1	<i>To develop & assess farmer capacity for improving vigor & growth of pulse crops on nutrient accumulation, pest/disease resistance and system productivity across a soil degradation gradient</i>											
Reports on in-community trainings & meetings			x									
Farmer trials established			x									

Objective 2	<i>To disseminate & evaluate through participatory approaches simple, low cost strategies for vigorous establishment/growth of pulse crops leading to increased system productivity and sustainability</i>											
NGO partner monitoring reports received			x	x								
Farmer data collected			x	x								
Exchange visits conducted & technologies evaluated			x	x								
Lessons learned reported	x			x								
Extension materials developed and distributed	x			x								

Objective 3	<i>To research factors (nutrients, pest/diseases and their interactions) affecting pulse productivity across a soil degradation gradient</i>											
Research experiments established for 2nd year			x									
Seasonal research results reported	x	x	x	x								
Site visit trip reports	x	x	x	x								
Germplasm testing reports				x								
Annual meeting report	x			x								
Nutrient analysis report	x											
Publications in preparation	x			x								

Objective 4	<i>To facilitate and support on-farm participatory research opportunities for Kenyan agricultural scientists and graduate students</i>											
Faculty progress reports			x	x								
Student research reports at annual meeting					x							
Masters degrees completed	x			x								
Publications submitted or presentations given at conference		x			x							

Name of the PI responsible for reporting on benchmarks	J.G. Lauren	J.O. Ojiam										
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Signature/Initials: _____

P1-ISU-1

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

Principal Investigator:

Robert Mazur, Iowa State University, U.S.A.

Collaborating Scientists:

Suzanne Hendrich, ISU, U.S.A.	Dorothy Nakimbugwe, Makerere University, Uganda
Mark Westgate, ISU, U.S.A.	Barnabas Kiiza, Makerere University, Uganda
Helen Jensen, ISU, U.S.A.	Gabriel Elepu, Makerere University, Uganda
Patricia Murphy, ISU, U.S.A.	Hilda Vasanthaalam, KIST, Rwanda
Manju Reddy, ISU, U.S.A.	Henry Kizito Musoke, VEDCO, Uganda
Michael Ugen, NCRII, Uganda	Agnes Nakimuli, VEDCO, Uganda

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 are 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 remain 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% sold some in 2007. The SL approach 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 with better nutritive value (Objective 1) or processing characteristics (Objective 2) is an important under-researched issue in this region. Improved linkages to emerging markets are also essential (Objective 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 re- 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 being 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 October 1, 2009 - September 30, 2010

Objective 1: To Improve Harvested Bean Quality and Yields.

Collaborators:

National Crops Resources Research Institute (Kampala, Uganda)

Michael Ugen

Volunteer Efforts for Development Concerns (Kampala, Uganda)

Agnes Nakimuli

Iowa State University (Ames, Iowa)

Mark Westgate, Gerald Sebuwufu

Makerere University (MAK-Kampala, Uganda)

Dorothy Nakimbugwe

Approaches and Methods:

Obj. 1a. Determine and Prioritize Key Production Constraints of Five Priority Bean Varieties

- Quantify the effects of abiotic stresses on physiology and yield formation of priority bean varieties
- Conduct meta-analysis of the effect of biotic and abiotic factors on yield and composition of common beans. This methodology involves analyzing yield and composition data from relevant journal articles and calculating the magnitude of major constraint effects. This approach is particularly important since complex and inter-related yield constraints can be parsed to quantify primary response factors. These have not been established for common beans.
- Conduct controlled environment (greenhouse) experiments to identify primary physiological responses and yield component responses of five priority varieties to abiotic stresses (limited water supply and high temperature) during grain filling. The purpose of these experiments is two-fold: first to establish the physiological basis for genotypic differences in stress response to focus breeding efforts for germplasm improvement, and second to train Ugandan students in physiology research techniques.
- Document impacts of a controlled abiotic stress on primary yield components: seed number, seed size, and seed nutrient composition. This information is critical for establishing primary yield formation constraints under typical field conditions.
- Provide seed with altered physical and chemical attributes for nutritional studies under Objective 2.

Benchmarks

Oct. 2009 – Mar. 2010

- Reported meta-analysis on the effect of water and temperature stress.
- Completed experiments on relative sensitivity of priority varieties to abiotic stresses
- Documented impact of controlled abiotic stresses on seed nutrient composition

- Increased bulk quantities of seed needed for processing and nutritional studies under Objective 2

Apr. 2010 – Sept. 2010

- Draft manuscripts on physiological studies and meta-analysis completed
- Collaborative physiological studies initiated with I. Rao (CIAT) and J. Kelly (CRSP program - Michigan State Univ.) on selected ‘stress tolerant’ varieties released from their breeding programs.

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

- Repeat season 1 in 2009 replicated field trials with 6 cooperating farmer groups (30 locations) to compare the yield of (NABE 6 [white dry bean, small seeded] and K 131 [carioca dry bean] and K 132 and NABE 4 [red mottled beans], and NABE 2 in Kamuli district)
- Repeat season 1 in 2009 assessment of benefits of improved soil fertility by comparing the yield of manure fertilized vs. non-fertilized treatments on K 132 [red mottled bean] in Kamuli district in Uganda.
- Document and analyze location x genotype effects on yield, yield components, and seed nutrient composition.
- Compare impact of timely harvesting on initial seed quality (germination, fungal and insect infestation, physical damage) and maintenance during storage.
- Harvest seed for nutritional and processing analysis under Objective 2
- Utilize new soils map of Uganda and available weather data to identify agro-ecological areas in Uganda and Rwanda beyond the test site where similar GxE responses might be expected.

Benchmarks

Oct. 2009 – Mar. 2010

- Collected and analyzed 2009 yield data from participatory field trials
- Analyzed 2009 seed composition from field trials
- Documented impacts on bean quality from improved harvest and storage techniques

Apr. 2010 – Sept. 2010

- Conducted 2010 trials using improved production practices
- Confirmed yield and nutritional profile of priority varieties under different growing conditions
- Provided seed from field trials for nutrient analysis, consumer evaluation, and processing evaluations under Objective 2
- Identified agro-ecological regions where stress tolerance characteristics of improved varieties would likely improve bean production

Obj. 1c. Evaluate and Reduce Post-Harvest Losses

- Develop post-harvest training materials and adaptation of existing ones
- Train farmers in pre- and post-harvest handling of beans for minimal deterioration
- Evaluate extent of adoption of innovations from training
- Evaluate influence of farmer innovation uptake on post-harvest losses

Benchmarks

Oct. 2009 – Mar. 2010

- Developed materials for post-harvest training
- Completed farmers' training in pre- and post harvest handling

Apr. 2010 – Sept. 2010

- Completed evaluation of extent of adoption
- Evaluated influence of innovations on post-harvest losses

Obj. 1d. Strengthen Farmers' Collective Capabilities to Learn and Share Innovative Practices

- 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
- Train cooperating farmers in bean production practices, including pre- and post-harvest handling, and marketing, and the importance of careful record keeping for research and demonstration activities using the production manual prepared for this project.
- Conduct field days at research/demonstration sites for farmers outside of VEDCO cooperators groups.

Benchmarks

Oct. 2009 – Mar. 2010

- All cooperating farmers and farmer group members trained in research methods
- Open field days conducted at selected variety trial and fertilizer trial sites

Apr. 2010 – Sept. 2010

- Farmer knowledge on participatory research methodologies/designs put into practice for improved field trial implementation
- Trainee follow-up conducted to reinforce implementation of recommended practices
- Recommended research results incorporated into training procedures and promotion protocols RDEs in other VEDCO operational areas and beyond (NaCRRI can use the 'lessons learned' to apply to their other areas of operation)
- Field days conducted for other NGOs, international agencies, and foundation representatives interested in the farmer-to-farmer approach to achieve sustainable food security – include other researchers from NARO institutes and other relevant organizations
- Results from objectives 1a and 1b (above) to be applied to other bean producing districts by NaCRRI and other research units or institutions

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

Collaborators:

Makerere University (MAK-Kampala, Uganda)

Dorothy Nakimbugwe, John Muyonga,

Iowa State University (ISU-Ames, Iowa)

Suzanne Hendrich, Patricia Murphy, Manju Reddy, Martin Mutambuka

Kigali Institute of Science and Technology (KIST-Kigali, Rwanda)

Hilda Vasanthakaalam

Center for International Tropical Agriculture Research (CIAT-Africa)

Martha Nyagaya

Approaches and Methods:

Obj. 2a. Determine the influence of Agronomic Conditions on Nutritional Quality of Beans

- The nutritional quality (mineral content, protein and starch digestibility, iron bioavailability, bean ferritin and anti-nutritional factors (phytate, trypsin inhibitors, polyphenols) and processing quality (rate of hydration, bean hardness) of the five bean varieties (NABE 2, NABE 4, NABE 6, K 131 and K 132) will be analyzed. The effect of various agronomic factors (water stress, heat stress, manure - see Objective 1) on these nutritional and processing attributes will also be determined.
- These varieties will be subjected to various processing techniques, performed according to procedures developed by Dr. Nakimbugwe at MAK and Drs. Hendrich and Murphy at ISU. The processed beans will be assessed for nutritional quality, focusing on mineral content (done in collaboration with Dr. Westgate's laboratory in Agronomy at ISU), protein and starch digestibility, iron bioavailability, bean ferritin and anti-nutritional factors (phytate, polyphenols) contents as key determinants of iron bioavailability.
- Iron bioavailability will be determined according to methods proposed by Proulx and Reddy (2007), ferritin analysis by ELISA (Lukac *et al.*, 2009). Starch digestibility will be determined using official AACC method 32-40 (AACC, 2000), protein digestibility and phytate content according to AOAC Official Method 986.11 and polyphenolic compounds according to AOAC Official Method 965.31, as well as by HPLC methods to be developed in Dr. Murphy's laboratory, ISU.

Benchmarks

Oct. 2009 – Mar. 2010

- Nutritional analysis of effects of agronomy on harvested beans from Season 1 in 2009 completed
- Analysis of effects of processing (first round of improvements) on nutrition quality completed

Apr. 2010 – Sept. 2010

- Nutritional analysis of effects of agronomy on harvested beans from Season 2 in 2009 completed
- Analysis of effects of processing (second round of improvements) on nutrition quality completed

Obj. 2b. Determine the Influence of Processing on the Nutritional and Sensory Quality of Beans

- A processing protocol for an extruded bean snack will be developed by the Ugandan PhD student at ISU, based on the preliminary treatments already developed by the MSc student at Makerere University.
- The product's nutritional and sensory characteristics will be optimized using the Response Surface Methodology (RSM).
- The effect of processing on the nutritional quality (ferritin content, iron bio-availability as well as the relationship between: phytate and polyphenol content; ferritin content and iron bio-availability) will be determined.
- A bean flour, suitable for use in instant soups and porridges, will also be produced from the extruded flour.
- The effect of bean consumption on the on human metabolism will be assessed, using the extruded bean snack.

Benchmarks

Oct. 2009 – Mar. 2010

- Processing protocol for an extruded bean snack developed
- Nutritional and sensory characteristics of bean snack optimized
- Effects of processing on nutritional quality determined

Apr. 2010 – Sept. 2010

- Bean flour suitable for use in instant soups and porridges produced from extruded flour
- Effect of bean consumption on human metabolism assessed

Obj. 2c. Develop Processing Techniques with Improved Efficiency, Feasibility and Consumer Acceptance of Bean-Based Food Products

- Based on the results of the rapid market survey (see Obj. 3b), developed during Mar.- Sept. 2009 will be up scaled and refined to provide a marketable bean flour, suitable for use as an ingredient for incorporation into home meals, for institutional use (particularly to be incorporated into cereal-based porridges in schools and hospitals) and for commercial use as an ingredient (to be incorporated into snacks suitable for school children).
- To promote use of the bean flour in communities, members of a Kamuli community as well as Makerere University Food Science & Technology students will be involved in a competition to develop acceptable recipes that utilize the developed bean flour

- Products of the developed recipes will be evaluated for consumer acceptance and the most acceptable recipes will be promoted within the community.
- A protocol for processing a bean flour-based product will be developed and optimized, basing on the results of the consumer market survey and product development competition.
- The potential of the bean flour to improve nutrient intake among infants and young children will be evaluated in a cross sectional dietary evaluation in communities, comparing meals with and without the bean flour incorporated.

Benchmarks

Oct. 2009 – Mar. 2010

- Protocol for producing bean flour up scaled and refined
- Recipes utilizing bean flour developed and evaluated in a competition
- Winning recipes promoted in communities

Apr. 2010 – Sept. 2010

- Protocol for bean flour-based product developed and optimized
- Potential contribution of developed bean-based products to nutrient intake assessed

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

Collaborators:

Makerere University (MAK - Kampala, Uganda)

Barnabas Kiiza, Gabriel Elepu

Volunteer Efforts for Development Concerns (VEDCO - Kampala, Uganda)

Agnes Nakimuli

Iowa State University (ISU - Ames, Iowa)

Helen Jensen, Robert Mazur

Approaches and Methods:

Obj. 3a. Identify Solutions to Production and Marketing Constraints Faced by Bean Producers

- Identify strategies to address barriers and challenges in market access faced by farmers/producers. This work builds on the ‘Baseline Data for Participating Households in Kamuli Bean Production and Marketing’ questionnaire in 2009. A follow up household survey will be conducted in Feb.-Mar. 2010.
- Identify strategies and approaches to strengthen value chain and returns to producers through value-added marketing efforts. This work builds on the ‘Business and Trading’ questionnaire in 2009.
- Identify specific requirements and segments for three target market areas (local, community markets, school meals and processing uses) (see Objective 3b). Makerere University and possible business partners (including VEDCO) will be involved.

- Help farmers and farm groups to more successfully market beans by developing chain partnerships. This involves improving market information systems, building farmers' entrepreneurial and negotiation skills, and training them to participate effectively in decision making. Developing these linkages will depend in part on the product development and testing of work conducted under Objective 2c.

Benchmarks

Oct. 2009 – Mar. 2010

- Value chain and marketing analyses completed
- Consumer requirements and market channels for bean flour identified
- Successful producer marketing strategies identified

Apr. 2010 – Sept. 2010

- Market information system improved
- Farmers and farmer organizations trained in improved bean marketing

Obj. 3b. Characterize Consumer Demand and Preferences for Beans and Agro-Processed Products

- In project discussions, three target markets have been identified for specific consideration: (1) local communities (specifically, direct marketing to household consumers); (2) school meals; and (3) processors (e.g., using product for snack foods). The processor market would allow consideration of the needs of smaller, individual producers preparing food for sale directly to consumer (e.g., street food), as well as the needs of specific products for larger scale production.
- A rapid market survey will be carried out among the three target consumers of the bean flour (homes, institutions such as schools and hospitals and snack-food makers), to determine their requirements and most appropriate marketing channels and arrangements.
- Determine market values of bean varieties and products. Collect market price information on bean varieties sold in market following harvest and at different stages in the value chain. This analysis will be used to identify opportunities for improved marketing, as well as confirm values attached to different bean varieties by consumers and by processors.
- Through a consumer survey, determine the requirements for the bean flour-based food, taking into account the 4Ps (type of *Product* demanded, *Places* where it can be marketed, the *Price* consumers will be willing to pay, and the type of *Promotion* suitable for the product).
- Develop and evaluate marketing information and marketing plans that incorporating market values and production traits in marketing plan. This includes consideration of the specific markets and requirements for the three target markets: local communities, school meals, and product used in processed foods (including product for street foods).

Benchmarks

Oct. 2009 – Mar. 2010

- Consumer requirements and most appropriate marketing channels and arrangements for bean products identified
 - Value of various bean varieties and value-added products in the market identified
- Apr. 2010 – Sept. 2010
- Consumer requirements for the bean flour-based food determined
 - Farmers and farmer organizations trained in developing marketing plans by incorporating market and production information.

Obj. 3c. Increase Awareness of Benefits of Consuming Beans and Value-Added Products and their Access to New Products

- Investigate the role of nutritional awareness in consumer choice and valuation of beans and bean products, including targeted women's groups and schools. This follows up nutrition education efforts.
- Develop and evaluate marketing strategies that take account of consumers' enhanced nutritional awareness.
- Assess emerging opportunities for processors and others in the bean value chain

Benchmarks

Oct. 2009 – Mar. 2010

- Identification of successful marketing approaches to consumers and for value added products
- Training of producers on effective bean marketing

Apr. 2010 – Sept. 2010

- Training of producers on successful marketing methods for beans and new products
- Training of processors and others in value chain on successful marketing methods for beans and new products

Objective 4: Capacity Building

To Increase the Capacity, Effectiveness and Sustainability of Agriculture Research Institutions that Serve the Bean Sector in Uganda and Rwanda

Collaborating Host Country and U.S. Researchers and Institutions:

Makerere University (MAK - Kampala, Uganda)

Dorothy Nakimbugwe, John Muyonga, Barnabas Kiiza, Gabriel Elepu

National Crops Resources Research Institute (NaCRRI - Kampala, Uganda)

Michael Ugen

Kigali Institute of Science and Technology (KIST-Kigali, Rwanda)

Hilda Vasanthakaalam

Iowa State University (ISU - Ames, Iowa)

Robert Mazur, Mark Westgate, Suzanne Hendrich, Patricia Murphy, Manju Reddy, Helen Jensen

Approaches and Methods

- Engage students in learning appropriate theories and methods in discipline and multidisciplinary format
- Integrate students into research projects
- Guide development of students' research proposals and supervise their research

Benchmarks

Oct. 2009 – Mar. 2010

- Training 2 new M.S. students (Food Science & Technology, and Agricultural Economics and Agribusiness) at Makerere University initiated
- Training M.S. student in Food Science & Technology from Rwanda on-going
- Training 2 Ph.D. students (Food Science & Human Nutrition, and Agronomy) at Iowa State University on-going

Apr. 2010 – Sept. 2010

- Training 3 M.S. students at Makerere University completed
- Training 2 Ph.D. at Iowa State University on-going
- Inter-organizational learning fostered
- Preliminary results disseminated (conferences, publications, websites)

Degree Training:

Trainee #1

First and Other Given Names: Gerald

Last Name: Sebuwufu

Citizenship: Ugandan

Gender: Male

Degree Program for training: PhD

Program Areas or Discipline: Agronomy

Host Country Institution to Benefit from Training: National Crop Resources Research Institute, Uganda
University to provide training: Iowa State University

If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes

Supervising CRSP PI: Mark Westgate

Start Date: August 2008

Projected Completion Date: May 2012

Type of CRSP Support (full, partial or indirect): partial

If providing Indirect Support, identify source(s)s of leveraged funds: Iowa State University

Amount Budgeted in Workplan, if providing full or partial support: \$46,089

Direct cost: \$38,375

Indirect cost: \$7,714

U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University

Trainee #2

First and Other Given Names: Martin

Last Name: Mutambuka

Citizenship: Ugandan

Gender: Male

Degree Program for training: PhD

Program Areas or Discipline: Food Science and Human Nutrition

Host Country Institution to Benefit from Training: Makerere University, Uganda

University to provide training: Iowa State University

If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes

Supervising CRSP PI: Suzanne Hendrich

Start Date: January 2009

Projected Completion Date: May 2012

Type of CRSP Support (full, partial or indirect): partial

If providing Indirect Support, identify source(s)s of leveraged funds: Iowa State University

Amount Budgeted in Workplan, if providing full or partial support: \$46,089

Direct cost: \$38,375

Indirect cost: \$7,714

U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University

Trainee #3

First and Other Given Names: Cyrille

Last Name: Sinayobye

Citizenship: Rwanda

Gender: Male

Degree: M.S.

Discipline: Food Science & Technology

Host Country Institution to Benefit from Training: Kigali Institute of Science and Technology - Rwanda

University to provide training: Makerere University

Supervising CRSP PI: Dorothy Nakimbugwe

Start Date: August 2008

Project Completion Date: August 2010

Training Status: Active

Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #4

First and given names: Catherine

Last name: Ndagire

Citizenship: Ugandan

Gender: Female

Degree program for training: MSc

Program areas / Discipline: Food Science & Technology

Host Country Institution to benefit from training: Makerere University, Uganda

University to provide training: Makerere University

Supervising CRSP PI: Dorothy Nakimbugwe

Start date: August 2009

Project completion date: August 2010

Type of CRSP Support (full, partial or indirect): partial

Trainee #5

First and given names: TBD

Last name: TBD

Citizenship: Ugandan

Gender: TBD

Degree program for training: MSc

Program areas / Discipline: Ag. Economics & Agribusiness or Ag. Extension & Education

Host Country Institution to benefit from training: Makerere University, Uganda

University to provide training: Makerere University

Supervising CRSP PI: TBD

Start date: August 2009

Project completion date: August 2010

Type of CRSP Support (full, partial or indirect): partial

Contribution of Project to Target USAID Performance Indicators

- Five scientists will undergo degree training (one female, four male) during this budget cycle at Makerere University (three MS) and Iowa State University (two PhD).
- We expect 67 farmers (56 female, 11 male) to participate in advanced training regarding production, harvesting, and post-harvest methods in Uganda.
- Important technologies and management practices that are under research or field testing are:
 - Protocols for matching bean varieties with agro-ecological regions and growing conditions (soil nutrients, amendments, and moisture) for optimum physiology (plant growth and development) and yield (seed number, size, and nutrient composition)
 - Post-harvest handling and storage training techniques being adapted and further development, incorporating results of project research
 - Protocols for producing bean flour, extruded bean snack and extruded instant bean flour
 - Recipes utilizing bean flour
 - Protocols for bean flour-based products
 - Improved market information system
 - Marketing plans for farmers and farmer organizations
- We hope that these approaches will be at or near readiness for transfer for use by Host Country farmers or researchers by the end of the 12-month cycle.
- We expect that 67 households will benefit directly from our training and support program.
- Two agricultural enterprises will benefit from the increased volume of product marketed and available for processing.
- We expect that all six participating producer organizations, two marketing associations, and an additional six producer organizations will receive useful and actionable technical assistance. All of these organizations have a significant or majority of women members.
- We expect that four Host Country partner organizations/institutions will benefit from these activities (two universities, one NARO, and one NGO).
- We anticipate that an additional 15 acres will be cultivated using improved technologies by the end of the 12-month budget cycle.

Target Outputs

- Reports regarding recommended practices for crop production, and both pre- and post-harvest management procedures to improve quality of harvested beans and increase yields
- Training manuals (for VEDCO's Rural Development Extensionists, farm group members, etc.)
- Stronger links between farmers groups and associations to diverse types of buyers
- Reports of superior processing methods to protect protein and carbohydrate digestibility
- Recipes for widespread use, including for nutritionally vulnerable people
- Protocol for bean flour processing promoted for commercialization
- New value-added bean products designed for identified consumer markets

Engagement of USAID Field Mission(s)

USAID agricultural initiatives in Africa seek to build economies, establish and enhance partnerships, and harness science and technology to meet the needs of the vulnerable and impoverished. This project will help USAID meet its goals for improved well-being in Uganda and Rwanda through agricultural activities designed to promote best practices, develop and market nutritious bean-based value-added products, and successfully link farmers and producers to markets. We will meet periodically with Mission staff devoted to realization of their agriculture-related strategic objectives (SO 617-007 Economic Growth, Agriculture and Trade in Uganda) and SO 696-007 (Economic Growth, Agriculture and Trade) in Rwanda. We will also invite them to project-sponsored activities and share results of our research-development activities.

Networking Activities 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 complementarity 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

Leveraging of CRSP Resources

- In addition to the direct collaboration between food scientists in Uganda, Rwanda and the U.S. in this project, work will be done by NaCRRI and ISU with ISAR (Institut des Sciences Agronomiques du Rwanda) and MSU through a linkage with the Pulse CRSP project directed by James D. Kelly
- Iowa State University is contributing to partial support for two Ph.D. students from Uganda
- Explore bases for possible collaboration with relevant USAID-funded projects in Uganda and Rwanda, as well as other relevant projects in these countries
- Identify, with Mission staff, the potential for an Associate Award
- Explore possibilities of funding from members of the bean producer and processor industry
- Work to identify agencies that may fund related research, training and outreach and prepare proposals as appropriate

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

PERFORMANCE INDICATORS
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	2010 Target	2010 Actual
	(October 1 2009-Sept 30, 2010)	
Degree Training: Number of individuals enrolled in degree training		
Number of women	1	
Number of men	4	
Short-term Training: Number of individuals who received short-term training		
Number of women	56	
Number of men	11	
Technologies and Policies		
Number of technologies and management practices under research	7	
Number of technologies and management practices under field testing	4	
Number of technologies and management practices made available for transfer	3	
Number of policy studies undertaken	0	
Beneficiaries:		
Number of rural households benefiting directly	67	
Number of agricultural firms/enterprises benefiting	2	
Number of producer and/or community-based organizations receiving technical assistance	14	
Number of women organizations receiving technical assistance	14	
Number of HC partner organizations/institutions benefiting	4	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	15	

Dry Grain Pulses CRSP (budget template 10/1/09-9/30/10)							
Enhancing Nutritional Value and Marketability on Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda							
	Third period (12 months) 10/01/09 - 09/30/10						
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	
Institution Name	ISU	ISU	Makerere U.	NaCRRI	VEDCO	Kigali Inst.	
a. Personnel Cost							
Salaries	\$4,560	\$18,426	\$11,400	\$4,800	\$8,837	\$5,100	
Fringe Benefit	\$210	\$2,137					
b. Travel	\$14,863	\$2,650	\$6,451	\$3,994	\$1,000	\$2,614	
c. Equipment (\$5000 Plus)	\$0		\$0	\$0	\$0	\$0	
d. Supplies	\$500		\$1,413	\$2,554	\$1,774	\$890	
e. Training							
Degree		\$8,284	\$1,500			\$750	
Non-Degree					\$4,650		
f. Other	\$1,037		\$1,637	\$250	\$200	\$424	
g. Total Direct Cost	\$21,170	\$31,497	\$22,401	\$11,598	\$16,461	\$9,778	
h. Indirect Cost	\$5,504	\$6,035	\$2,240	\$1,160	\$1,646	\$978	
i. Indirect Cost on Subcontracts (First \$25000)	\$0.00						
j. Total Indirect Cost	\$5,504	\$6,035	\$2,240	\$1,160	\$1,646	\$978	
Total	\$26,674	\$37,532	\$24,641	\$12,758	\$18,107	\$10,756	
Grand Total			\$130,468				
				Amount	Percentage		
				\$52,667.00	46.65%		
				\$60,238.00	53.35%		
Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind Cash	\$31,736.00		\$0.00	\$0.00	\$0.00	\$0.00	\$ 31,736.00
	\$0.00		\$0.00	\$0.00	\$0.00	\$0.00	\$ -
Total	\$ 31,736.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 31,736.00
Attribution to IEHA Objectives							
Percentage of effort	81.00%	81.00%	90.00%	90.00%	90.00%	90.00%	85.57%
Amount corresponding to effort	\$21,605.94	\$30,400.92	\$22,176.90	\$11,482.20	\$16,296.30	\$9,680.40	\$111,642.66
Attribution to Capacity Building (Theme "D")							
Percentage of effort	55.00%	55.00%	89.00%	89.00%	83.00%	87.00%	71.27%
Amount corresponding to effort	\$14,670.70	\$20,642.60	\$21,930.49	\$11,354.62	\$15,028.81	\$9,357.72	\$92,984.94
Name of PI & Institutional Affiliation: Dr. Robert Mazur, Iowa State University							

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

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							
Identify Benchmark Indicators by Objectives	Iowa State	Makerere	NaCCRI	VEDCO	KIST			
	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10
Objective 1	Improve Bean Quality and Yields							
1a. Meta-analysis report on effect of water & temp. stress on yields	x							
1a. Completed experiments on sensitivity of varieties to water stress	x							
1a. Documented impact of stress on seed nutrient composition	x							
1a. Increased quantities of seed for processing & nutritional studies	x							
1a. Manuscripts on physiological studies & meta-analysis completed		x			x			
1a. Collaborative studies initiated, selected stress tolerant varieties		x			x			
1b. Collected and analyzed 2009 yield data	x			x		x		
1b. Analyzed 2009 seed composition from field trials	x			x				
1b. Document impacts on quality from improved harvest & storage	x			x				
1b. Conducted 2010 trials using improved production practices		x			x		x	
1b. Confirmed yield and nutritional profile of priority varieties	x			x				
1b. Provided seed from field trials for analyses in Objective 2	x			x				
1b. Identified agro-ecological regions for using stress tolerance char	x			x				
1c. Developed materials for post-harvest training	x			x		x		
1c. Farmers/group members trained in research methods				x		x		
1c. Completed farmers' training in pre- and post harvest handling				x		x		
1c. Evaluated influence of innovations on post-harvest losses	x			x		x		
1d. Farmers/group members trained in research methods				x		x		
1d. Open field days conducted at selected trial sites				x		x		
1d. Farmer knowledge put into practice for field trial					x		x	
1d. Trainee follow-up conducted					x		x	
1d. Recommended research results incorporated into training					x		x	
1d. Field days conducted					x		x	
1d. Results applied to other bean producing districts				x		x		
Objective 2	Enhance the Nutritional Value and Appeal of Beans							
2a. Nutritional analysis of effects of agronomy on harvested beans	x	x	x	x				
2a. Analysis of effects of processing on nutrition quality	x	x	x	x				
2b. Processing protocol for an extruded bean snack developed	x							

2b. Nutritional and sensory characteristics of bean snack optimized	x										
2b. Effects of processing on nutritional quality determined	x										
2b. Bean flour for soups & porridges produced from extruded flour		x									
2b. Effect of bean consumption on human metabolism assessed		x									
2c. Protocol for producing bean flour up scaled and refined			x							x	
2c. Recipes using bean flour developed & evaluated in competition			x								
2c. Winning recipes promoted in communities				x							x
2c. Protocol for bean flour-based product developed and optimized		x		x							x
2c. Contribution of bean-based products to nutrient intake assessed		x		x							x
Objective 3	Increase Marketing and Consumption of Beans and Bean Products										
3a. Value chain and marketing analyses completed	x		x				x				
3a. Consumer requir. & market channels for bean flour identified	x		x				x				
3a. Successful producer marketing strategies identified	x		x		x		x				
3a. Market information system improved		x		x		x			x		
3a. Farmers/farmer orgs. trained in improved bean marketing	x		x		x		x		x		
3b. Consumer req. & market channels for bean products identified	x		x		x		x		x		
3b. Value of bean vars, and value-added prod. in markets identified	x		x		x		x		x		
3b. Consumer req. for the bean flour-based food determined		x		x		x			x		
3b. Farmers & farmer orgs. trained in developing marketing plans	x		x		x		x		x		
3c. Identification of successful marketing approaches	x		x		x		x				
3c. Producers trained on effective bean marketing	x		x		x		x				
3c. Producers trained on marketing for new beans products	x		x		x		x		x		
3c. Processors/value chain trained to market beans, new products	x		x		x		x		x		
Objective 4	Incr. Capacity, Effectiveness & Sustainability of Ag. Research Institut.										
Training 2 new M.S. (FST and AgEcon) at MAK initiated			x								
Training M.S. student in FST from Rwanda on-going			x							x	
Training 3 M.S. students at Makerere University completed				x							x
Training 2 Ph.D. at Iowa State University ongoing	x	x									
Inter-organizational learning fostered		x		x		x		x		x	
Preliminary results disseminated (conferences, publications, websites)		x		x		x		x		x	

Name of the PI responsible for reporting on benchmarks	R. Mazur	D. Nakimbugwe	M. Ugen	H.K. Musoke	H. Vasanthaalam
Signature/Initials:					

Date: _____

P1-MSU-1

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

Principal Investigator:

James Kelly, Michigan State University, U.S.A.

Collaborating Scientists:

Eduardo Peralta, INIAP, Ecuador

Sieglinda Snapp, MSU, U.S.A.

Louis Butare, ISAR, Rwanda

Domitille Mukankubana, ISAR, Rwanda

Edward Murwanashyaka, ISAR, Rwanda

George Abawi, Cornell University, U.S.A.

Augustin Musoni, ISAR, Rwanda

Alfred Rumongi, ISAR, Rwanda

Felicite Nsanzabera, ISAR, Rwanda

Gerardine Mukeshimana, NUR, Rwanda

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 October 1, 2009 - September 30, 2010

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.

Collaborators:

Institute des Sciences Agronomique du Rwanda (Rwanda)
Augustine Musoni, Felicite Nsanzabera, Louis Butare

Instituto Nacional de Investigaciones Agropecuarias (Ecuador)
Eduardo Peralta

Cornell University (U.S.A.)
George Abawi

Michigan State University (U.S.A.)
Sieg Snapp

Approaches and Methods:

1. Continue to select parental breeding materials for crossing in Ecuador, Rwanda and U.S.
2. Identify select group of lines from Rwandan breeding for crossing with new introduced differential lines from Ecuador and CIAT.
3. Cross advanced lines back to resistance sources of bean common mosaic virus (BCMV) and angular leaf spot (ALS) to fix resistance which appears to lack stability in Rwanda.
4. Cross Rwandan sources of resistance for ALS, rust, anthracnose, Fusarium wilt and Pythium and major foliar pathogens into large seeded lines with contrasting colors. Confirm resistance of selected parental lines to target root pathogen(s) in a screenhouse/greenhouse test, if needed in Rwanda or at Cornell.
5. Utilize markers in early-generation selection for major disease resistant traits in Ecuador and conduct inheritance studies in the greenhouse for anthracnose in Yunguilla and rust resistance in JE.MA.
6. Initiate marker-assisted selection at one central lab (Ruhengeri) in Rwanda.
7. 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
8. Continue seed increase of most promising lines in all three countries
9. Expand on farm trials with advanced lines in Rwanda and Ecuador
10. Release four climbing beans and four bush bean varieties in three commercial types across agro-ecological zones in Rwanda; and a bush bean variety with broad disease resistance for production in Ecuador

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.

Collaborators:

Institute des Sciences Agronomique du Rwanda (Rwanda)
Augustine Musoni, Felicite Nsanzabera, Louis Butare

Instituto Nacional de Investigaciones Agropecuarias (Ecuador)
Eduardo Peralta

Cornell University (U.S.A.)
George Abawi

Michigan State University (U.S.A.)
Sieg Snapp

Approaches and Methods:

1. Four inbred backcross line (IBL) populations will be evaluated in growers field under conditions of drought in Ecuador
2. Evaluate specific populations at two sites for reaction to drought and non-stress in Rwanda
3. Advance other IBL populations with specific drought and root rot resistance traits that are under development.
4. Evaluate sub-set of best drought tolerant lines from thesis study of Louis Butare at two locations in Rwanda.
5. Complete characterization of 141 new local traditional lines (bush, climbers) collected from growers in Ecuador to determine level of drought tolerance under rainfed conditions in highlands.
6. Preliminary characterization and seed multiplication of 90 accessions (bush, climbers) collected in province of Bolivar, Ecuador.
7. Trials will be conducted for root rot resistance sources in Ecuador each season and
8. Validation studies will be conducted of markers linked to sources of root rot resistance and drought tolerance.
9. Identify field site for root rot evaluation (Pythium, Fusarium wilt and Macrophomina), and initiate screening of promising germplasm in Rwanda. Field identification will be accomplished by surveys or bioassay of soil samples with beans (known to be susceptible to target pathogens) in greenhouse/screenhouse tests.
10. Characterize germplasm for reaction to individual root pathogens at Cornell using selected promising germplasm for Rwanda and Ecuador.

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

Collaborators:

Institute des Sciences Agronomique du Rwanda (Rwanda)

Augustine Musoni, Felicite Nsanzabera, Louis Butare

Instituto Nacional de Investigaciones Agropecuarias (Ecuador)

Eduardo Peralta

Cornell University (U.S.A.)

George Abawi

Michigan State University (U.S.A.)

Sieg Snapp

Approaches and Methods:

1. In Rwanda conduct surveys to diagnose major root diseases and collect isolates of root pathogens for characterization. The survey will be expanded to western production region. These surveys will be continued throughout 2009 and completed in 2010.
2. In Ecuador complete characterization of root rot isolates collected previously in both Northern and Southern production regions at Cornell and/or Ecuador, following discussion among collaborators during a visit in 2009.
3. Assess potential for germplasm/root rot isolate interactions in greenhouse at Cornell.

4. Phenotypic evaluation of Rwandan germplasm for resistance to root rot(s); and local isolates of anthracnose, ALS and BCMV.
5. Continue the collection of isolates of anthracnose, and ALS in Rwanda and Ecuador from diverse agro-ecological zones for race typing
6. Initiate genetic characterization/race typing of rust, ALS and anthracnose isolates and maintain and increase seed of the differentials for anthracnose, ALS and rust in Rwanda; and initiate characterization of ALS in Ecuador. In addition, race characterization of Fusarium wilt pathogen and the aggressiveness of isolates of Macrophomina, Rhizoctonia, and F. solani will be conducted on selected bean germplasm.
7. In Rwanda, plan to document and summarize past studies on mapping and/or variability of Fusarium wilt, Pythium, ALS, anthracnose by CIAT/ISAR and MS theses since many of the studies are in French.
8. Continue to document and publish results of recent and on-going breeding activities in Rwanda.

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

Collaborators:

Institute des Sciences Agronomique du Rwanda (Rwanda)
Augustine Musoni, Felicite Nsanzabera, Louis Butare

Instituto Nacional de Investigaciones Agropecuarias (Ecuador)
Eduardo Peralta

Cornell University (U.S.A.)
George Abawi

Michigan State University (U.S.A.)
Sieg Snapp

Approaches and Methods:

1. Design and validate sustainable farming practices including integrated crop management systems for smallholder farmers in Rwanda. Snapp and student Isaacs will collaborate with Nsanzabera and members of DERN (NGO in N. Rwanda) to develop and distribute a report by the end of 2009 on the cropping system survey and literature review outputs from prior workplan, as a foundation for participatory on-farm bean cropping system assessment.
2. Compare and contrast advanced line selection practiced by breeders and farmers in mid-altitude and high agroecological agroecozones in Rwanda
 - Plan genotype by environment farmer participatory assessment of advanced lines within intercrops and sole crops, start planning in October, 2009 (Snapp and Isaacs to focus on cropping system science and participatory research aspects, collaborating closely with the bean breeding program).
 - On-farm assessment at pilot basis start during main growing season of 2009 with baseline and set up of one set of station and on-farm trials for first season in 2010, expanded on-farm trials in September 2010

- This integrated cropping system and breeding effort will build over time a system of systematically linked research station and on-farm trials to facilitate: 1) quantification of farmer assessment of new lines, 2) evaluation of line performance across different environments, for a range of farmer cropping systems and market niches (including consumption on the farm).
3. Evaluation of 12 tests with 10 CIALs each growing cycle in Ecuador.
 4. Strengthen non-conventional seed production in Ecuador and both conventional and non-conventional seed production in Rwanda.
 5. Release one bush bean and one climbing bean in Ecuador using farmer participatory approach.
 6. Evaluate both in field and lab promising lines suited for canning (processing) in Ecuador.
 7. Organize a visit of scientists from Rwanda to Ecuador to interchange experiences on population management, germplasm bank, evaluation of early generation materials at different stations; interchange of experience on farmer participatory and seed production for local use by small farmers and members of CIALs in Choto and Mira valleys. Tentative date Nov. 2009.
 8. Initiate interchange of experience in Rwanda on participatory methods and seed production for local community use with smallholder farmer members anticipated date August 2010. Training of trainers (extension, research technicians, NGO staff, expert farmers, seed company technicians) on seed and farming system production, and work with progressive farmers. This activity will be coordinated with root health workshop planned for 2010.

Objective 5: Capacity Building

- Doctoral student from Rwanda for training in plant breeding and genetics at MSU started in 2008. Student initiated greenhouse studies on physiology of drought resistance in winter 2009. Genotypic data on parents and population was initiated in summer 2009. Population advanced of RIL population will conclude with F4-derived populations in January 2010 in Puerto Rico. Population was advanced 4-generations in Puerto Rico in collaboration with Drs. Beaver and Porch due to the photoperiod sensitivity of the parents and progeny. Seed will be shipped to Rwanda to initiate field studies and population will be phenotyped by student for drought in 2010/11.
- Doctoral student from Rwanda for training in participatory plant breeding and agroecology at MSU to start in 2009 when appropriate student is identified.
- Doctoral student from US for training in participatory plant breeding and nutrition at MSU started in 2008. Student Isaacs initiated grower surveys and field studies in Rwanda in June 2009

Degree Training:*Trainee #1*

First and Other Given Names: Gerardine

Last Name: Mukeshimana

Citizenship: Rwandan

Gender: F

Degree Program for training: Doctorate

Program Areas or Discipline: Plant Breeding and Genetics

Host Country Institution to Benefit from Training: National Univ. Rwanda

University to provide training: MSU

If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? Yes

Supervising CRSP PI: James D. Kelly

Start Date: August 2008

Projected Completion Date

Type of CRSP Support (full, partial or indirect): Full

If providing Indirect Support, identify source(s)s of leveraged funds

Amount Budgeted in Workplan, if providing full or partial support:\$30, 000

Direct cost: \$30,000

Indirect cost: \$15,600

U.S. or HC Institution to receive CRSP funding for training activity: MSU

Trainee #2

First and Other Given Names: Krista

Last Name: Isaacs

Citizenship: US

Gender: F

Degree Program for training: Doctorate

Program Areas or Discipline: Participatory plant breeding and nutrition

Host Country Institution to Benefit from Training: Indirect benefits for National Univ. Rwanda

University to provide training: MSU

If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? Not applicable

Supervising CRSP PI: Sieglinde Snapp

Start Date: January 2010, student was funded from other sources prior to this date

Projected Completion Date: May 2012

Type of CRSP Support (full, partial or indirect): Full

If providing Indirect Support, identify source(s) of leveraged funds: Sustainable agriculture CS

Mott funding fellowship

Amount Budgeted in Workplan, if providing full or partial support: \$30,000

Direct cost: \$30,000

Indirect cost:\$15,600

U.S. or HC Institution to receive CRSP funding for training activity: MSU

Trainee #3

First and Other Given Names: TBD

Last Name:

Citizenship: Rwandan

Gender: F/M

Degree Program for training: Doctorate

Program Areas or Discipline: Participatory plant breeding and agroecology

Host Country Institution to Benefit from Training: Rwanda

University to provide training: MSU

If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? Yes

Supervising CRSP PI: Sieglinde Snapp

Start Date: TBD

Projected Completion Date

Type of CRSP Support (full, partial or indirect): Full

If providing Indirect Support, identify source(s)s of leveraged funds

Amount Budgeted in Workplan, if providing full or partial support:\$

Direct cost:

Indirect cost:

U.S. or HC Institution to receive CRSP funding for training activity: MSU

Short-term Training:

Type of training: Workshop on Participatory plant breeding in Rwanda; Molecular marker-assisted selection; and plant pathology training to be conducted in Africa if suitable candidates from Rwanda can be identified.

Description of training activity: Organize and conduct participatory plant breeding and hands-on root/soil health training workshops in Rwanda planned for third year in 2010, but may be offered earlier in 2009 if possible. The root/soil health training will be planned as a train-the-trainer workshop for research, extension and NGO's personnel.

Location: Rubona, Rwanda

Duration 4-5 days

Scheduling of training activity

Participants/Beneficiaries of Training Activity

Anticipated numbers of Beneficiaries (male and female) 30

Amount Budgeted in Workplan \$7,000

 Direct cost: \$7,000

 Indirect cost:

If Leveraged Funding is to be used to Support this Training Activity, indicate the Source and Amount

Equipment (costing > \$5,000):

Specific Type of Equipment to be purchased: Two Vencedora Maqton model 350 bean threshers from Brazil

Justification for equipment to achieve workplan objectives: As CIALs in Ecuador expand seed production of new bean varieties there is a critical shortage of threshing equipment to support this effort. The program would like to purchase two threshers for use by CIALs in the Mira and Choto valleys. The thresher would have a capacity of threshing 1ton bean seed/hour. Vencedora Maqton model 350 thresher from Brazil costs \$13,000 delivered to Quito. These items were not budgeted into the original budget but there is a clear need for this type of equipment to help sustain bean production in Ecuador and support the seed production efforts among CIALs. Total cost of the request: \$26,000. Further details and web sites are available upon request. We will work with INIAP to find matching funds for the threshers but we want to make clear that this is an item that will be needed should any additional supplemental funds become available through the CRSP.

Institution to benefit from equipment: INIAP

Institution to purchase equipment: INIAP

Amount Budgeted for Equipment item: 0

Contribution of Project to Target USAID Performance Indicators

Two women are currently in doctoral degree training, and plans exist for short term training for other female technicians in the program. The scientific assistance provided to farmers is shared among men and women as both genders are active in bean production in both Ecuador and Rwanda.

1. The development and release of locally adapted, acceptable and disease resistant bean cultivars for the major production regions in Rwanda, Ecuador and Michigan. During 2009, six cultivars in contrasting seed types were released in Ecuador and Michigan. New cultivars are anticipated from programs in Rwanda and Michigan in 2010-11.
2. Increased sustainable productivity and profitability of bean production due to increased yield and reduced inputs.
3. Improved grower income and stability of bean production will contribute to better nutrition and health of farm families.
4. Increased awareness and knowledge of participatory breeding methods, root health and soil health issues will further improve bean productivity, long-term land management, environmental risk, thus contributing to sustainability of bean production and agricultural communities.
5. Identification of germplasm sources that are of benefit in the improvement of selected bean traits for the U.S. market.
6. Enhanced human resource development, gender equity and improved infrastructure capacity of participating institutions in Rwanda and Ecuador.
7. Identification of major root pathogens impacting bean production, characterizing sources of resistance to major root pathogens, incorporation of resistance factors into advanced bean lines, and increased awareness of root pathogens and their impact on bean productivity.

Engagement of USAID Field Mission(s)

The PI and HC PI visited the USAID field mission in Kigali in May 08 and January 09 to describe the CRSP program and update them on status of the current work in Rwanda. 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 will be provided to the Mission Director.

Networking Activities with Stakeholders

ISAR, Government Extension, Farmers cooperatives and seed production agencies, NGO in Rwanda; World Vision, CARE, ADRA, CARITIUS, Catholic Relief Services, DERN; Cooperatives in Rwanda (COAMV in the North; RDO in the East; Rwanda Seed Company – RWASCO). 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.

Leveraging of CRSP Resources

In Rwanda, funding was secured through AGRA – Alliance for a Green Revolution in Africa and PABRA (Robin Buruchara) network. Funding prospects from Harvest Plus and Kirkhouse Trust to the bean breeding program are also at advanced stages in Rwanda. In Ecuador, NGO-PRODECI and Government Funding from CEREPS was also secured, but a reduction in allocation of 50-70% has occurred in 2009 due to the downturn in the global economy that impacted Ecuador. Collaboration will be established on root rot studies with Cornell-KARI project in Western Kenya through researchers at Cornell.

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	2010 Target	2010 Actual		
	(Oct 1 2009-Sept 30, 2010)			
Degree Training: Number of individuals who have received degree training				
Number of women	2			
Number of men	1			
Short-term Training: Number of individuals who have received short-term training				
Number of women	2			
Number of men	2			
Technologies and Policies				
Number of technologies and management practices under research	19			
Number of technologies and management practices under field testing	10			
Number of technologies and management practices made available for transfer	11			
Number of policy studies undertaken				
Beneficiaries				
Number of rural households benefiting directly	8000			
Number of agricultural firms/enterprises benefiting	20			
Number of producer and/or community-based organizations receiving technical assistance	75			
Number of women organizations receiving technical assistance	13			
Number of HC partner organizations/institutions benefitting	38			
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	16000			

Dry Grain Pulses CRSP : THIRD PERIOD						
Combining Conventional, Molecular and Farmer Participatory Breeding Approaches to Improve Andean Beans for Resistance to Biotic and Abiotic Stresses						
	Third period (12 months) 10/01/09 - 09/30/10					
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name	Mich. State Univ	Rwanda	Cornell Univ.	Ecuador	Rwanda	0
a. Personnel Cost						
Salaries	\$3,040.00	\$38,626.00	\$12,052.00	\$9,000.00	\$10,000.00	
Fringe Benefit	\$1,820.00	\$3,940.00	\$6,098.00			
b. Travel	\$8,000.00		\$5,000.00	\$2,000.00	\$4,000.00	
c. Equipment (\$5000 Plus)						
d. Supplies	\$10,000.00		\$3,250.00	\$10,000.00	\$10,000.00	
e. Training						
Degree		\$19,826.00		\$2,000.00	\$2,000.00	
Non-Degree					\$7,000.00	
f. Other, In country workshop						
g. Total Direct Cost	\$22,860.00	\$62,392.00	\$26,400.00	\$23,000.00	\$33,000.00	\$0.00
h. Indirect Cost	\$11,887.20	\$22,134.32	\$6,600.00	\$2,000.00		
i. Indirect Cost on Subcontracts (First \$25000)			\$0.00			
j. Total Indirect Cost	\$11,887.20	\$22,134.32	\$6,600.00	\$2,000.00	\$0.00	\$0.00
Total	\$34,747.20	\$84,526.32	\$33,000.00	\$25,000.00	\$33,000.00	\$0.00
Grand Total			\$210,273.52			

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	\$67,747.00	36.01%
Total direct cost budgeted for H.C institution(s)	\$120,392.00	63.99%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind	\$10,000.00		\$0.00	\$0.00	\$0.00		\$ 10,000.00
Cash							\$ -
Total	\$ 10,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 10,000.00
Attribution to IEHA Objectives							
Percentage of effort	30.00%	100.00%	25.00%		100.00%		64.77%
Amount corresponding to effort	\$10,424.16	\$84,526.32	\$8,250.00	\$0.00	\$33,000.00	\$0.00	\$136,200.48
Attribution to Capacity Building (Theme "D")							
Percentage of effort	50.00%	100.00%	25.00%	25.00%	25.00%		59.28%
Amount corresponding to effort	\$17,373.60	\$84,526.32	\$8,250.00	\$8,250.00	\$8,250.00	\$0.00	\$124,649.92

Name of PI & Institutional Affiliation: James D. Kelly, Michigan State University

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 – September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: Please enter your project title here

Identify Benchmark Indicators by Objectives	Abbreviated name of institutions						
	MSU	Cornell	Ecuador	Rwanda			
4/1/10 9/30/10	4/1/10 9/30/10	4/1/10 9/30/10	4/1/10 9/30/10	4/1/10 9/30/10	4/1/10 9/30/10	4/1/10 9/30/10	4/1/10 9/30/10

Objective 1

Selection Parental Lines,elite lines	x	x			x	x	x	x
Nursery evaluation		x		x	x	x	x	x
Crossing	x	x		x	x	x	x	x
Marker assisted selection	x	x		x	x	x	x	x
Advanced yield trials		x		x	x	x	x	x
On farm trials				x	x	x	x	x
Variety Releases		x			x			x

Objective 2

Advanced Population development	x	x						
Test Populations in Rwanda, drought						x	x	
Other population development				x	x			
Characterize resistance sources	x	x	x	x	x	x	x	x
Increase, characterize local germplasm				x	x	x	x	x
Characterize germplasm to root pathogens			x	x	x	x	x	x
Root rot screening methods, and sites			x	x	x	x	x	x

Objective 3

Survey root pathogens in Rwanda			x	x			x	x
Characterize root rot isolates			x	x	x			
Root Pathogen x germplasm interaction			x	x			x	x
Collect foliar pathogens in Rwanda								
Race characterization root foliage pathogens	x	x	x	x	x	x	x	x
Publish and document results		x		x		x		x

Objective 4

Workshop Participatory soil health in Rwanda						x		
Evaluation of elite lines in CIALs				x	x			
Non conventional seed production				x	x	x	x	x
Farmer vs. Breeder Selection practices				x	x	x	x	x
Validate sustainable practices, nutrient mgt	x		x	x	x	x	x	x
Training participatory between countries					x			x

Name of the PI responsible for reporting on benchmarks	James D. Kelly						
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Signature/Initials:

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Date:

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P1-MSU-2

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

Principal Investigator:

Richard Bernsten, Michigan State University, U.S.A.

Collaborating Scientists:

Duncan Boughton, MSU, U.S.A.

Cynthia Donovan, MSU, U.S.A.

Feliciano Mazuze, IIAM, Mozambique

Juan Carlos Rosas, EAP Honduras

David Kiala, Agostinho Neto University, Angola

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 opportunities 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.

Preliminary 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, although 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 (small reds)to the US market.

Planned Project Activities for October 1, 2009 - September 30, 2010

Objective 1: Angola. This project component has 3 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.

Collaborators:

Dr. David Kiala and Dr. Cynthia Donovan are jointly working on this objective, with MS candidate Estevão Chaves.

Objective 1.1: This component is coordinated by D. Kiala (Universidade Agostinho Neto), in collaboration with C. Donovan, who will make a site visits and maintain contact by e-mail and phone/SKYPE communications.

Objective 1.2: This component is coordinated by D. Kiala (Universidade Agostinho Neto), with participation of C. Donovan. Among those who will be contacted in this research are staff at the Ministry of Agriculture, including staff of the IIA (Agricultural Research Institute). World Vision, ADRA, and CLUSA, as well as the Ministry of Commerce.

Objective 1.3: This component is coordinated by D. Kiala (Universidade Agostinho Neto), in collaboration with C. Donovan, and the Federal University of Viçosa in Brazil, where MS graduate training will occur.

Approaches and Methods:

Objective 1.1: Identification of information/data sources.

Researchers will 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.

Benchmarks:

- a) Revised document summarizing both earlier and new secondary information on agricultural production and markets in Angola, focusing on beans and cowpeas.

Objective 1.2: Value chain diagnosis and capacity building.

Interview additional 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.

Benchmarks:

- a) Value chain diagnostic: Revised report, based on smallholder survey results and additional research with private sector
- b) UAN Thesis: Farmer constraints and opportunities
- c) UAN Thesis: Development of the seed sector for common beans
- d) MS Thesis proposal (delayed from previous period)

Objective 1.3: Identification of constraints and opportunities.

Use the information from the smallholder survey in the Angolan Altiplano to identify constraints and opportunities for interventions that would improve smallholder returns to bean production (common bean and cowpeas)

Benchmarks:

- a) Draft articles from each of the two theses from UAN
- b) Article on smallholder marketing
- c) Outreach with NGO on smallholder marketing results

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.

Collaborators:

Feliciano Mazuze from IIAM will be the HC PI with Cynthia Donovan as the MSU PI, with additional support from Duncan Boughton. Cynthia Donovan will be based on Mozambique starting late September 2009 through September 2010, enabling close collaboration with MINAG/IIAM. Ana Lidia Gungulo is the MS candidate at University of Pretoria and will be involved in research. Jill Findeis and colleagues with IIAM for the Pulse CRSP project of Pennsylvania State University in Mozambique will be contacted to assess potential ways to collaborate on the production side. CIAT researcher Andy Farrow will also be contacted to assess collaboration on the spatial aspects of the research.

Objective 2.1: Staff from the Market Information System (SIMA) of the Directorate of Economics (DE) in MINAG, and social scientists from IIAM/CESE.

Objective 2.2: F. Mazuze will work with C. Donovan, SIMA staff and other staff from the Department of Statistics

Objective 2.3: Staff from the Market Information System (SIMA) of the Directorate of Economics (DE) in MINAG, Department of Policy of the DE in MINAG, social scientists from IIAM/CESE, biological scientists from the Legumes Program of the Directorate of Agriculture and Natural Resources of IIAM (IIAM/DARN), and NGOs working in the main bean/cowpea production regions.

Approaches and Methods:

Objective 2.1: Taskforce development and temporal ad spacial analysis.

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.

Benchmarks

- a) Mapping of spatial analysis from TIA
- b) Final summary report on markets and price analysis (SIMA data)
- c) Synthesis Paper on spatial and temporal analysis of production

Objective 2.2: Identification of constraints and opportunities.

This objective will be met using the previously described multidisciplinary action research approach with the task force. The objective will be achieved through focus group discussions with smallholders and field observations in the main agro-ecologies, based on the earlier 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, expanded with information from the rapid appraisal and preliminary TIA analysis. 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.

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

Benchmarks

- a) Presentation of the diagnostic results to stakeholders
- b) Establishment of a bean/cowpea task force (delayed pending market appraisal report)
- c) Joint meeting with IIAM breeders on the market results and consumer preferences to identify potential interventions with production
- d) Final working paper (for objectives 2.1and 2.2)
- e) Final policy brief (for objective 2.2)

Objective 2.3: Capacity building

a) Participant trainee is enrolled at University of Pretoria to pursue MS degree program in Agricultural Economics. During her degree program she will acquire skills to undertake econometric analysis using appropriate and relevant statistical packages.

b) MS coursework in agricultural economics

Benchmarks:

- a) Draft MS thesis proposal

Objective 3: Honduras. This project component has 4 sub-objectives for this period. The sub-objectives in the current workplan are to: 3.1) put in place arrangements for exporting small-red beans from Honduras to US retailers, which are certified as organic and produced using sustainable production practices; 3.2) validate via field trials existing agronomic recommendations for growing organic small-red beans; 3.3) recruit interested smallholders and train the farmers to produce organic small-red beans that meet the grades and standards required by US retailers; 3.4) establish local market linkages required for small-scale small-red bean farmers to export organic/sustainably-produced beans to US markets.

Available evidence indicates that there is a demand for fair trade, organic small beans in the US. A recent study (DeVilla, Lara. 2008. "Assessing the Potential of Marketing air Trade Beans of Central American Origin in the United States". Unpublished MS. Thesis, Department of Agricultural Economics, Michigan State University, East Lansing, MI) found that there was considerable interest among US retailers (who market organic/ethical food product) in purchasing/selling fair trade organic small-red beans. Regarding the capacity of Honduran bean-farmers to supply the demand of this market, at meetings in 2008 and 2009, leaders and farmer-members of the cooperative ARSAGRO expressed strong interest in growing small-red beans for export to the US, which met USDA organic and Rainforest Alliance standards for sustainably produced/fair trade beans. Currently, the approximately 500 members of this cooperative plants over 1,000 hectares of beans in the Primera season. Supplying the initially projected export quantity of 20 mt of small-red beans would require the participation of only 20-30 farmers.

Collaborators:

This component is being coordinated by R. Bernstein and Juan Carlos Rosas.

Objective 3.1: R. Bernsten will lead this research component, in collaboration with J.C. Rosas (EAP) and with technical guidance private/public sector participants—including from 3rd party certifiers (e.g., staff of the Rainforest Alliance), MSU's Partnership for Food Industry Development (PFID), a staff member of Kalsec Inc. (a major US importer/distributor of spices), and purchasing agents of US food retailers/natural food distributors (e.g., Whole Foods Markets, Wal-Mart, Alter-Eco, UNFI—the major wholesaler of natural food products to retail stores).

Objective 3.2: J. C. Rosas (EAP) will lead this research in collaboration with IPM and organic farming EAP researchers.

Objective 3.3: J. C. Rosas (EAP) will lead this research, in collaboration with the participation of village-level research committees (CIALS).

Objective 3.4: R. Bernsten will be responsible for this component, in collaboration with J.C. Rosas (EAP).

Approaches and Methods:

Objective 3.1: Put in place arrangements for exporting small-red beans from Honduras to US retailers.

Contact US retailers to confirm their interest in purchasing small-red beans from Honduras, possibly visiting selected farms to negotiate purchase agreements

Benchmarks:

- a) Confirmation of US retailers' interested in importing small-red beans from Honduras
- b) Negotiation of purchase agreements with US retailers
- c) Export of small-red beans from Honduras to US retailers.

Objective 3.2: Validate via field trials existing agronomic recommendations.

Researchers at EAP will test methods that meet international standards for organic production via on-farm trials in collaboration with farmers. Organic fertilizers and amendments to enhance soil fertility and IPM practices will be included.

Benchmarks:

- a) Conduct organic bean production field trials during the postrera (Oct-Dec) 2009 season.
- b) Report on results of organic bean production field trials from postrera 2009.
- c) Publish results of set of organic bean production field trials for 2009 and 2010 season.

Objective 3.3: Recruit interested smallholders and train the farmers to produce organic small-red beans.

EAP researchers will recruit and train farmer groups (CIALS) and collaborating NGO interested in growing small-red organic beans on organic bean production methods.

Benchmarks:

- a) Recruit farmers/groups/NGOs interested in growing small-red organic beans
- b) Train farmers and technicians on small-red organic bean production methods
- c) Train farmers on requirements for third-party certification
- d) Initiate organic small-red bean production for the US market (Primera, 2010)

Objective 3.4: Establish local market linkages required for small-scale bean farmers to export organic/sustainably-produced small-red beans to US markets. Researchers at EAP and MSU will contact market chain participants to finalize their roles in the project.

Benchmarks:

- a) Finalize process for third-party certifiers to certify the collaborating farms as organic/grown using sustainable production practices
- b) Finalize agreements with farmers to produce specific quantities of small-red beans
- c) Finalize agreement with Honduran processor/exporter (Rojitos) to export small-red beans

Objective 4: Capacity Building

Angola: Short-term in-service training will be conducted on data analysis using the household survey data. Chianga, Huambo, Angola, November 2009.

Mozambique: Follow up training on statistical analysis. Maputo, Mozambique, October 2009, and Simple GIS tools with survey data, Maputo, Mozambique, November 2009.

Honduras: Short-term training will be conducted at Zamorano to teach farmers organic small-red bean production methods (October 2009 and March 2010) and the protocols they must follow for their farms to be certified as organic and using sustainable production methods (Nov2009 and April 2010).

Degree Training:

Trainee #1

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: Donovan, Cynthia

Start Date: 2/09

Project Completion Date: 10/10

Training Status: Active

Type of CRSP Support (full, partial or indirect): Full (Category 1)

Trainee #2

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 Vicos, Brazil

Supervising CRSP PI: Donovan, Cynthia

Start Date: 2009

Project Completion Date: 2011

Training Status: Active

Type of CRSP Support (full, partial or indirect): Full (Category 1)

Short-term Training:

Training #1

Type of Training: Organic fertilizer production

Description of training activity: Training in the production of organic fertilizers

Location: Zamorano, Honduras

When will the activity occur?: October 2009, March 2010

Duration: 4 days

Who will benefit from this activity?: Farmers and technicians collaborating in the production of organic beans

Number of Beneficiaries: 15

PI/Collaborator responsible for this Training Activity: Juan Carlos Rosas

List other funding sources that will be sought (if any): Norwegian Development Fund

Training justification: Farmers/technicians have limited knowledge to the practices and/or production of organic fertilizer and utilization details for beans

Trainee #2

Type of Training: Organic certification training

Description of training activity: Training in requirements for organic certification

Location: Zamorano, Honduras

When will the activity occur?: November 2009 and April 2010

Duration: 3 days

Who will benefit from this activity?: Farmers/technicians participating in organic bean production

Number of Beneficiaries: 15

PI/Collaborator responsible for this Training Activity: Juan Carlos Rosas

List other funding sources that will be sought (if any): Norwegian Development Fund

Training justification: Farmers/technicians have limited knowledge of the requirements of the certification process/requirements for the production of organic small-red beans.

Training #3

Type of Training: Basic survey analysis using STATA

Description of training activity: The training will refresh participants' skills in using the national household surveys for data analysis.

Location: Maputo, Mozambique

When will the activity occur?: October 2009

Duration: 3 days

Who will benefit from this activity?: Analysts of the National Agricultural Research Institute (IIAM) and the Directorate of Economics of the Ministry of Agriculture

Number of Beneficiaries: 10

PI/Collaborator responsible for this Training Activity: Cynthia Donovan

List other funding sources that will be sought (if any): USAID/MSU Food Security Project

Training justification: Research staff at IIAM and DE have requested practical training in survey data analysis.

Training #4

Type of Training: Basic GIS tools with survey data

Description of training activity: The training will introduce participants to basic mapping skills in using the national household surveys

Location: Maputo, Mozambique

When will the activity occur?: November 2009

Duration: 3 days

Who will benefit from this activity?: Analysts of the National Agricultural Research Institute (IIAM) and the Directorate of Economics of the Ministry of Agriculture

Number of Beneficiaries: 10

PI/Collaborator responsible for this Training Activity: Cynthia Donovan

List other funding sources that will be sought (if any): USAID/MSU Food Security Project

Training justification: Research staff at IIAM and DE have requested training in basic GIS use.

Training #5

Type of Training: Statistical analysis

Description of training activity: The training will refresh participants' skills in analyzing recent household surveys.

Location: Huambo, Angola

When will the activity occur?: November 2009

Duration: 5 days

Who will benefit from this activity?: Students and faculty members of the Agricultural Sciences Faculty at the University of Agostinho Neto

Number of Beneficiaries: 8

PI/Collaborator responsible for this Training Activity: Cynthia Donovan

List other funding sources that will be sought (if any):

Training justification: Students and faculty have requested practical training in survey data analysis.

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.

Target Outputs

Angola: Project outputs will include: 1) a draft article from a UAN thesis on smallholder farmer production and marketing of beans and cowpeas based on rapid assessments; 2) a draft article from a UAN thesis that evaluates production systems combining beans and potatoes; 3) a research paper that details the relationships throughout the domestic value chain for beans and cowpeas; and 4) an MS thesis proposal (Federal University of Viçosa, Brazil), based on the bean value chain and interventions that can ensure that when constraints are addressed, increased production will find market opportunities w/ sustained producer incentives. All of these outputs will be the subject of outreach, with developers of the market information system and farmer extension programs of NGOs. The research results will also be communicated to GOA, USAID/Angola, and other stakeholders via reports, seminars, and meetings.

Mozambique: Project outputs will include: 1) a final research paper and a policy brief summarizing objectives 1 and 2 (subsector overview and constraints to increasing smallholder productivity and market participation); 2) continued in-service training for new CESE socio-economists in market appraisal, value chain analysis, basic GIS, and data analysis with STATA; 3) collaboration between CESE and SIMA to publish report on marketsheds and consumer preferences; 4) an MS thesis proposal with later research paper and policy brief quantifying determinants of smallholder market participation and constraints that must be relaxed to insure broad-based participation by households with differing asset portfolios.

Honduras: Project outputs will include: 1) agreements with US retailers to purchase organic small-red beans produced by small-scale Honduran farmers; 2) third-party certification of farm as meeting the standards for organic/sustainable production; 3) validation of agronomic practices for growing organic beans; 4) training of smallholders on organic small-red bean production; 4) establishment of market linkages for marketing organic beans to US retailers; and 5) a research paper summarizing strategy for producing/marketing organic fair trade small-red beans, including constraints

Engagement of USAID Field Mission(s)

During the design phase, USAID Missions were contacted for input. Communication between PIs and missions in Angola, Mozambique, and Honduras will continue through email. During the annual visits of the US-PI, the HC and UP-PI will meet with USAID Mission staff to describe the project, solicit input, and explore opportunities for Mission buy-ins. Since travel to Mozambique and Angola is paired with other, non-CRSP related activities, there will be additional opportunities to discuss the activities and progress with Mission staff. In addition, for all outreach activities, Mission staff will be notified and invited. Where applicable, the PIs will develop success story briefs for presentation to the Mission.

Networking Activities with Stakeholders

Angola: 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 project on Horticultural Value Chains. The strong collaboration between MSU, UAN and World Vision in the implementation of a smallholder baseline survey and the use of the data from that survey enables students and researchers at UAN and MSU to complete the 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 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 is particularly important as work on the value chain continues.

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).

Mozambique: An informal 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.

Honduras: 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.

Leveraging of CRSP Resources

Across the countries, we will be seeking funding to enable the sharing of experiences between the Central American research on advanced value chains and value chain development in Southern Africa.

Angola: The project will leverage Angolan government resources from the University of Agostinho Neto, Faculty of Agricultural Sciences. Production training and research at UAN is funded publicly, and the salaries and facilities of staff will provide a basis for the project operations. The Bean Program at IIA is also publicly funded and their participation has been sought in this training/research. MINADER has indicated strong interest in establishing market information services using public sector funding, and the project will be able to link with that work, as both the project and MINADER will use the rapid market appraisal methodology and results. Given the investments in smallholder market development by private sector agents, including Chevron, the project seeks to tie in with those efforts in specific areas of operations.

World Vision development projects in the Altiplano serve as a logical base for extension of project results as well as serving as the base for the household data collection effort.

Mozambique: Public sector funding through the common-fund mechanism PROAGRI contributes substantially to the development of this research and training program. That funding provides the salaries and facilities for the CESE staff members, including the HC-PI in Mozambique. In addition, MINAG funds through PROAGRI funds the Bean Program of IIAM. The National Directorate of Economics and the provincial MINAG offices support both the national household surveys (TIA) and the market data collection of the Agricultural Market Information System (SIMA), through public sector funding. Rockefeller Foundation is supporting the local MIS in one of the high bean potential areas, a leverage point for innovation market information efforts.

Honduras: EAP, a private university will support the project by salary support for the HC-PI's participation in the project. In addition, the PIs will contact several organizations to solicit additional leveraged funds, including 1) EAP (e.g., units/projects interested in participating organic agriculture training), 2) the Department of Agriculture and Animal Husbandry (agribusiness section and DICTA), 3) Red SICTA (a Central American organization that integrate regional research institutions, which is has a mandate for technology transfer and is now focusing on strengthening agribusiness/food chains for smallholders), and 4) Honduran-based NGOs involved in agricultural initiatives.

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

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

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

Lead U.S. PI and University: Bernstein, Boughton, Donovan; Michigan State University

Host Country(s): Angola, Mozambique, Honduras

Output Indicators	2010 Target	2010 Actual
	(October 1 2009-Sept 30, 2010)	
Degree Training: Number of individuals enrolled in degree training		
Number of women	1	
Number of men	1	
Short-term Training: Number of individuals who received short-term training		
Number of women	15	
Number of men	37	
Technologies and Policies		
Number of technologies and management practices under research	0	
Number of technologies and management practices under field testing	8	
Number of technologies and management practices made available for transfer	4	
Number of policy studies undertaken	2	
Beneficiaries:		
Number of rural households benefiting directly	20	
Number of agricultural firms/enterprises benefiting	2	
Number of producer and/or community-based organizations receiving technical assistance	9	
Number of women organizations receiving technical assistance	1	
Number of HC partner organizations/institutions benefiting	5	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	100	

Comment: In Honduras, the technologies and management practices under testing and made available for transfer will be the production and use of organic fertilizers (bokashi, compost, others) and biological products for disease and pest control)

Dry Grain Pulses CRSP : THIRD PERIOD							
	#REF!						
	Third period (12 months) 10/01/09 - 09/30/10						
	U.S. Institution	U.S. for Host Country		HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name	MSU	MSU	Brazil	Angola	Mozambique	Honduras	South Africa
a. Personnel Cost							
Salaries	\$12,916	\$0				\$5,496	\$9,367
Fringe Benefit	\$4,001	\$0				\$2,170	\$852
b. Travel	\$10,725	\$3,500	\$0	\$4,500	\$1,500	\$17,150	
c. Equipment (\$5000 Plus)							
d. Supplies	\$4,037	\$4,000		\$1,500	\$500	\$4,050	
e. Training							
Degree		\$0	\$12,540				\$8,205
Non-Degree				\$4,859			
f. Other							
g. Total Direct Cost	\$31,679	\$7,500	\$12,540	\$10,859	\$2,000	\$28,866	\$18,424
h. Indirect Cost	\$16,472	\$3,900					
i. Indirect Cost on Subcontracts (First \$25000)			\$2,399	\$2,823	\$0	\$0	\$3,179
j. Total Indirect Cost	\$16,472	\$3,900	\$2,399	\$2,823	\$0	\$0	\$3,179
Total	\$48,151	\$11,400	\$14,939	\$13,682	\$2,000	\$28,866	\$21,603
Grand Total			\$140,641				
				Amount	Percentage		
			Total direct cost budgeted for U.S. institution(s)	\$31,679	28.32%		
			Total direct cost budgeted for H.C Institution(s)	\$80,189	71.68%		
Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind Cash	\$12,038						\$ 12,038
							\$ -
Total	\$ 12,038	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 12,038
Attribution to IEHA Objectives							
Percentage of effort	40.00%	100.00%	0.00%	100.00%	0.00%	0.00%	23.22%
Amount corresponding to effort	\$19,260	\$11,400	\$0	\$2,000	\$0	\$0	\$32,660
Attribution to Capacity Building (Theme "D")							
Percentage of effort	0.00%	100.00%	100.00%	100.00%	0.00%	100.00%	34.62%
Amount corresponding to effort	\$0	\$11,400	\$13,682	\$2,000	\$0	\$21,603	\$48,685
Name of PI and Institution affiliation: Richard H. Bernstein, Michigan State University							

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 – September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title:

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

	Abbreviated name of institutions							
	MSU	Univ. Agos. Neto	IIAM	EAP				
Identify Benchmark Indicators by Objectives	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10
Objective I: Angola								
Objective 1. Identification of information/data sources								
Revised document summarizing both earlier and new secondary information on agricultural production and markets in Angola, focusing on beans and cowpeas.	X							
Objective 2. Value chain diagnosis and capacity building								
Value chain diagnostic: Revised report, based on smallholder survey results and additional research with private sector	X							
UAN Thesis: Farmer constraints and opportunities		X						
UAN Thesis: Smallholder production systems with beans and potatoes		X						
MS Thesis proposal (delayed from previous period)	X							
Objective 3. Identification of constraints and opportunities								
Draft articles from each of the two theses from UAN			X					
Article on smallholder marketing	X							
Outreach with NGO on smallholder marketing results		X						
Objective II. Mozambique								
Objective 1. Taskforce development and temporal and spatial analysis								
Mapping of spatial analysis from TIA	X							
Final summary report on markets and price analysis (SIMA data)				X				
Synthesis Paper on spatial and temporal analysis of production					X			
Policy brief on production and marketing	X							
Objective 2. Identification of constraints and opportunities								
Presentation of the diagnostic results to stakeholders				X				
Establishment of a bean/cowpea task force (delayed pending market appraisal)					X			
Joint meeting with IIAM breeders on the market results and consumer preferences to identify potential interventions with production						X		
Final working paper (for objectives 2.1 and 2.2)	X							
Final policy brief (for objective 2.2)	X							
Objective 3. Capacity building								
Draft MS thesis proposal		X						

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 – September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title:

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

	Abbreviated name of institutions					
	MSU	Univ. Agos. Neto	IIAM	EAP		
Identify Benchmark Indicators by Objectives	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10
Objective III. Honduras						
Objective 1. Put in place arrangements for exporting beans from Honduras to US retailers						
Confirm US retailers' interest in importing beans from Honduras	X					
Negotiate purchase agreements with US retailers		X				
Finalize arrangements for exporting bean to the US		X				
Objective 2. Validate via on-farm trials organic bean production methods						
Conduct organic bean production field trials during postrera (Oct-Dec) 2009 season						X
Report on results of organic bean production field trials from postrera 2009						X
Conduct organic bean production field trials during primera 2010 season						X
Publish results of set of organic bean production field trials for 2009 & 2010 season						X
Objective 3. Recruit interested smallholders & train farmers to produce organic beans that meet the grades/standards required by US retailers						
Recruit farmers/groups/NGOs interested in growing organic beans						X
Train farmers and technicians on organic bean production methods						X
Train farmers on requirements for third-party certification						X
Initiate organic bean production for the US market (postrera)						X
Objective 4. Establish local market linkages required for small-scale farmers to export organic/sustainably-produced beans to US markets						
Finalize process for third-parties to certify farms as organic/sustainable practices						X
Finalize agreements with farmers to produce specific quantities of beans						X
Finalize agreement with Honduran processor/exporter (Rojitos) to export						X
Objective IV. Institution Building						
Angola						
One MS student in Ag Econ at Univ Federal of Vicos, completing first year			X			
One MS student in Ag Econ at Univ Federal of Vicos, completing MS coursework				X		
One in-service training in data analysis	X					
Mozambique						
One MS student in Ag Econ at Univ. of Pretoria, completing first year					X	
One MS student in Ag Econ at Univ. of Pretoria, coursework for MS degree						X
One in-service in the basics of GIS	X					
One in-service training in data analysis	X					
Honduras						
Train farmers and technicians on organic bean production methods						X
Train farmers on requirements for third-party certification						X
Name of the PI responsible for reporting on benchmarks	R. Bernstein	D. Kiala	F. Mazuze	J. C. Rosas	C. Donovan	R. Bersnsten
Signature/Initials:						
Date:						

P1-PSU-1

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

Principal Investigator:

Jonathan Lynch, Pennsylvania State University, U.S.A.

Collaborating Scientists:

Juan Carlos Rosas, EAP, Honduras

Jill Findeis, PSU, U.S.A.

Magalhaes Miguel, IIAM, Mozambique

Kathleen Brown, PSU, U.S.A.

Soares Almeida Xerinda, IIAM, Mozambique

Roland Chirwa, CIAT, Malawi

Rose Mongi-Henday, ARI - Uyole, Tanzania

Celestina Jochua, IIAM Mozambique

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 (e.g., 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 October 1, 2009 - September 30, 2010

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

Collaborators:

In Latin America: INTA (Nicaragua), Nicaraguan farmers group, CIALs from Honduras, members of the Central American and Caribbean bean network, and NGOs.

In Africa: Manuel Amane (IIAM), Carvalho Ecole, IIAM, Centro Zonal Noroeste, IIAM, Public extension services, Patricio Augustin (World Vision International), farmers associations (APLA), Rowland Chirwa (CIAT- Malawi, SABRN), CIAT, Rose Mongi, Uyole Agricultural Research Institute, Tanzania.

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. We will engage both male and female farmers in these activities with the goal of equitable representation of the local community.

Estimated timeline for genetic improvement (as requested by TMAC):

Target Output	Description	Status/time expected to be completed
Markers	<ul style="list-style-type: none"> Identification of chromosome location region/regions with candidate genes involved in BRWN a trait contributing for P acquisition efficiency in bean 	Both genotypic and phenotypic data analysis has been completed. QTL analysis will be completed by Sept. 2009
Plant material	<ul style="list-style-type: none"> Aggregation of the bean germplasm 	<ul style="list-style-type: none"> Has been completed. Currently available germplasm include materials from CIAT-HQ, CIAT Malawi, national program and landraces from the farmers
Plant characterization	<ul style="list-style-type: none"> Plants have been evaluated for root characteristics for P acquisition efficiency, promising genotypes identified and characterized in the field using a method (in development) for evaluation of a large number of materials in the field 	<ul style="list-style-type: none"> Promising already genotypes identified Field Method of genotype evaluation to be completed by April, 2010
Superior cultivar development	<ul style="list-style-type: none"> Bean varieties with better performance in low P soils and preferred by farmers in the Mozambique are in the last face of development (F5-6) 	<ul style="list-style-type: none"> Crossing and introgression activities will be completed in Sept 2009. On-station Performance test currently being conducted.
Seed availability	<ul style="list-style-type: none"> Multi-local evaluation for new varieties in the different regions of Mozambique, involving farmers. Establishment of seed multiplication plots 	<ul style="list-style-type: none"> To be completed by April, 2010 To be completed by Sept 2010
Variety readiness for release	<ul style="list-style-type: none"> Availability of performance and yield stability of the new varieties Work for variety release by the National Seed services at Ministry of Agriculture of Mozambique 	<ul style="list-style-type: none"> Not within the scope of this project

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

Collaborators:

Instituto de Investigacao Agraria de Mocambique (Mozambique)
Carvalho Ecole, Momade Ibraimo, Domingos Dias, Manuel I. V. Amane

World Vision (Mozambique)

Patricio Augustin

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 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 test 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.

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

Collaborators:

Pennsylvania State University (U.S.A.)

Bayou Demeke, Rachel Smith

Instituto de Investigacao Agraria de Mocambique (Mozambique)

Feliciano Mazuze, Maria Daluz Quinhentos, Venancio Salegua, Ana Lidia Gunguro

Approaches and Methods:

During FY 2010, farm household surveys will be completed, coded and analyzed for four study areas in Mozambique (Sussundenga, Lichinga, Gurue, Angonia). Two villages have been selected for indepth study in each area, one village proximate to IIAM activities related to testing and diffusion of the low-P beans, and the other not currently (potentially) influenced by IIAM activities. The paired sites will be part of a quasi-experimental study to understand bean seed diffusion processes which are critical to ensuring widespread impacts.

A total of four survey instruments comprise the Mozambique Vulnerable Soil Vulnerable Household (VSVH) Survey: 1) Male Core Survey, 2) Female Core Survey, 3) Household Profile Survey, and 4) Agricultural Plot Survey. All participating households are asked to identify 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. Survey questions related to the implications of human disease for production, marketing and health status are also included on the survey instruments. The Male Core and Female Core surveys include sets of identical questions asked of both the primary male and female in the household. This structure provides insight into potentially different perspectives on preferred legume characteristics; decision-making, and particularly that in regard to new agricultural technology; food production, market participation and food security; and relevant social and economic networks; as examples. In addition, the village municipal chief and traditional chief are asked to participate in a key informant interview to establish a historical perspective on changes in soil conditions, food security, and trends at the village and regional levels.

Large-scale laminated Google maps printed using Google Pro are used for all villages (both a full view landscape map and a smaller scale ‘quadrant’ village map) to help participants identify households comprising their relevant networks, and those individuals (or households) that exert the most influence on their technology adoption decisions (food and health). Bean sharing networks are explicitly delineated both for male and female householders. All households in the local village site are numbered to facilitate network identification. Households asked to participate in the surveys are randomly sampled from the numbered households. The lage-scale maps are also used to indicate all markets, scalar trader locations, fields, IIAM test sites, location of health clinics, and other relevant data. Basic GPS readings (longitude, latitude elevation) are

taken for all locations, including all surveyed households. Complementary geo-referenced data are being linked to the Google maps using ‘crosswalk’ software developed at Penn State. All CESE IIAM personnel who participate in the interviewers are being trained by the project team in methods and software (network systems, GIS) being used, as part of IIAM capacity building.

The Mozambique Vulnerable Soil Vulnerable Household (VSVH) Survey (baseline survey) and related analyses will be completed by the close of Phase I. Ensuring ‘gender equity’ is a major goal of Objective 3. Women are interviewed in all households, to understand the direct and often nuanced impacts of the new technology on their livelihoods (income, food security, nutrition), participation in key decision-making within the household, and inclusion in farmer’s organization networks and market network chains at the village level and higher. Women in the villages are interviewed by women in the IIAM CESE unit and other women recruited for the survey effort. Similarly, male interviewers are used to survey male respondents.

Objective 4: Capacity Building

Increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors in developing countries.

Short-term Training:

Type of training: in service

Description of training activity: in service training of Central American (Nicaraguan or Honduran) agronomists in root biology

Location: Penn State

Duration: 3 months

Scheduling of training activity: late spring to early fall 2008 and 2009

Participants/beneficiaries of training activity: Central American agronomists

Anticipated numbers of beneficiaries (male and female): 2

Equipment (costing > \$5,000):

Specific type of equipment to be purchased: We are planning to purchase and install Satellite dish for direct internet access at Chokwe research station, where part of project activities will take place.

Justification for equipment: to achieve workplan objectives: Internet access is very important during the implementation of the project. It will facilitate communication between HC researchers and U.S. principal investigators, as well as information access and sharing among the scientific community.

Institution to benefit from equipment: IIAM will benefit from the equipment.

Institution to purchase equipment: IIAM

Amount budgeted for equipment item: \$8,000

Degree Training:*Trainee #1*

First and Other Given Names: Virginia

Last Name: Chesale

Citizenship: Malawi

Gender: Female

Degree Program for training: MS

Program Areas or Discipline: Horticulture (Plant Breeding)

Host Country Institution to Benefit from Training: Malawi Ministry of Agriculture

University to provide training: Penn State

If enrolled at a US university, will Trainee be a 'Participant Trainee' as defined by USAID?: I suppose so - not quite sure of USAID definitions

Supervising CRSP PI: Jonathan Lynch

Start Date: as soon as a proper visa can be obtained- hopefully June 2009

Projected Completion Date: 24 months after start date

Type of CRSP Support (full, partial or indirect): full

If providing Indirect Support, identify source(s)s of leveraged funds: NA

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: tuition = \$27635, stipend = \$32760

Indirect cost: this should be in the budget we submitted

U.S. or HC Institution to receive CRSP funding for training activity: Penn State

Trainee #2

First and Other Given Names: Herminio

Last Name: Abade

Citizenship: Mozambique

Gender: Male

Degree: M.S.

Discipline: Plant Nutrition

Host Country Institution to Benefit from Training: IIAM

Training Location: English language training in the Republic of South Africa, followed hopefully by graduate study at Penn State

Supervising CRSP PI: Lynch, Jonathan

Start Date: 6/09 (language training)- 9/09 (graduate study)

Project Completion Date: 5/11

Training Status: Mr. Abade is about to begin language training as of this date

Type of CRSP Support (full, partial or indirect): Full (Category 1)

Contribution of Project to Target USAID Performance Indicators

The project will serve to improve food security and increase household incomes in broad areas of Eastern Africa through selection and breeding of beans well suited to local, degraded soils. The project will also result in 1) improvements in soil quality to enhance overall agricultural production in the region, 2) better seed systems that will significantly increase the number of households positively impacted by the new technologies being developed under this project, and 3) increase gender representation in research results and impacts.

Target Outputs

This is clearly identified in the benchmarks document, and target outputs are presented below.

The project will result in the following outputs:

- Identification of parents, traits, and markers for improved adaptation to low fertility, drought-prone soils of Eastern and Southern Africa.
- Phenotypic profiling of root traits in regional germplasm.
- Methods developed for phenotypic profiling of root traits and web-based training materials available in English, French, Portuguese, and Spanish.
- Information generated regarding effect of P-efficient bean genotypes on soil erosion.
- Information generated regarding effect of P-efficient bean genotypes on maize intercrop systems.
- Information generated regarding interaction of P-efficient bean genotypes with locally available P sources.
- Capability of African scientists to improve root biology of beans enhanced by training and improved infrastructure.
- Policy brief on seed systems (Objective 3)
- Summary report on Objective 3 survey results
- Full report on Objective 3 survey results, focusing on constraints, intra-household impacts, and technology diffusion and bean sharing networks
- Training of IIAM CESE personnel on GIS and network systems methodologies (Objective 3).

Engagement of USAID Field Mission(s)

In Mozambique, we will be reporting to the USAID Mission the progress made during the implementation of the activities as we achieve the expected benchmarks during each period of project implementation. In addition, we will be inviting USAID Mission staff members to perform field visits as a means to verify the benchmarks reported in each period, as well as to encourage the participation of USAID Mission staff members in field days with farmers.

The USAID Mission in Honduras has been very supportive of Bean/Cowpea CRSP research activities conducted by Zamorano over the last 18 years. They are aware of the impact of the cultivars released by the program in bean production in Honduras. EAP will be reporting to the USAID mission in Honduras about the progress made during the implementation of the project. In addition, when US PIs and MO staff visits project activities in Honduras, EAP will encourage them to perform a courtesy visit to the Mission, when it is possible.

Networking Activities with Stakeholders

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

Leveraging of CRSP Resources

This project is highly leveraged against synergistic activities under the supervision of the project participants, including an \$800,000 grant from the McKnight Foundation to JL and MM and a colleague in China, two other Pulse CRSP grants to JCR, FAO/IAEA projects to JL and MM, an International Science and Education grant to JF, a \$900,000 project from the Generation Challenge Program to JL, IIAM, and CIAT, a ca. \$2M project from the Howard G Buffett Foundation to JL involving IIAM and CIAT, and over \$1.5M in related root biology projects in the Lynch lab at Penn State.

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): Honduras

Output Indicators	2010 Target	2010 Actual		
	(Oct 1, 2009-Sept 30, 2010)			
Degree Training: Number of individuals who have received degree training				
Number of women	1			
Number of men	1			
Short-term Training: Number of individuals who have received short-term training				
Number of women	1			
Number of men	1			
Technologies and Policies				
Number of technologies and management practices under research	13			
Number of technologies and management practices under field testing	8			
Number of technologies and management practices made available for transfer	5			
Number of policy studies undertaken	3			
Beneficiaries:				
Number of rural households benefiting directly	630			
Number of agricultural firms/enterprises benefiting	280			
Number of producer and/or community-based organizations receiving technical assistance	5 organizations			
Number of women organizations receiving technical assistance	1			
Number of HC partner organizations/institutions benefiting	3			
Developmental outcomes:				
Number of additional hectares under improved technologies or management practices	1,225			

Dry Grain Pulses CRSP (budget template 10/1/09-9/30/10)							
Improving bean production in drought-prone, low fertility soils of Africa and Latin America - an integrated approach							
	Third period (12 months) 10/01/09 - 09/30/10						
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	
Institution Name	PSU	PSU	IIAM	EAP			
a. Personnel Cost							
Salaries	\$6,290.00	\$37,588.00	\$1,200.00	\$6,600.00			
Fringe Benefit	\$516.00	\$5,088.00	\$0.00	\$1,400.00			
b. Travel	\$9,000.00		\$8,000.00	\$3,000.00			
c. Equipment (\$5000 Plus)			\$0.00				
d. Supplies	\$15,000.00		\$5,000.00	\$5,000.00			
e. Training							
Degree		\$11,506.00	\$0.00				
Non-Degree			\$3,000.00	\$1,500.00			
f. Other			\$556.00				
g. Total Direct Cost	\$30,806.00	\$54,182.00	\$17,756.00	\$17,500.00	\$0.00	\$0.00	
h. Indirect Cost	\$14,603.00	\$20,228.00	\$0.00	\$2,500.00			
i. Indirect Cost on Subcontracts (First \$25000)							
j. Total Indirect Cost	\$14,603.00	\$20,228.00	\$0.00	\$2,500.00	\$0.00	\$0.00	
Total	\$45,409.00	\$74,410.00	\$17,756.00	\$20,000.00	\$0.00	\$0.00	
Grand Total			\$157,575.00				
				Amount	Percentage		
			Total direct cost budgeted for U.S. Institution(s)	#DIV/0!			
			Total direct cost budgeted for H.C Institution(s)	#DIV/0!			
Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind	\$53,634.00						\$ 53,634.00
Cash							\$ -
Total	\$ 53,634.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 53,634.00
Attribution to IEHA Objectives							
Percentage of effort	90.00%		100.00%	10.00%			38.47%
Amount corresponding to effort	\$40,668.10	\$0.00	\$17,756.00	\$2,000.00	\$0.00	\$0.00	\$60,624.10
Attribution to Capacity Building (Theme "D")							
Percentage of effort	90.00%		100.00%	100.00%			49.90%
Amount corresponding to effort	\$40,668.10	\$0.00	\$17,756.00	\$20,000.00	\$0.00	\$0.00	\$78,624.10
Name of PI and Institution affiliation							

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: *Improving Bean Production in Drought-prone, Low Fertility Soils of Africa and Latin America- An Integretate Approach*

	Abbreviated name of institutions					
	EAP	IIAM	PSU			
Identify Benchmark Indicators by Objectives	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10

Objective 1: Breeding

Phenotype root traits	X	X		X		
Screen for drought/low P tolerance	X	X		X		
Introgress root traits for drought/low P tolerance	X	X				
Field trial with selected genotypes	X	X		X		

Objective 2: Agroecology

analyze erosion study results Lichinga			X			
establish soil moisture plots Chokwe				X		
Conduct greenhouse studies w RP (continued)				X		
Field evaluation of RP				X		
Identification of genotypes w best response to RP				X		
Intercropping study						

Objective 3: Socio-economics

Code face-to-face surveys			X		X	
Clean coded data set			X			
Transcribe historical survey			X			
Conduct network analyses				X		X
Analyze data				X		X
Draft survey report 1				X		X

Objective 4: Capacity building

Training of Central American technicians	X	X				X
Application of root phenotyping methods	X	X				
Recruit IIAM student/English training					X	
MS student coursework					X	X
MS student research					X	X
Maintenance of Internet Access in Chokwe			X	X		
web resource root methods					X	X
short term training in use of RF				X		

Name of the PI responsible for reporting on benchmarks	J.C. Rosas	M. Miquel	J. Lynch
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Signature/Initials:

Date:

P1-UCR-1

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

Principal Investigator:

Phillip Roberts, University of California-Riverside, U.S.A.

Collaborating Host Country and U.S. PIs and Institutions:

Ndiaga Cisse, ISAR, Senegal

Jeff Ehlers, UCR, U.S.A.

Issa Drabo, INERA, Burkina Faso

António Chicapa Dovala, IIA, Angola

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 October 1, 2009 - September 30, 2010

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.

Collaborators:

Centre National Recherches Agronomie (Senegal)
Moctor Wade, Ngor Diagne, Ousseynou Ciss

Institut Senegalais de Recherches Agricole (Senegal)
Moctor Wade, Ngor Diagne, Ousseynou Ciss

Institut de l'Environnement et des Recherches Agricole (Burkina Faso)
 Tignegre Jean-Baptiste, Clementine Dabire

Instituto Investigacao Agronomica (Angola)
 Jose Pedro, Antonio Castame Francisco

Universidade Agostinho Neto (Angola)
 David Kiala,

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, released as ‘CB50’	UCR	UCR	Blackeye	Post release assessment under different production conditions including irrigation regimes and plant populations
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	Final on-farm evaluation, Breeder and Foundation Seed increase
Melakh	ISRA	INERA	White	Final on-farm evaluation, Breeder and Foundation Seed increase
KVx421-2J	INERA	INERA	White	Final on-farm evaluation, Breeder and Foundation Seed increase
ISRA 2065	ISRA	ISRA	White	Final on-farm evaluation (2009 season), 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 and in the southeastern region. Following this 2009 season (July – October) ISRA-2065

will be formally released as a variety. Each on-farm trial will consist of plots $\frac{1}{4}$ ha in size. Two advanced yield trials will be conducted at the Bambey and Thilmakha ISRA field stations for the second year. The first trial will include 98 lines from the cross Nd. AW x Yacine and the two parents. The experimental design will be a 10 x 10 lattice with 2 replications. Two-row plots 5 m long will be used. The second trial will include 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 will be Mouride, Mélakh, Yacine, and ISRA 2065. A randomized block design with 4 replications will be used. Individual plots will be 4 rows, 5 m long. The two center rows will be used for yield and agronomic characterization of each line,

Concomitantly a third trial will be designed which will include the best lines from the above crosses identified from the previous trials at Bambey and Thilmakha. This trial will include 10 – 15 lines and will be tested throughout the cowpea zone (station and on-farm). The rationale is to speed up the variety identification process, so that at the end of 2010 growing season, potential new cultivars are identified.

In Burkina Faso, the 3 varietal candidate lines will be grown in on-farm trials by 5 farmer groups at 10 sites in Central and Northern Burkina Faso. Sites will be considered as replications and each plot will be 300 m². In addition, six other new candidate varieties that have been developed at INERA will be evaluated for a second year in on-farm trials at the same 10 sites in Central and Northern Burkina Faso.

In Angola, cowpea field evaluations will be conducted at two locations, with the aim of identifying candidate varieties among local landraces, and Bean/Cowpea CRSP (in Ghana, Senegal and/or Burkina Faso) and IITA varieties. Seed has been sent to Angola from UCR for the next season plantings, and Angola seed has been produced of local landraces for the comparative plantings. We anticipate plantings in both 2009 and 2010 will be needed to provide necessary field evaluation data. One or more of these candidates will become the first varieties to be formally produced under the project.

In California: Monitor performance and optimize management of new variety CB50. In 2008, 2 ha of Foundation Seed was planted that produced 18,000 lbs of Certified Seed that is being sold to growers for the 2009 planting season., We will continue to monitor the performance and adoption as this variety is grown more widely by a diverse group of growers in the southwestern US. In close collaboration with Farm Advisors in California, we will conduct a large scale strip trial that will provide growers with information on how to optimize economic returns with CB50 by looking at reduced irrigation regimes and three planting densities at two locations (Shafter and Kearney).

In California: Release of all-white and dry green cowpeas. For all-white breeding line 07-11-572 and dry green breeding line 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.

In California: Continued testing of elite lines. A set of three 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 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 if their performance justifies release.

In California: Identification of new lines for replicated yield tests. We will continue development of new blackeye-type breeding lines by evaluating about 200 F₇ lines. These lines will be planted at Shafter for evaluation of grain quality and agronomic traits. These lines are now sufficiently stable (inbred) that seed of selected lines can be harvested in bulk for replicated yield testing in 2010.

In California: Development of new breeding populations. We will initiate a new round of crosses for breeding varieties with increased yield potential and resistance to lygus and aphids. New hybrids will be made between P-87, CB50, CB46, CB46-72Rk², 07KN-42, 07KN-46, 07KN-76 and other selected lines in the greenhouse during the spring of 2009. During the summer or fall, the F₁ seed from these crosses will be grown out to obtain F₂ generation seeds. 07KN-42, 07KN-46 and 07KN-76 appear to combine very high yield potential and resistance to lygus bug, but improvement in seed quality is needed. Line CB46-72Rk² is an advanced backcross derived breeding line closely resembling CB46 but with greater resistance to root-knot nematodes, but that has smaller grain size than CB46. This line will be used to cross with CB46 to create a nematode resistant version of CB46 and also as a donor parent for improved nematode resistance in other crosses. Breeding lines 07KA-34, 07KA-173, IT97K-556-6 and several USDA plant introductions (such as PI 582810) showed strong resistance in an aphid resistance germplasm screening trial (funded by a USDA grant) conducted at Kearney in 2008, and these resistant genotypes will be crossed with CB46 and CB50 as part of the process of transferring aphid resistance to adapted varieties.

In California: Continue to develop lygus bug resistant blackeyes. Three lines (04Kly-2, 04Kly-23, and 04Kly-152) had low percent loss in yield due to lygus and/or significantly less grain damage than CB46 under unprotected conditions in 2007. They were included with 24 new lines selected from lygus resistance screening nurseries that were also conducted in 2007 at Kearney. These 27 lines were grown in a trial with check entries CB46, CB50 and CB27 under unprotected conditions in a replicated trial conducted at Kearney in 2008. Data on grain yield and % seeds damaged by lygus were collected and the results showed that three lines significantly out-yielded the best check (CB46). Six other lines had higher absolute yields than CB46, and lower seed damage. In 2009 and 2010, we will assess the level of lygus resistance of these 9 lines. The 2009 trial will be conducted with both protected and unprotected treatments using a paired plot/strip plot design (with Temik protected and unprotected strips and entries paired across the strips) with six replications and having CB46 as a check.

We will continue with a new two-tiered breeding strategy that was initiated in the current (2008-2009) workplan period, to meet the immediate and longer term needs of farmers. The **Short-Term Strategy** uses 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. The selected varieties being improved by this approach are given in Table 2.

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

Recurrent Parent Line	Institution	Trait being introgressed	Trait donor (non-recurrent) parent
Yacine	ISRA	Macrophomina	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
KVX 745-11P	INERA	Large seed	KVX 414-22-2 derived line
IT98K-205-8	INERA	Large seed	Montiero and KVx 414-22-2 derived line
CB5	UCR	Fusarium wilt	CB27
CB46	UCR	Green grain	UCR 03-11-747
CB46	UCR	Root-knot nematode res.	IT84S-2049
CB46	UCR	Large grain size	Montiero (Brazil)
CB46	UCR	All-white grain	Bambey 21(Senegal)
CB46	UCR	Aphid res.	IT97K-556-6 & UCR 779
CB46	UCR	Lygus res.	IT93K-2046

In Senegal, new crosses will be initiated to develop varieties with medium to late maturity to cope with the changing cropping season length in the northern zones and with the growing interest in cowpea in the south and eastern areas. These materials will include thrips resistance and good grain qualities.

During the current workplan period crosses between the recurrent and non-recurrent parents were made, plus the first and second backcrosses, followed by inbreeding the second backcross progenies to develop BC₂F₂ families. In the second workplan period, these progenies will be evaluated for trait expression in greenhouse and(or) field nursery screenings. A third backcross will be made onto selected individuals. In addition, a preliminary yield trial will be conducted in Burkina Faso with the advanced lines developed during the Bean/Cowpea CRSP phase.

During the new workplan period, 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. We have almost completed the development of a 384-SNP genotyping platform for use in the Illumina BeadExpress high throughput genotyping system. This will be

available starting in summer 2009, at which time we will initiate marker screening for key traits to make individual and family selections in the recurrent backcross process. This should expedite the variety improvement under the short-term strategy.

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 are using a ‘two-stream’ recurrent selection approach initiated in the current workplan period. One stream includes the six possible biparental crosses between highly drought tolerant lines SuVita 2, 58-57, TN88-63, IT93K-503-1. The F₁’s were made at UCR, then advanced to the F₂ generation and subjected to seedling screening for drought tolerance. A set of 100 drought-tolerant F₂ individuals were identified and are being advanced to the F₃ for each population. By the start of the new workplan period, the 100 F₃ lines of each population will be developed. They will then be selected again for drought tolerance at the seedling stage, and 50 F₄ lines selected at UCR. Two of the six populations of 50 F₄ lines will be distributed to each program (UCR, ISRA, and INERA) for drought tolerance phenotyping. A smaller subset of 10 lines will be selected from this evaluation, and reevaluated for drought tolerance at the F₅ generation in summer 2010. 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 current workplan period, breeders in Senegal and Burkina Faso chose a set of popular local cowpea varieties for targeted genetic improvement through MAS or MARS. These were hybridized to sources of known thrips resistance and heat/drought tolerance. The crosses are described in Table 3. Using greenhouse and off-season nurseries, the F₁ and F₂ generations are being advanced to F₄ and F₅. Individuals selected with markers will be evaluated for trait expression to validate the usefulness of the markers in different genetic backgrounds. We consider the population sizes to be adequate to make significant genetic gain, based on our ability for selection of contributing trait determinant QTL by the high-throughput SNP genotyping capability.

Table 3. Crosses made and advanced to F2-F4 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.	F3 – F4 in greenhouse now
IT93K-503-1/IT84S-2246	Elite Drought Tol. x Elite Drought Tol.	F3 – F4in greenhouse now
Mouride /IT84S-2246	Elite Drought Tol. x Elite Drought Tol.	F3 – F4in greenhouse now
IT97K-499-39/IT93K-503-1	Elite Drought Tol. x Elite Drought Tol.	F3 to be planted Fall 2009
IT97K-503-1/IT97K-556-6	Elite Drought Tol. x Elite Drought Tol.	F3 to be planted Fall 2009
Mouride/Apagbaala	Elite Drought x Elite Heat Tolerant	F3 to be planted Fall 2009
KVx61-1/Mouride	Elite x Elite Drought Tolerant	F3 to be planted Fall 2009
IT93K-503-1/UCR 779	Elite Drought Tolerant x Drought Tolerant and aphid resistant landrace	F3 to be planted Fall 2009
Apagbaala/IT82E-18	Elite Heat Tolerant x Elite	F3 to be planted Fall 2009
IT97K-819-45/Ein El Ghazal	Elite x Elite Drought Tolerant	F3 to be planted Fall 2009
Ein El Ghazal/KVx544-6-151	Elite Drought Tolerant x Elite	F3 to be planted Fall 2009
IT98K-558-1/Mouride	Elite x Elite Drought Tolerant	F3 to be planted Fall 2009
Apagbaala/IT98K-558-1	Elite Heat Tolerant x Elite	F3 to be planted Fall 2009
IT95K-1479/Mouride	Elite x Elite Drought Tolerant	F3 to be planted Fall 2009

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

Collaborators:

Centre National Recherches Agronomie (Senegal)

Samba Thiaw,

Institut Senegalais de Recherches Agricole (Senegal)

Samba Thiaw

Institut de l'Environnement et des Recherches Agricole (Burkina Faso)

Tignegre Jean-Baptiste

Centro Nacional de Recursos Fitogenetico (Angola)

Jose Pedro

Universidade Agostinho Neto (Angola)

David Kiala

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, additional 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 m² 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 7 tonnes of Foundation Seed. This will address the estimated 5% shortage of Foundation Seed, kick-starting an expansion of the self-sustaining seed production system. Training of farmers as Certified Seed producers will be done at Tougan (Sourou province). A total of 40 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 1 ha of Melakh, 1 ha of Yacine and ½ ha of ISRA-2065 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 4 locations (Thilmakha region, Merina district, Mekhe, and Sangalkam). 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. This plan builds on and expands the effort underway in the current period.

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 had planned 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. However, the planting failed due to severe Ascochyta infection. Therefore, a repeat of this effort in a different location will be made in the new workplan period. Seeds for this effort were recently sent to Angola.

Objective 3: Capacity Building

Develop a cowpea breeding program in Angola and strengthen existing breeding programs in Senegal and Burkina Faso through targeted training.

Collaborators:

University of Puerto Rico (Puerto Rico)
James Beaver

Universidade Agostinho Neto (Angola)
David Kiala

Instituto de Investigacao Agronomica (Angola)
Antonio David

Approaches and Methods:

A cowpea breeding program in Angola will be developed and the existing cowpea breeding programs in Burkina Faso and Senegal will be strengthened through targeted training of existing

and new cowpea program personnel, and the development and provision of user-friendly manual-format and web-based cowpea breeding guidelines. The Host Country partners provide a spectrum of opportunities and needs for developing and strengthening cowpea breeding programs. They are representative of neighboring cowpea producing countries in this sub-Saharan production area. Therefore, training activities and outputs can be 'regionalized' to attain broader impact, for example in Ghana, Mali, Niger, Nigeria, and Zambia. We have partnered with Burkina Faso and Senegal cowpea breeding programs for many years. The programs in these countries are relatively mature, particularly in Senegal, and have benefited from staffing with senior cowpea breeders and other scientists working on agronomic, pest and disease problems, coupled with recognition and support from their national institutions (INERA and ISRA). In contrast, Angola represents a cowpea producer with excellent production, marketing and consumption potential, but requiring considerable aid to develop a viable national cowpea breeding program. The Pulse CRSP can make significant positive impact toward this goal, by taking advantage of the interest and experience of key scientific personnel, led by HC PI Dr. Antonio Chicapa. Dr. Chicapa has longterm experience working with legume crops, with focus on plant pathology problems, and exchanges of cowpea germplasm and testing have started with the UC Riverside program. Promising breeding selections in Angola will be extended to neighboring Zambia where we will link with the Legume Program of the Zambian Agriculture Research Institute (ZARI). The targeted training will comprise the following components:

Degree (MS and PhD level) training for two African scientists will be undertaken with the goal of developing the next generation of cowpea breeders. The project team has now identified trainee candidates and applications are pending. One trainee (Antonio David) has been identified from Angola, where a new cowpea breeder will fully complement the plans to develop a new cowpea breeding program. This trainee will complete the MS course in plant breeding at the U. Puerto Rico, in collaboration with Dr. James Beaver. He will start the UPR MS course in August 2009. His training will run through the new workplan period. We have been working with several trainee applicants for the PhD program at UC Riverside, but have yet to have one accepted in and matching with the program. Currently 2 candidates are in the application process, with a start date in the PhD program of Winter Quarter 2010 (January 2010). Of these two, Madame Penda Sarr is an applicant from Senegal where she is working with HC PI Dr. Cisse and ISRA scientists with interest in Plant Pathology and cowpea breeding. The second candidate is Mr. Arsenio Daniel Ndeve, from Mozambique, who recently completed a MS degree in Denmark and is working with cowpea breeder Dr Rogerio Chiulele, at Universidade Eduardo Mondlane. He would provide an excellent alternate candidate for training in cowpea breeding and pathology, building on the vigorous cowpea breeding program being established by Dr. Chiulele with assistance from IAMM and their research stations at Umbelezi and especially Chokwe, where the station manager is Celestina Jochua, HC PI for Jonathon Lynch's Pulse CRSP project in Mozambique. In countries with established senior cowpea breeders such as Burkina Faso, Senegal, and Nigeria, PhD student training would anticipate gaps arising as senior breeders reach retirement. Degree training in Mozambique would anticipate needs to build on a newly developing program where University and NARS facilities and mentoring personnel are available. Degree training for one PhD student will be conducted at the University of California Riverside in the Plant Biology (Genetics) or Plant Pathology graduate program. Research topic and guidance will be overseen by the UCR PIs and encompass Objective 1 activities for marker-assisted cowpea breeding focused on abiotic and biotic stress resistance traits.

Training current cowpea breeders in the development and application of DNA-based markers for MAS in the cowpea breeding programs will be embedded in the research effort under Objective 1. Cowpea breeders will be trained in marker application utilizing their own breeding populations generated by the high x high crosses and recurrent back-crossing for existing variety improvement made within the programs. This will focus on the Senegal and Burkina Faso programs and to some extent on Angola, starting in Fall 2009 with the availability of the new SNP-genotyping platform for cowpea. ‘Shuttle’ screening of progenies with trait markers and yield QTL will be done between UC Riverside and the Host Countries, with joint interpretation of data sets and progeny selections as a hands-on MAS and MARS experience. Markers linked to traits including drought tolerance and *Macrophomina* and thrips resistance will be emphasized.

Development of a practical guide to cowpea breeding is underway with the goal of a first draft by the start of the new workplan period. The guide will emphasize primary target constraints to cowpea yield in Africa and incorporate application of DNA marker technology to breeding. This first draft of the guidelines will be ‘field-tested’ by the senior breeders and trainees in the 2009-2010 period. The feedback from field-testing will be used to revise the guidelines before issuing in final form by the end of the full project period. We plan to develop the guidelines in hard-copy manual format that can be taken to the field, greenhouse or lab, and a web-based version of the same document that can have a broad distribution and be easily accessed as a teaching/training resource. The aim is to have the cowpea breeding guide available for all cowpea breeding programs in Africa and elsewhere. The key elements of the guide will cover maintenance and storage of cowpea germplasm, selecting parents, making crosses and selfing for breeding line development, field and greenhouse grow-out and selection, major trait phenotypes (agronomic characters, pest, disease and abiotic stress symptoms and resistance), application of molecular markers for traits for MAS and MAB, and requirements for candidate variety testing and new variety release protocols.

Degree Training:

Student #1

First and Other Given Names: Antonio Nkulo Ndengoloka

Last Name: David

Citizenship Angola

Gender: Male

Degree Program for training: MS

Program Areas or Discipline: Plant Breeding/Genetics/Plant Pathology

Host Country Institution to Benefit from Training: Angola

University to provide training: University of Puerto Rico

If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? Yes

Supervising CRSP PI: PA Roberts and HC PI

Start Date August, 2009

Projected Completion Date September 2011

Type of CRSP Support (full, partial or indirect) Full

If providing Indirect Support, identify source(s) of leveraged funds:

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$40,000

Indirect cost: None

U.S. or HC Institution to receive CRSP funding for training activity: UC-Riverside.

Student #2

First and Other Given Names TBD

Last Name TBD

Citizenship African country (likely Senegal or Mozambique)

Gender: Female or Male

Degree Program for training: PhD

Program Areas or Discipline: Plant Breeding/Genetics/Plant Pathology

Host Country Institution to Benefit from Training TBD

University to provide training: UC-Riverside

If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes

Supervising CRSP PI: PA Roberts and HC PI

Start Date January, 2010

Projected Completion Date October 2012

Type of CRSP Support (full, partial or indirect) Partial

If providing Indirect Support, identify source(s)s of leveraged funds: UC-Riverside GSR funds;

GCP project funded to UC-R

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$21,045

Indirect cost:

U.S. or HC Institution to receive CRSP funding for training activity: University of California - Riverside

Student #3

First and Other Given Names: Marti

Last Name: Portorff

Citizenship US

Gender: Female

Degree Program for training: PhD

Program Areas or Discipline: Plant Breeding/Genetics/Plant Pathology

Host Country Institution to Benefit from Training N/A

University to provide training: UC-Riverside

If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? No

Supervising CRSP PI: PA Roberts and HC PI

Start Date October, 2008

Projected Completion Date October 2012

Type of CRSP Support (full, partial or indirect) Partial

If providing Indirect Support, identify source(s)s of leveraged funds: UC-Riverside GSR funds;

CGIAR-GCP project funded to UC-R

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$15,045

Indirect cost:

U.S. or HC Institution to receive CRSP funding for training activity: University of California – Riverside

Contribution of Project to Target USAID Performance Indicators

The Performance Indicators presented as 2010 workplan targets, are projections from the three Host Countries (Angola, Burkina Faso, Senegal) covering cowpea breeding, seed systems development, and training activities, and based on the following considerations. IEHA supports good governance and collaborative relationships to promote conditions that will allow agriculture to flourish in Africa, including support of science and technology driven strategies and partnerships to accelerate advances that will reduce hunger. Our project is the first comprehensive program focused on bringing modern plant breeding tools and strategies that are commonly used in other crops, to cowpea genetic improvement efforts. These tools and strategies will speed up the delivery of improved cowpea varieties to farmers. Modern plant breeding is rapidly evolving as improvements in molecular marker and other technologies evolve, and the use of modern breeding methods in African breeding programs, as we propose, represents an on-going type of dynamic and highly relevant training for African scientists.

The IEHA program has West and Southern Africa Regional Programs that include Senegal and Angola. USAID-Angola focuses on food security, democratic governance, improved maternal/child health, and economic reform. Our project contributes to food security, an important objective for all of the host countries through the development and dissemination of varieties tolerant to drought and pest attack by harnessing recent advances in plant breeding for the benefit resource-poor farmers.

Women produce much of the African cowpea crop, but are also some of the most disadvantaged in terms of access to capital to purchase farm inputs and to ‘good’ land. Our improved varieties will yield better than varieties presently in use in the face of pest attack and do not require purchased inputs of fertilizers and pesticides to add value. Thus the improved varieties are of particular benefit to the majority of women farmers who cannot afford inputs.

Women are the main processors of popular value-added cowpea-based food products such as ‘Akara’ that are extensively sold in urban centers of West and Central Africa. Hence a large portion the benefits of increased productivity and improved grain quality made possible with improved varieties will flow to women producers of cowpea-based value-added foods in the form of lower prices for the raw product and higher quality of grain available in the marketplace.

In consideration of biodiversity conservation, and social, political and environmental goals, this project will increase farmer yields through the development and dissemination of cowpea varieties with improved yields as a result of improved yield potential and through the possession of resistance to abiotic and biotic stresses. Loss of biodiversity in Africa can be countered by increased rural prosperity through increased yields. Increased rural incomes will lessen the pressure on farm families to engage in environmentally destructive practices such as wood harvesting for manufacture and sale of charcoal to generate income, and unsustainable crop rotations. Pesticide use in rural Africa presents an array of human health problems. The varieties that will be released and the seed systems strengthened by this project will be more productive without pesticides, with fewer or ‘softer’ pesticides than existing varieties, reducing the environmental and health hazards associated with insecticides. Increased rural incomes resulting from the improved varieties will allow farmers to purchase soil-improving fertilizers, especially phosphorus, which is currently being unsustainably mined by present cropping practices in West

and Central Africa. The more productive varieties should allow farmers to make money even in the face of reduced cowpea prices. The reduced price will encourage consumption. Increased acreage of cowpea, as a nitrogen-fixing legume, will improve soils for subsequent staple cereal and tuber foods. Thus, the improved varieties can contribute to the start of positive momentum towards more productive and sustainable systems in the targeted host countries.

Target Outputs

- Develop six elite x elite drought tolerant F₅ breeding populations.
- Release of new cowpea varieties in Burkina Faso (2 varieties), Senegal (2 varieties) and California (3 varieties).
- Two California blackeye varieties improved with four traits
- Two Burkina Faso cowpea varieties improved with three traits
- Three Senegal cowpea varieties improved with five traits
- Cowpea breeding manual in hard copy and web-based format.
- Foundation and Certified Seed production strengthened in Burkina Faso and Senegal.
- One MS student from Angola trained in plant breeding with research on cowpea.
- One Host Country and one US PhD student enrolled in graduate program at UCR.
- HC cowpea breeders trained in application of new molecular markers for key traits.

Engagement of USAID Field Mission(s)

The US and HC Principal Investigators will meet with USAID Missions in Angola and Senegal during U.S. Principal Investigator visits to the host country projects. In each case the Mission staff will be informed about project activities and significant accomplishments and look for opportunities for Mission funding of projects that leverage the goals of our proposal. Similarly, the USAID West African Regional Program, which is responsible for USAID programming in Burkina Faso but located in Ghana, will be contacted about funding opportunities that are consistent with the goals of this proposal. These engagements will be used to share and learn of any opportunities for Mission Associate awards or other support for our CRSP activities.

Networking Activities with Stakeholders

We will work closely with national and international cowpea breeders, including Drs. Ousmane Boukar and Christian Fatokun, Senior Scientists and Cowpea Breeders at IITA, Dr. Mohammed Ishiyaku of the IAR in Nigeria, and Dr. Rogerio Chiulele, Eduardo Mondlane University, Maputo, in Mozambique. We will continue to work with national extension services, World Vision International and other NGOs to extend new cowpea technologies. Specifically in the Host Countries for this project, we will network with NGOs in Burkina Faso, Senegal, and Angola. This will be especially important in the Objective 2 activities on advancing and developing seed production and delivery systems.

Leveraging of CRSP Resources

Other resources leveraged from current and future funded complementary cowpea research projects include the following:

California Dry Bean Advisory Board and its Blackeye Varietal Council (funds currently and typically set at \$18,000 – 20,000 per year) funded for cowpea breeding in California. This is a continuing, long term research arrangement in support of the UC Riverside cowpea breeding program.

The CGIAR Generation Challenge Program (GCP) Tropical Legumes I Project funded for 3 years (May 2007-April 2010) with expectation for extension of funded research. The cowpea component of this project is lead by UC Riverside (Ehlers, Roberts, and Close) and includes collaborative funded cowpea breeding and research with the cowpea breeding programs in Burkina Faso (with PI I. Drabo), Cameroon (PI O. Boukar) and Senegal (PI N. Cisse), and IITA (PI, C. Fatokun). This project funded at nearly \$1.9M is developing cowpea genomic resources, including cDNAs, BACs, ESTs and SNP genotyping for genetic and physical mapping and for development of high throughput marker platform for major traits. Traits targeted are insect resistance, especially flower Thrips, nematode and disease resistance, and drought and heat tolerance. The more upstream genomics and marker work funded under this project provides an excellent leveraging for CRSP activities described here to be used for more application (downstream) breeding.

A second GCP project funded to UC Riverside (Ehlers, Roberts, and Close) for \$450,000 (January 2008 to December 2010), focuses on development of phenotyping protocols for cowpea drought tolerance, with work in the West Africa partner countries, California and Texas. This provides direct leveraging opportunities for the drought tolerance efforts.

The Pulse CRSP funds proposed herein will also be leveraged with opportunity funds within the Host Countries via NGOs and national sources through presentation of the CRSP effort and the associated opportunities for participatory funding.

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

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

Project Title: Modern Cowpea Breeding to Overcome Critical Production Constraints in Africa and the US

Lead U.S. PI and University: Philip Roberts, University of California, Riverside

Host Country(s): Angola, Burkina Faso, Senegal

Output Indicators	2010 Target	2010 Actual
	(October 1 2009-Sept 30, 2010)	
Degree Training: Number of individuals enrolled in degree training		
Number of women	1	
Number of men	1	
Short-term Training: Number of individuals who received short-term training		
Number of women	26	
Number of men	22	
Technologies and Policies		
Number of technologies and management practices under research	13	
Number of technologies and management practices under field testing	13	
Number of technologies and management practices made available for transfer	4	
Number of policy studies undertaken		
Beneficiaries:		
Number of rural households benefiting directly	9,000	
Number of agricultural firms/enterprises benefiting	19	
Number of producer and/or community-based organizations receiving technical assistance	35	
Number of women organizations receiving technical assistance	14	
Number of HC partner organizations/institutions benefiting	24	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	35,000	

Dry Grain Pulses CRSP : THIRD PERIOD

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

	Third period (12 months) 10/01/09 - 09/30/10					
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name	UC Riverside	Training	Burkina Faso	Senegal	Angola	
a. Personnel Cost						
Salaries	\$24,102.00		\$10,000.00	\$10,000.00	\$10,000.00	
Fringe Benefit	\$7,713.00					
b. Travel	\$6,000.00		\$2,000.00	\$2,000.00	\$2,000.00	
c. Equipment (\$5000 Plus)						
d. Supplies	\$2,900.00		\$8,000.00	\$8,000.00	\$8,000.00	
e. Training						
Degree		\$60,607.00				
Non-Degree						
f. Other						
g. Total Direct Cost	\$40,715.00	\$60,607.00	\$20,000.00	\$20,000.00	\$20,000.00	\$0.00
h. Indirect Cost	\$20,357.50					
i. Indirect Cost on Subcontracts (First \$25000)						
j. Total Indirect Cost	\$20,357.50	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total	\$61,072.50	\$60,607.00	\$20,000.00	\$20,000.00	\$20,000.00	\$0.00
Grand Total			\$181,679.50			

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	\$40,715.00	25.24%
Total direct cost budgeted for H.C institution(s)	\$120,607.00	74.76%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind							\$ 15,268.13
Cash	\$15,268.13						\$ -
Total	\$ 15,268.13		\$ -	\$ -	\$ -	\$ -	\$ 15,268.13
Attribution to IEHA Objectives							
Percentage of effort	75.00%	75.00%	75.00%	75.00%	75.00%		75.00%
Amount corresponding to effort	\$45,804.38	\$45,455.25	\$15,000.00	\$15,000.00	\$15,000.00	\$0.00	\$135,259.63
Attribution to Capacity Building (Theme "D")							
Percentage of effort	35.00%	35.00%	35.00%	35.00%	35.00%		35.00%
Amount corresponding to effort	\$21,375.38	\$21,212.45	\$7,000.00	\$7,000.00	\$7,000.00	\$0.00	\$63,587.83

Name of PI & Institutional Affiliation: Phil Roberts, University of California, Riverside

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 – September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: *Modern Cowpea Breeding to Overcome Critical Production Constraints in Africa and the U.S.*

Identify Benchmark Indicators by Objectives	Abbreviated name of institutions							
	UCR	ISRA	INERA	IIA	UCR	ISRA	INERA	IIA
4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10

Objective 1 - Breeding

Varietal identification and release	x		x	x	x		x	
Germplasm seed increases	x	x	x	x	x	x	x	
Germplasm screening	x	x	x	x	x	x	x	x
Varietal candidate screening - Angola						x	x	
Advance and test BC2F2 pops	x			x	x	x		
Advance/test elite F3-F5 Pops		x	x	x	x	x		
SNP genotyping	x	x						

Objective 2 - Improve Seed Systems

Breeder's seed production	x	x	x	x	x		x	
Foundation Seed Production			x	x	x	x		
Certified Seed producer training			x	x	x	x		
Assess seed system needs - Angola	x						x	

Objective 3 - training

MS Training (Breeding) Angola/UPR	x	x				x	x	
PhD Training (Breeding -HPR)	x	x						
Training in MASD with SNP markers	x		x		x		x	
Breeding Guide	x							

Name of the PI responsible for reporting on benchmarks	Roberts	Cisse	Drabo	Chicapa
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Signature/Initials:	PAR	NC	ID	ACD
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Date:	23-Mar-09
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P1-UIUC-1

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

Principal Investigator:

Barry Pittendrigh, University of Illinois at Urbana-Champaign, U.S.A.

Collaborating Scientists:

Ibrahim Baoua, INRAN, Niger

Clémentine Dabiré, INERA, Burkina Faso

Niang Malick Ba, INERA, Burkina Faso

Mohammad Ishiyaku, IAR, Nigeria

Jeremy McNeil, UWO, Canada

Manuelle Tamo, IITA, Benin

David Onstad, UIUC, U.S.A.

Julia Bello, UIUC, U.S.A.

William Muir, Purdue, U.S.A.

Joseph Huesing, Monsanto, U.S.A.

Mamadou N'Diaye, IER, Mali

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. However, the previous lack of cultivars that resist major insect pests like legume pod borer, bruchids, and pod sucking bugs had not been filled by conventional breeding because attempts to find genes conferring resistance in the cowpea genome to these pests have failed so far. Recent breeding efforts have resulted in some varieties that are more tolerant or resistant to some of these insect systems. However, deployment into the hands of farmers of some of these varieties remains has not occurred. 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 and deploy alternative strategies for control of insect pests of cowpea, in order to reduce the levels of pesticides used on cowpea crops or to promote the use of chemistries that are safer for the environment and humans (*e.g.*, shifting from using deltamethrin to the bio-pesticide Spinosad).

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, triple bagging of cowpeas to reduce insect attack has been promoted to reduce the use of pesticides on stored cowpea. Although this is an effective methodology, not all farmers have access to such bags, and in some cases there is a need to present “green chemistry” alternatives to farmers that still need or choose to treat their stored seeds with pesticides (Sanon *et al.*, in press). Second, 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. However, we are at the best years away from deployment of transgenic cowpea in the field. Third, 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.

Understanding the biology of the insect systems is necessary for us to determine when and where to deploy these alternative pest control strategies.

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 sucking-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 that we propose to work. Also, there are several opportunities to develop strategies to control these pests:

- 1) 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.
- 2) 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. Where appropriate we will test such varieties with the intent to ultimately integrate them into our farmer field schools.
- 3) We now have a cowpea variety resistant to the pod-sucking bug, *C. tomentosicollis* (KVx 908-1). When this resistant variety is also sprayed with neem, the thrips, pod borers, as well as the pod-sucking bugs are controlled at a level comparable to traditional insecticide sprays (Ba *et al.*, 2008). This combined control strategy is currently being used in our farmer field schools in Burkina Faso (summer 2009) and will be tested in our other farmer field schools in the summer of 2010.
- 4) Deployment of the parasitoid *Apanteles taragamae*, for control of *M. vitrata*, appears to be a promising candidate in controlling *Maruca* populations (work by Dr. M. Tamo). Additionally, this parasitoid can easily be reared in the laboratory. Our CRSP project is well-positioned to begin tests with this parasitoid in other collaborative host countries in 2010.
- 5) Deployment of the parasitoid *Ceranisus femoratus*, for control of cowpea thrips, appears to be effective in reducing *M. sjostedti* populations on alternative host plants in southern Benin and Ghana (Tamo *et al.* 2002, 2003). These parasitoids originate from Cameroon. Additionally, as the thrips are known to live on wild alternative hosts (in Burkina Faso, Niger, and northern Nigeria) in the dry season, the parasitoid populations can be maintained all year around once established. Dr. Manu Tamo has developed a methodology to establish thrips, and is developing training protocol around this issue, which will be shared with our other collaborators in Nigeria, Niger, Mali, and Burkina Faso. Briefly, plant plots of *Tephrosia candida* need to be planted nine months before the effective date of the release of the parasitoids. The presence of these alternative host plants allows for an increase in thrip numbers in order to provide an 'in-field' multiplication of the parasitoids within the field plots. In FY10 training efforts by Dr. Tamo will occur to develop the skill sets of our collaborators, in Niger, Burkina Faso, Mali, and Nigeria, on how to release these parasitoids. By the end of FY10, we expect to

be in a position to be able to transfer the thrips and the associated rearing-technologies to the other host countries. This will set the next stage for our project where we will propose a subsequent two-year period to release these parasitoids. However, our first 2.5 years of work on this project, determining where the specific pest problems are the greatest, will have allowed us to determine the priority areas where these need to be released for the greatest level of impact.

- 6) The multiple nucleo-polyhedrosis viruses (*MaviMNPV*), useful in the control of *M. vitrata*, are also currently being tested in Benin at IITA (Dr. M. Tamo).
- 7) In places where triple bags for storage of cowpea (to prevent bruchid attack) are not available, and farmers still need to use pesticides in the storage of cowpeas, the use of the “green chemistry” spinosad can be used instead of the pyrethroid deltamethrin (Sanon *et al.*, in press). In places where triple bags are available, their use can be encouraged.

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 (*e.g.*, host plant resistance or parasitic wasps) 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, which will reduce the negative impacts that these insect pests have on cowpeas? (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? Also, as many traditional insecticides that are commonly used to control pests of cowpeas (*e.g.*, deltamethrin) can potentially be replaced by newer, “greener” (fewer negative impacts on humans and the environment), biopesticides there is a need to also determine opportunities to encourage farmers to use safer pesticide alternatives. Regardless if biological control, insect resistant varieties, or transgenic plants, limited pesticide sprays (or “greener chemistry” pesticides), or a combination of these approaches are ultimately used, this project will provide a scientific foundation for such strategies.

Planned Project Activities for October 1, 2009 - September 30, 2010

Objective 1: 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 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. Deploying IPM strategies first requires knowledge of when and where the pest populations are occurring (*i.e.*, which are the most important pests in a given region). Potential IPM control strategies, including the use of parasitoid wasps or the use of *MaviMNPV*, will require knowledge of the pest populations in the different regions where cowpea is grown. For example, in southern Burkina Faso our previous years’ data suggests a

robust *Maruca* population on wild alternative hosts in the off-season (Ba et al., submitted). Thus, in southern Burkina Faso, it is likely that parasitoids can be maintained in the wild in high numbers. The introduction of these biocontrol measures into other regions of Burkina Faso, northern Nigeria, and Niger will require a better understanding of the pest biology in order to maximize the success of such an approach. For example, where *Maruca* is strictly migratory, introducing the biocontrol agents in the regions where they migrate from may ultimately be a more effective use of resources.

Collaborators:

University of Illinois at Urbana Champaign (U.S.A.)

Dr. David Onstad

University of Western Ontario (Canada)

Dr. Jeremy McNeil

Institut de l'Environnement et des Recherches Agricole (Burkina Faso)

Dr. Drabo

International Institute of Tropical Agriculture (Benin)

Dr. M. Tamo

Approaches and Methods: Light trapping will occur throughout the 12 months at the existing locations: (i) in Niger; (ii) in Nigeria; and, (iii) in Burkina Faso. 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 molecular analysis (for polymorphisms). The aforementioned work will be the responsibility of the host country P.I.'s.

The molecular marker analyses will be continued by Dr. Weilin Sun, in Dr. Pittendrigh's laboratory, over the last 12 months of the project. We will also test other novel molecular strategies (e.g., polymorphisms in cDNA) to determine if these are appropriate approaches to address our questions of insect movement patterns. A female Nigerian graduate student at UIUC will assist Dr. Sun in this activity.

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. This will provide the basis for other IPM-based pest control strategies (e.g., *A. taragamae* or *MaviMNPV*) for both *Maruca* and other pest insects of cowpea (e.g., planting of KVx 908-1 to control pod-sucking bugs; release of parasitoids to control thrips).

Collaborators:

Purdue University (U.S.A.)

Dr. Larry L. Murdock. Dr. William Muir

University of Western Ontario (Canada)

Dr. Jeremy McNeil

International Institute of Tropical Agriculture (Benin)
Dr. Manuele Tamò

Approaches and Methods: We will complete one more field season of 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 working on the pests of cultivated cowpea. All experimental designs have been 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 2010. The KVx 908-1 strain will be included in these experiments (in Niger and northern Nigeria) to determine the impact on their pod-sucking bugs (both with and without neem treatment). These experiments (KVx 908-1 strain plus neem) have already been completed in Burkina Faso. Additionally, the KVx 908-1 (plus neem) treatment approach has already been incorporated into the farmer field schools in Burkina Faso. Farmers have been provided with seeds for their test plots such that they can make comparisons with traditional varieties. Data collection will occur upwards until the end of the 2010 budget cycle.

We will set the stage for limited releases of *A. taragamae* in Burkina Faso and Niger to determine their ability to propagate in *Maruca* populations. Additionally, we will also set the stage for limited releases of *C. femoratus* in Burkina Faso and Niger.

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.

Collaborators:

Purdue University (U.S.A.)
Dr. Larry L. Murdock, Dr. William Muir

University of Western Ontario (Canada)
Dr. Jeremy McNeil

Monsanto Company (U.S.A.)
Dr. Joe Huesing

Approaches and Methods: A standardized scouting plan will be established within the last 18-months of the project and will be used in the 2010 component 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 less 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 have already been performed in previous seasons. 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 and determine if there are *Maruca* hosts for the parasite *A. taragamae* in the off season.

Objective 4: Capacity Building. Increase capacity, effectiveness and sustainability of agriculture research institutions, in order to serve the bean and cowpea sectors in Burkina Faso, Niger, and northern Nigeria. We will perform degree and non-degree training in order to build institutional capacity. We will also perform farmer field schools in order to develop the capacity for the eventual deployment of novel pest control strategies. Within the current funding cycle the main goal is to train farmers in the basic biology of the insect pests. We will also include insect tolerant and resistant varieties in these farmer field schools, along with other biological control strategies (*e.g.*, parasitic wasps) where possible.

Approaches and Methods:

- 1) *Farmer Field School:* We will perform a minimum of two farmer field schools in each of the countries in the summer of 2009 (and 2010), including (where it is possible) an approximate 50%: 50% mix of men and women. Each farmer field school will have a minimum of 18-20 individuals. In previous farmer field schools the farmers have provided our host country collaborators with details on their pest problems. This information will be critical for our decisions to determine which control approaches are most needed in which region in the next proposed phase of this project. Based on the regional pest problems, local host country collaborators will help to create content for solar powered audio or video MP3 players that can be taken back to the village along with supporting materials (6 individuals will receive such players). Where feasible, the messages will also be supplied to another 6 villages by local radio stations. The third group will neither have radio station deployment nor MP3 players. Once these materials have been taken to the village, host-country collaborators will perform interviews in the villages (that have received the devices and those villages that have not received the devices) to determine if people have heard the messages and determine the knowledge level of the topic of those that have heard the messages in the village. We will seek human subjects research permission from UIUC to perform these tests before the summer of 2010. Depending on the feedback from the human subjects research panel, we may need to limit these tests to one country to obtain more focused and solid data. From the other countries we will obtain the messages that have been produced for further long-term testing beyond this stage of our CRSP project. We will work with groups on the UIUC campus that have expertise in performing the necessary surveys for such efforts. An equal number of men and women will participate in producing the messages and the same gender equity will occur in the three test groups.
- 2) *Non-degree training:* Within Africa, the H.C. P.I.s will interact with each other to provide training on insect biology as well as their respective experimental designs and outcomes.

This will also include exchanges of information regarding biological control strategies that we will begin to establish in the host countries in FY10.

- 3) *Degree Training:* Dr. Pittendrigh will have a female Nigerian graduate student in his laboratory in FY10 (Ph.D. program). She will continue her graduate studies throughout 2010. She will focus on issues associated with this project, including performing both molecular biology work and assisting in turning current datasets into manuscripts for submission to peer review journals.

Dr. Dabire will also continue to train a student through the University of Ouagadougou.

Degree Training:

UIUC student -- We currently have female applicant from Nigeria applying to enter UIUC during the 2010 budget cycle, under Dr. Pittendrigh's direction. The student will be funded from UIUC funds.

Trainee #1

First and Other Given Names: Tolulope
Last Name: Adeniran
Citizenship: Nigerian
Gender: Female
Degree Program for training: M.S./Ph.D.
Program Areas or Discipline: Entomology

Trainee #2

INERA student
First and Other Given Names: Traore
Last Name: Fousseni
Citizenship: Burkina Faso
Gender: Male
Degree Program for training: MS
Program Areas or Discipline: Life Sciences

Host Country Institution to Benefit from Training: For one student Burkina Faso and for the second student this is still to be determined

University to provide training: University of Ouagadougou and University of Illinois at Urbana-Champaign

If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID?
Yes.

The student will be directly funded by UIUC and thus will enter either through an F1 or university J1 VISA.

Supervising CRSP PI: Dr. Dabire in Burkina Faso and Dr. Pittendrigh at UIUC

Start Date: For the student in Burkina Faso training will occur in this budget cycle. For the student at UIUC, the date is to be determined based on admission and VISA considerations.

Projected Completion Date: The completion date will be beyond the scope of the currently funded project.

Type of CRSP Support (full, partial or indirect): Full support for the student in Burkina Faso. For the student at UIUC the funding will be 100% leveraged resources.

If providing Indirect Support, identify source(s) of leveraged funds

Endowment funds to Dr. Pittendrigh, Teaching Assistance support, general university funds, or a combination of the aforementioned funding sources.

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$6000

Indirect cost: \$900

U.S. or HC Institution to receive CRSP funding for training activity: INERA

Short-term Training:

Training #1

Type of Training: Farmer field Schools

Description of training activity: Farmer field schools will occur in four of the host countries (Note: Each host country collaborator will be responsible for this Training activity)

When will the activity occur: Summer 2010

Duration: 1-3 days

Location: Niger, Nigeria, Burkina Faso, and Mali

Who will benefit from this activity: Farmers and local production organizations

Number of Beneficiaries: 150

PI/Collaborator responsible for this Training Activity: Barry Pittendrigh

Training justification: The farmer field schools provide an opportunity to deploy new knowledge to farmers and for CRSP scientists to gain insights from farmers about pests of cowpeas.

Training #2

Type of Training: Farmer field Schools

Description of training activity: Farmer field schools will occur in four of the host countries (Note: Each host country collaborator will be responsible for this Training activity)

When will the activity occur: Summer 2010

Duration: 1-3 days

Location: Niger, Nigeria, Burkina Faso, and Mali

Who will benefit from this activity: Farmers and local production organizations

Number of Beneficiaries: 150

PI/Collaborator responsible for this Training Activity: Barry Pittendrigh

Training justification: The farmer field schools provide an opportunity to deploy new knowledge to farmers and for CRSP scientists to gain insights from farmers regarding cowpea pests.

Type of training: (1) Farmer field schools

Participants/Beneficiaries of Training Activity: Our overall network of African researchers

Anticipated numbers of Beneficiaries (male and female): 50:50

Amount Budgeted in Workplan

Direct cost: \$4,000

Indirect cost: \$500.00

If Leveraged Funding is to be used to Support this Training Activity, indicate the Source and Amount: N/A

Contribution of Project to Target USAID Performance Indicators

1. Two scientists will receive degree training activities during this budget cycle (one male and one female)
2. Over 50 female farmers and 50 male farmers will participate in farmer field schools in four host countries (including Niger, Nigeria, Burkina Faso, and Mali).
3. We are investigating three forms of biological control (i-ii), (iii) one host plant resistance strategy, and (iv) bio-pesticide insect control strategies.
4. These approaches will be useful at various stages of potential for transfer into the hands of host country researchers or farmers by the end of the 12-month FY10 cycle. In the case of bio-pesticides, such approaches can be used without regulatory approval. We are currently using insect resistant cowpeas in farmer field schools in Burkina Faso and will expand this to the other host countries.
5. We expect over 150 households will benefit directly from our farmer field school program.
6. We expect a minimum of two producers or community organizations per country benefiting from these activities with a minimum of 50% of these being women's organizations.
7. We expect a minimum of five HC partner organizations/institutions will benefit from these activities.
8. The number of additional hectares under improved technologies will be determined at the end of the 12-month budget cycle. It is difficult for us to predict *a priori* which technologies will be adopted at what level.

Target Outputs

- Better understanding of pest biology -- where/when they are a concern
- Networks for the development of IPM programs for pests of cowpea
- FFS will lay the foundation for the deployment of IPM programs
- Important information for the development of an IRM program for *Bt* cowpea
- Limited test release of bio-control agents and deployment host plant resistant variety in farmer field schools.
- Capacity building

Engagement of USAID Field Mission(s)

We will work with the Management Entity at MSU to determine opportunities to engage USAID field missions. Dr. Pittendrigh has already visited the field missions in Mali and Nigeria in order to determine the possibility of common interests and possible synergistic activities. Common interests were identified with the mission office in Mali. Dr. Pittendrigh's group will continue to interact with the mission office in Mali.

Networking Activities with Stakeholders

Our primary focus will be to work with farmer field schools. However, we will explore the possibility of interacting with other NGO organizations in the development and deployment of pest control strategies.

1. Dr. Pittendrigh will leverage funds from (i) his endowed chair position, (ii) general university funds provided to him, (iii) or both, at UIUC, to support a graduate student at UIUC.
2. Part of Dr. Pittendrigh's time at UIUC will be cost-shared.
3. Dr. Joe Huesing's (Monsanto Company) time will be donated to the project.
4. Where possible, Drs. Dabire, Baoua, and Ishiyaku will hold farmer field schools in conjunction with other NGOs in order to increase the impact of the current resources.

Leveraging of CRSP Resources

1. Dr. Pittendrigh will leverage funds from (i) his endowed chair position, (ii) general university funds provided to him, (iii) or both, at UIUC, to support a graduate student.
2. Part of Dr. Pittendrigh's time at UIUC will be cost-shared.
3. Dr. Joe Huesing's (Monsanto Company) time will be donated to the project.
4. Where possible, Drs. Dabire, Baoua, and Ishiyaku will hold farmer field schools in conjunction with other NGOs in order to increase the impact of the current resources.

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

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

Project Title:

Lead U.S. PI and University:

Host Country(s):

Output Indicators	2010 Target	2010 Actual
	(October 1 2009-Sept 30, 2010)	
Degree Training: Number of individuals enrolled in degree training		
Number of women	1	
Number of men	1	
Short-term Training: Number of individuals who received short-term training		
Number of women	>100	
Number of men	>100	
Technologies and Policies		
Number of technologies and management practices under research	4	
Number of technologies and management practices under field testing	4	
Number of technologies and management practices made available for transfer	4	
Number of policy studies undertaken	N/A	
Beneficiaries:		
Number of rural households benefiting directly	>150	
Number of agricultural firms/enterprises benefiting	N/A	
Number of producer and/or community-based organizations receiving technical assistance	10	
Number of women organizations receiving technical assistance	5	
Number of HC partner organizations/institutions benefiting	5	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	N/A	

Dry Grain Pulses CRSP (budget template 10/1/09-9/30/10)						
Project title						
	Third period (12 months) 10/01/09 - 09/30/10					
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name	UIUC		INERA	INRAN	IAR	
a. Personnel Cost						
Salaries	\$30,900.00		\$8,000.00	\$8,000.00	\$8,000.00	
Fringe Benefit	\$10,956.00		\$2,000.00	\$2,000.00	\$2,000.00	
b. Travel	\$6,246.00		\$3,000.00	\$3,000.00	\$3,000.00	
c. Equipment (\$5000 Plus)						
d. Supplies	\$7,827.00		\$4,000.00	\$4,000.00	\$4,000.00	
e. Training						
Degree			\$3,000.00			
Non-Degree			\$2,000.00	\$1,000.00	\$1,000.00	
f. Other			\$480.00	\$480.00	\$480.00	
g. Total Direct Cost	\$55,929.00	\$0.00	\$22,480.00	\$18,480.00	\$18,480.00	\$0.00
h. Indirect Cost	\$30,760.95		\$3,372.00	\$2,772.00	\$1,848.00	
i. Indirect Cost on Subcontracts (First \$25000)						
j. Total Indirect Cost	\$30,760.95	\$0.00	\$3,372.00	\$2,772.00	\$1,848.00	\$0.00
Total	\$86,689.95	\$0.00	\$25,852.00	\$21,252.00	\$20,328.00	\$0.00
Grand Total			\$154,121.95			
				Amount	Percentage	
				Total direct cost budgeted for U.S. institution(s)	\$55,929.00	48.50%
				Total direct cost budgeted for H.C institution(s)	\$59,440.00	51.50%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind Cash	\$43,790.00						\$ 43,790.00
Total	\$ 43,790.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 43,790.00
Attribution to IEHA Objectives							
Percentage of effort	50.00%		50.00%	50.00%	50.00%		50.00%
Amount corresponding to effort	\$43,344.98	\$0.00	\$12,926.00	\$10,626.00	\$10,164.00	\$0.00	\$77,060.98
Attribution to Capacity Building (Theme "D")							
Percentage of effort	50.00%		50.00%	50.00%	50.00%		50.00%
Amount corresponding to effort	\$43,344.98	\$0.00	\$12,926.00	\$10,626.00	\$10,164.00	\$0.00	\$77,060.98

Name of PI and Institution affiliation

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 – September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title:

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

Identity Benchmark Indicators by Objectives	Abbreviated name of institutions					
	Pittendrigh UIUC 4/1/10	Dabire INERA 9/30/10	Baoua INRAN 4/1/10	Ishiyaku IAR 9/30/10	Tamo IITA 4/1/10	N'Diaye IER 9/30/10
Objective 1 - Light Trapping and Molecular Marker work						
Run Existing light traps		X	X	X	X	X
ship Maruca samples to UIUC		X	X	X	X	X
Microsatellite/molecular work	X	X				
Pittendrigh visits collaborators		X				
Objective 2 - Insect Pests on Cultivated Cowpeas						
Share previous data		X	X	X	X	X
Planting		X	X	X	X	X
Data Recording		X	X	X	X	X
Data Sharing	X	X	X	X	X	X
Objective 3 - Survey of Wild Alternative host plants (in and off season)						
Scouting for Wild Alt Host Plts		X	X	X	X	X
Survey fields for insect pests		X	X	X	X	X
Objective 4 Farmer Field School and General Training						
Train in insect biology			X	X	X	X
IPM control techniques					X	X
Graduate student at UIUC	X	X				
Grad Student in BF			X	X		
Cross-institutional information exchange on IPM		X	X	X	X	X
MP3 players distributed to host countries & used	X		X	X	X	X
Name of the PI responsible for reporting on benchmarks	Dr. Pittendrigh	Dr. Dabire	Dr. Baoua	Dr. Ishiyaku	Dr. Tamo	Mr. N'Diaye
Signature/Initials:						
Date:	16-Mar-09	16-Mar-09	16-Mar-09	16-Mar-09	16-Mar-09	16-Mar-09

P1-UPR-1

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

Principal Investigator:

James Beaver, University of Puerto Rico, U.S.A.

Collaborating Host Country and U.S. PIs and Institutions:

Juan Carlos Rosas, EAP, Honduras	Timothy Porch, USDA-ARS, U.S.
António Chicapa Dovala, IIA, Angola	Emmanuel Prophete, CRDA, 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.

The development of improved bean varieties has proven to be an effective strategy to address biotic and abiotic factors that limit bean production in Central America and the Caribbean. During the past 10 years, however, only a limited number of black bean cultivars have been released in Latin America and the Caribbean. This is the result of a lower level of investment in black bean breeding and less emphasis in Central America on the testing and on-farm evaluation of advanced black bean breeding lines by national programs. As a consequence, black bean cultivars tend to have lower seed yield potential and less disease resistance than the most recently released small red bean cultivars. The most promising small red bean cultivars developed at Zamorano can be readily used to improve black beans. In fact, the lowland bean breeding project of the Bean/Cowpea CRSP initiated the development of black bean breeding lines and a sizeable number of breeding lines have already been distributed to bean research network members in Guatemala and Haiti. The bean research network supported by the Bean/Cowpea CRSP was a key element in the success of the cultivar development program in Central America. The Dry Grain Pulse CRSP project will emphasize field-testing of black bean breeding lines in Central American and Caribbean countries. The project will also complete the evaluation, release and dissemination of Andean (red mottled and light red kidney) bean lines that have resistance to BGYM, BCNM and rust.

The research project is in the position to make significant impacts in Central America, the Caribbean, and Angola. Many small red and black bean breeding lines with enhanced disease resistance and tolerance to abiotic stress are already in an advanced stage of development. There is an established network of bean researchers in Central America with a proven capability of testing, releasing and disseminating improved bean cultivars. The Dry Grain Pulse CRSP project will complement ongoing collaborative bean research in Central America. In addition, it will bring in partners from Haiti that will extend the potential impact of the collaborative research. The project will provide formal and informal training to Instituto de Investigacão Agronómica (IIA) researchers based on the critical experiences and successes in Central America and the Caribbean. The project also plans to improve Instituto de Investigacão Agronómica facilities and develop populations and bean breeding lines that will permit the Legume Program to develop improved bean cultivars for Angola.

Improved bean breeding lines developed by the Dry Grain Pulse CRSP bean breeding program in Central America and the Caribbean may be useful in some bean production regions of Africa, given the similarity in agroecological zones and production constraints. Some small red bean cultivars and breeding lines developed in Central America have resistance to diseases (BCNM, rust, angular leaf spot, and anthracnose) and tolerance to abiotic stresses (low soil fertility, drought and high temperature) that are important constraints to bean production in Africa. Because there is increased interest in Africa in bean production at lower altitudes, Central American bean breeding lines with resistance to common bacterial blight and web blight may be of particular value to northeastern Angola where small red beans are produced in hot and humid conditions. Although black beans are estimated to account for < 5% of bean production in Africa, this seed type is often a component of mixtures grown in low fertility soils. The lowland bean breeding team has also developed Andean (red mottled and light red kidney) bean breeding lines with resistance to BCNMV (bc3) and rust (Ur-11) that may be useful in Southern Africa.

Planned Project Activities for October 1, 2009 - September 30, 2010

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

Collaborators:

University of Puerto Rico(Puerto Rico)

James Beaver

USDA-ARS Tropical Agriculture Research Station (Puerto Rico)

Timothy Porch

Escuela Agrícola Panamericana-Zamorano (Honduras)

Juan Carlos Rosas

National Seed Program, Ministry of Agriculture (Haiti)

Emmanuel Prophete

Instituto de Investigacao Agronomica (Angola)

António Chicapa Dovala, António Francisco Castame

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 (IIA) 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. The project will make crosses to help initiate a breeding program in Angola. Juan Carlos Rosas and James Beaver plan to travel to Angola in August 2009. During the visit we will meet with Antonio Chicapa Dovala, António Francisco Castame, and other members of the IIA Legume Program to develop a strategy to release, multiply and disseminate seed of at least one improved bean variety before the end of the current period of funding.

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

Collaborators:

University of Puerto Rico(Puerto Rico)

James Beaver

USDA-ARS Tropical Agriculture Research Station (Puerto Rico)

Timothy Porch

Escuela Agrícola Panamericana-Zamorano (Honduras)

Juan Carlos Rosas

National Seed Program, Ministry of Agriculture (Haiti)

Emmanuel Prophete

Instituto de Investigacao Agronomica (Angola)

António Chicapa Dovala, António Francisco Castame

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 field site 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 F₃ and F₄ 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 F₄ generation for root rot resistance in a field maintained specifically for root rot screening and selection. The most promising F₅ 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.

Objective 3: Develop molecular markers for disease resistance genes.

Collaborators:

University of Puerto Rico(Puerto Rico)
James Beaver

USDA-ARS Tropical Agriculture Research Station (Puerto Rico)
Timothy Porch

Escuela Agrícola Panamericana-Zamorano (Honduras)
Juan Carlos Rosas

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, B386₉₀₀, has been reported to be linked in coupling with one of the resistance genes (*Mp-1*) whereas B459₁₆₀₀ was reported to be linked in repulsion with the other resistance gene (*Mp-2*). A recombinant inbred line population will be evaluated from a cross with BAT 477 to attempt to identify new molecular markers for the charcoal rot resistance genes using bulk segregant analysis (BSA). A RIL population was acquired from CIAT derived from the cross ‘DOR 364 x BAT 477’ and was evaluated at the Isabela Substation for reaction to charcoal rot. Lines resistant and susceptible to charcoal rot were selected. These lines will be used to identify putative markers for resistance to this disease using AFLP markers and bulk segregant analysis. Greenhouse screening techniques using inoculation with *Macrophomina* at germination and inoculation of stems with *Macrophomina* infested toothpicks are being optimized.

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.

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

Collaborators:

University of Puerto Rico(Puerto Rico)

James Beaver

Escuela Agrícola Panamericana-Zamorano (Honduras)

Juan Carlos Rosas

National Seed Program, Ministry of Agriculture (Haiti)

Emmanuel Prophete

Instituto de Investigacao Agronomica (Angola)

António Chicapa Dovala, António Francisco Castame

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.

Cowpea [*Vigna unguiculata* (L.) Walp] is 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.

Objective 5: Capacity Building

Increase the capacity, effectiveness and sustainability of agriculture research institutions that serve the bean and cowpea sectors in Central America, Haiti and Angola.

Collaborators:

University of Puerto Rico(Puerto Rico)

James Beaver

USDA-ARS Tropical Agriculture Research Station (Puerto Rico)

Timothy Porch

Escuela Agrícola Panamericana-Zamorano (Honduras)

Juan Carlos Rosas

National Seed Program, Ministry of Agriculture (Haiti)

Emmanuel Prophete

Instituto de Investigacao Agronomica (Angola)

António Chicapa Dovala, António Francisco Castame

University of California, Riverside (U.S.A.)

Jeff Ehlers, Phillip Roberts

Degree Training:*Trainee # 1*

First and Other Given Names: Monica

Last Name: Mmbui-Martins

Citizenship: Angolan

Gender: Female

Degree Program for Training: Masters

Program Areas or Discipline: Plant Breeding and Genetics

Host Country Institution to Benefit from Training: Angola

University to provide training: University of Puerto Rico

If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? –

No

Supervising CRSP PI: Tim Porch or James Beaver

Start Date: August 2009

Projected Completion Date: January 2012

Type of CRSP Support (full, partial or indirect): Partial

If providing Indirect Support, identify source(s) of leveraged funds

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$25,000

Indirect cost: None

U.S. or HC Institution to receive CRSP funding for training activity: The University of Puerto Rico

Trainee # 2

First and Other Given Names: Antonio

Last Name: Ndengoloka-David

Citizenship: Angolan

Gender: Male

Degree Program for Training: Masters

Program Areas or Discipline: Plant Breeding and Genetics

Host Country Institution to Benefit from Training: Angola

University to provide training: University of Puerto Rico

If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? –

No

Supervising CRSP PI: Tim Porch or James Beaver

Start Date: August 2009

Projected Completion Date: January 2012

Type of CRSP Support (full, partial or indirect): Partial

If providing Indirect Support, identify source(s) of leveraged funds

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$25,000

Indirect cost: None

U.S. or HC Institution to receive CRSP funding for training activity: The University of Puerto Rico

Trainee # 3

First and Other Given Names: TBD

Last Name: TBD

Citizenship: TBD

Gender: Female

Degree Program for training: B.S.

Program Areas or Discipline: Plant Science

Host Country Institution to Benefit from Training: TBD

University to provide training: Zamorano

If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? -

No

Supervising CRSP PI: Juan Carlos Rosas

Start Date: January 2009

Projected Completion Date: December 2009

Type of CRSP Support (full, partial or indirect): Partial

If providing Indirect Support, identify source(s)s of leveraged funds

Family support

Amount Budgeted in Workplan, if providing full or partial support:

Direct cost: \$ 4,000.00

Indirect cost: 0

U.S. or HC Institution to receive CRSP funding for training activity: Zamorano

Short-term Training:

Training activity # 1

Type of training: Informal training for seed production and storage on small farms

Emmanuel Prophete, Gasner Demosthene

Location: Haiti

Duration: One week

Scheduling of training activity: Winter months 2009-2010

Participants/Beneficiaries of Training Activity: Bean producers in Haiti

Anticipated numbers of Beneficiaries (male and female): 20 people

Amount Budgeted in Workplan

Direct cost: \$1,000

Indirect cost: \$0

If leveraged funding is to be used to Support this Training Activity, indicate the Source and Amount:

None

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 with 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 are 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 risks 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 to strengthen the capacity of the bean research programs in Central America, the Caribbean and Angola.

Target Outputs

The most important output of the proposed Dry Grain Pulse CRSP project is the release and dissemination of bean cultivars having enhanced levels of resistance to disease, pests and abiotic stress. The research team has a proven record of success. At present, more than 100,000 farmers in Central America plant small red bean cultivars developed by the Bean/Cowpea CRSP project. We propose to use a similar approach to develop, release and disseminate improved black bean varieties. Because promising black and red mottled bean lines are already in an advanced stage of development, it is likely that the project will demonstrate significant impact in Central America and the Caribbean during the first 30 months of funding from the Dry Grain Pulse CRSP through the dissemination and release of improved bean breeding lines. We expect to test and release at least one improved black bean in Central America. In Haiti, we expect to test and release one black and one red mottled cultivar. In El Salvador, Honduras and Nicaragua, we expect to release at least two new small red cultivars in collaboration with CIAT and national bean programs. In Puerto Rico, we expect to release improved light red kidney and white bean

cultivars. At the end of the first 30 months of funding, sufficient seed stocks of these cultivars will be produced to initiate on-farm testing of these cultivars throughout Central America and the Caribbean.

Research achievements in Angola are expected to be more modest. It should be possible, however, to identify potential sources of resistance to the principal biotic and abiotic constraints and to initiate the development of bean breeding populations. The project plans to conduct informal training activities that would strengthen bean research capabilities in Angola. At the end of the 30 month period of funding, bean research personnel in Angola should have sufficient experience and skills to continue to develop, test and release improved bean lines. In addition, a focus will be placed on the broad training of Masters Degree students at the University of Puerto Rico in the areas of plant breeding, plant pathology, and molecular methods. Upon their return to Angola, these personnel will be prepared to continue and expand the common bean and cowpea breeding programs.

The development and release of bean germplasm better adapted to low N soils would be of potential benefit throughout the Tropics where inputs such as fertilizer are beyond the means of many small-scale bean producers. Bean producers in the U.S. would also benefit from bean cultivars that have a lower requirement for N fertilizer. At the end of the 30 month period of funding, at least one bean germplasm line with greater adaptation to low N soils is expected to be released.

Molecular markers have become an important tool for bean breeders in developed countries. There is a need, however, to continue to develop molecular markers for genes of economic importance, particularly for traits that are needed for the improvement of beans for the Tropics. During the first 30 months of funding, the project would focus on the development of molecular markers for the putative dominant genes for resistance to charcoal rot. These molecular markers will improve the efficiency and effectiveness of selection for resistance to this disease and should contribute to the development of breeding lines having greater levels of resistance to terminal drought. A manuscript describing the protocol to use the molecular markers will be prepared for the Annual Report of the Bean Improvement Cooperative.

At least 30 Lima bean landraces will be collected from Puerto Rico and Haiti. Morphological, phenological and agronomic traits of the landraces will be collected at the Isabela Substation. Arrangements will be made to include the Lima bean landraces in the USDA and CIAT germplasm collections. Landraces with superior performance will be considered for release in Haiti and/or Puerto Rico.

Project personnel will collaborate with the Dry Grain Pulse CRSP cowpea breeding project in the evaluation of cowpea breeding lines in Haiti and Central America. A cowpea breeding line with superior performance will be considered for release as a cultivar.

Engagement of USAID Field Mission(s)

U.S. and Host Country Principal Investigators will maintain USAID Missions in Central America, Haiti and Angola informed of progress in achieving research and training objectives. Project personnel will meet with USAID Mission representatives during visits to the Host Countries to identify additional research and training activities that might lead to buy-ins.

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 20% 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.

Leveraging of CRSP Resources

The Dry Grain Pulse CRSP has access to mature bean breeding projects at the Escuela Agrícola Panamericana in Honduras and the University of Puerto Rico. Both breeding programs have alternative sources of funding that will indirectly benefit the research goals of the project. Promising bean breeding lines are already in an advanced stage of development that will enable the project to achieve significant impact in a short period. Ing. Emmanuel Prophete is the leader of the Ministry of Agriculture seed program in Haiti that will provide resources for the multiplication and distribution of bean cultivars developed by the proposed Dry Grain Pulse CRSP project. The EAP is an active participant in the Central American bean research network supported by IICA/COSUDE that provides a limited amount of resources for activities that complement proposed research and training activities. Dr. Rosas is a leader of a participatory

plant breeding program supported by the Norwegian Development Fund that funds bean research in Central America. Dr. Beaver plans to prepare a proposal to the USDA *Phaseolus* Crop Germplasm Committee to support the collection and evaluation of *P. lunatus* landraces from the Caribbean. Project personnel will attempt to obtain additional support for research and training activities from USAID Missions. For example, Dr. Rosas recently provided seed of a promising black bean cultivar to CIAT and USAID personnel in Haiti for seed multiplication and on-farm evaluation trials. The project will also seek opportunities for support or collaboration with NGO's and private companies.

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

PERFORMANCE INDICATORS
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 Angola.

Lead U.S. PI and University: James Beaver / Univ. of Puerto Rico

Host Country(s): Angola

Output Indicators	2010 Target	2010 Actual
	(October 1 2009-Sept 30, 2010)	
Degree Training: Number of individuals enrolled in degree training		
Number of women	1	
Number of men	1	
Short-term Training: Number of individuals who received short-term training		
Number of women	6	
Number of men	6	
Technologies and Policies:		
Number of technologies and management practices under research	3	
Number of technologies and management practices under field testing	1	
Number of technologies and management practices made available for transfer	1	
Number of policy studies undertaken		
Beneficiaries:		
Number of rural households benefiting directly	100	
Number of agricultural firms/enterprises benefiting	2	
Number of producer and/or community-based organizations receiving technical assistance	2	
Number of women organizations receiving technical assistance	1	
Number of HC partner organizations/institutions benefiting	2	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	50	

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

PERFORMANCE INDICATORS
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 Angola.

Lead U.S. PI and University: James Beaver / Univ. of Puerto Rico

Host Country(s): Central America and Haiti

Output Indicators	2010 Target	2010 Actual
	(October 1 2009-Sept 30, 2010)	
Degree Training: Number of individuals enrolled in degree training		
Number of women		
Number of men		
Short-term Training: Number of individuals who received short-term training		
Number of women	12	
Number of men	12	
Technologies and Policies		
Number of technologies and management practices under research	20	
Number of technologies and management practices under field testing	10	
Number of technologies and management practices made available for transfer	5	
Number of policy studies undertaken		
Beneficiaries:		
Number of rural households benefiting directly	2000	
Number of agricultural firms/enterprises benefiting	2	
Number of producer and/or community-based organizations receiving technical assistance	10	
Number of women organizations receiving technical assistance	2	
Number of HC partner organizations/institutions benefiting	3	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	10000	

Dry Grain Pulses CRSP : THIRD PERIOD

Development, testing and dissemination of genetically improved bean cultivars for Central America, the Caribbean and Angola.

	Third period (12 months) 10/01/09 - 09/30/10					
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name	UPR	0	USDA-ARS	EAP	Haiti	Angola
a. Personnel Cost						
Salaries	\$11,250.00		\$18,000.00	\$18,000.00	\$7,200.00	\$1,500.00
Fringe Benefit	\$3,750.00		\$3,600.00	\$3,600.00	\$2,400.00	\$500.00
b. Travel	\$6,000.00	\$0.00	\$9,500.00	\$4,000.00	\$2,000.00	\$5,000.00
c. Equipment (\$5000 Plus)			\$0.00	\$0.00	\$0.00	\$0.00
d. Supplies	\$5,000.00		\$3,900.00	\$8,000.00	\$3,234.00	\$4,659.00
e. Training						
Degree	\$0.00	\$20,000.00	\$0.00	\$3,000.00	\$0.00	\$0.00
Non-Degree	\$0.00		\$0.00	\$3,330.00	\$1,000.00	\$2,000.00
f. Other		\$0.00	\$0.00	\$10,000.00	\$0.00	
g. Total Direct Cost	\$26,000.00	\$20,000.00	\$35,000.00	\$49,930.00	\$15,834.00	\$13,659.00
h. Indirect Cost						
i. Indirect Cost on Subcontracts (First \$25000)	\$6,500.00		\$0.00	\$8,820.00		\$0.00
j. Total Indirect Cost	\$6,500.00	\$0.00	\$0.00	\$8,820.00	\$1,166.00	\$1,341.00
Total	\$32,500.00	\$20,000.00	\$35,000.00	\$58,750.00	\$17,000.00	\$15,000.00
Grand Total				\$178,250.00		

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	\$58,500.00	35.69%
Total direct cost budgeted for H.C institution(s)	\$105,400.00	64.31%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind							
Cash	\$24,412.00			\$45,000.00			\$ 69,412.00
	\$0.00			\$10,700.00			\$ 10,700.00
Total	\$ 24,412.00		\$ -	\$ 55,700.00	\$ -	\$ -	\$ 80,112.00
Attribution to IEHA Objectives							
Percentage of effort	10.00%		100.00%	20.00%		100.00%	36.47%
Amount corresponding to effort	\$3,250.00	\$0.00	\$35,000.00	\$11,750.00	\$0.00	\$15,000.00	\$65,000.00
Attribution to Capacity Building (Theme "D")							
Percentage of effort	25.00%		25.00%	50.00%		50.00%	30.15%
Amount corresponding to effort	\$8,125.00	\$0.00	\$8,750.00	\$29,375.00	\$0.00	\$7,500.00	\$53,750.00

Name of PI & Institutional Affiliation: James S. Beaver, Dept. of Agron. and Soils, Univ. of Puerto Rico, Mayaguez, PR 00681-9030

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 – September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

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

Identify Benchmark Indicators by Objectives:	Abbreviated name of institutions									
	UPR	USDA	EAP	IIA	Haiti					
	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10	4/1/10	9/30/10

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

Germplasm acquired for key abiotic and biotic stress factors										
Germplasm tested	X		X		X		X		X	
Breeding populations developed	X	X	X	X	X	X	X	X	X	
Breeding populations tested	X	X	X	X	X	X	X	X	X	
Advanced lines tested	X		X		X		X		X	
Varieties released		X		X					X	
Seed multiplied & disseminated		X		X					X	

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

Completion of one cycle of recurrent selection for adaptation to low soil N	X			X						
Testing of advanced lines	X	X			X	X		X	X	
Release of a germplasm line with better adaptation to low N soil		X			X					

Objective 3: Develop molecular markers for disease resistance genes.

Development of molecular markers for ashy stem blight resistance genes		X	X							

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

Lima bean landrace collection completed		X							X	
Characterize the phenological, morphological, and agronomic traits of <i>P. lunatus</i> (Haiti, PR)			X							
Evaluation of cowpea breeding lines in Haiti and Central America for adaptation and disease and abiotic stress resistance			X						X	

Objective 5: Increase the capacity, effectiveness and sustainability of agricultural research institutions that serve the bean and cowpea sectors in Central America, Haiti and Angola

M.S. Training of Antonio David will have been initiated	X									
M.S. Training of Monica Mmbua will have been initiated	X									
B.S. degree training of a student at Zamorano					X					
Workshop on Bean Seed production techniques in Haiti										X

Name of the PI responsible for reporting on benchmarks	James Beaver	Tim Poch	Juan Carlos Rosas	Antonio Chicape	Emmanuel Prophete					
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Signature/Initials:

Date:
