**P1-UPR-1**

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

**Lead U.S. Principle Investigator and University:**
James Beaver, UPR, U.S.

**Collaborating Host Country and U.S. PIs and Institutions:**
Juan Carlos Rosas, EAP, Honduras
António Chicapa Dovala, IIA, Angola
Timothy Porch, USDA-ARS, U.S.
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 Investigação Agronómica (IIA) researchers based on the critical experiences and successes in Central America and the Caribbean. The project also plans to improve Instituto
de Investigação 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:**
James Beaver, University of Puerto Rico  
Timothy Porch, USDA-ARS Tropical Agriculture Research Station, Mayaguez  
Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras  
Emmanuel Prophete, National Seed Program, Ministry of Agriculture, Haiti  
António Chicapa Dovala and António Francisco Castame, Instituto de Investigação Agronomica (IIA), Angola

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

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

The project will initiate collaborative research with Mr. Antonio Chicapa Dovala, Head of the Legume Program of the Instituto de Investigacão Agronómica (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:**
James Beaver, University of Puerto Rico
Timothy Porch, USDA-ARS Tropical Agriculture Research Station, Mayaguez
Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras
Emmanuel Prophete, National Seed Program, Ministry of Agriculture, Haiti
António Chicapa Dovala and António Francisco Castame, Instituto de Investigacão Agronomica (IIA), Angola

**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:**
James Beaver, University of Puerto Rico
Timothy Porch, USDA-ARS Tropical Agriculture Research Station, Mayaguez
Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras

**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 B45₉₆₀ 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:**
James Beaver, University of Puerto Rico  
Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras  
Emmanuel Prophete, National Seed Program, Ministry of Agriculture, Haiti  
António Chicapa Dovala and António Francisco Castame, Instituto de Investigacao Agronomica (IIA), Angola

**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:**
James Beaver, University of Puerto Rico  
Timothy Porch, USDA-ARS Tropical Agriculture Research Station, Mayaguez  
Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras
Emmanuel Prophete, National Seed Program, Ministry of Agriculture, Haiti
António Chicapa Dovala and António Francisco Castame, IIA, Angola
Jeff Ehlers, University of California, Riverside, California
Phillip Roberts, University of California, Riverside, California

**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) 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 Augustinho 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.
## Performance Indicators

**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

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<th>Output Indicators</th>
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<th>2010 Actual</th>
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Dry Grain Pulses CRSP

FY10 Workplans DRAFT

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

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<th>2010 Actual</th>
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<td>(October 1, 2009-Sept 30, 2010)</td>
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<td>Number of women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term Training: Number of individuals who received short-term training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of women</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Number of men</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Technologies and Policies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of technologies and management practices under research</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Number of technologies and management practices under field testing</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Number of technologies and management practices made available for transfer</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of policy studies undertaken</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beneficiaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of rural households benefiting directly</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Number of agricultural firms/enterprises benefiting</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Number of producer and/or community-based organizations receiving technical assistance</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Number of women organizations receiving technical assistance</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Number of HC partner organizations/institutions benefiting</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Developmental outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of additional hectares under improved technologies or management practices</td>
<td>10000</td>
<td></td>
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</table>
## 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 - 08/30/10

<table>
<thead>
<tr>
<th>Institution Name</th>
<th>U.S. Institution</th>
<th>U.S. for Host Country</th>
<th>HC or U.S. Institution (1)</th>
<th>HC or U.S. Institution (2)</th>
<th>HC or U.S. Institution (3)</th>
<th>HC or U.S. Institution (4)</th>
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<tbody>
<tr>
<td></td>
<td>UPR</td>
<td>0</td>
<td>USDA-ARS</td>
<td>EAP</td>
<td>Haiti</td>
<td>Angola</td>
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<tr>
<td>a. Personnel Cost</td>
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<td></td>
<td></td>
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<tr>
<td>Salaries</td>
<td>$11,250.00</td>
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<td>$18,000.00</td>
<td>$18,000.00</td>
<td>$7,200.00</td>
<td>$1,500.00</td>
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<tr>
<td>Fringe Benefits</td>
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<td>$3,600.00</td>
<td>$3,600.00</td>
<td>$2,400.00</td>
<td>$500.00</td>
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<tr>
<td>b. Travel</td>
<td>$6,000.00</td>
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<td>$9,500.00</td>
<td>$4,000.00</td>
<td>$2,000.00</td>
<td>$5,000.00</td>
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<tr>
<td>c. Equipment ($5000 Plus)</td>
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<td></td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td>d. Supplies</td>
<td>$5,000.00</td>
<td></td>
<td>$3,900.00</td>
<td>$8,000.00</td>
<td>$3,234.00</td>
<td>$4,659.00</td>
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<tr>
<td>e. Training</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Degree</td>
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<td></td>
<td>$3,000.00</td>
<td>$0.00</td>
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<tr>
<td>Non-Degree</td>
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<td>$3,330.00</td>
<td>$1,000.00</td>
<td>$2,000.00</td>
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<tr>
<td>f. Other</td>
<td>$0.00</td>
<td></td>
<td>$10,000.00</td>
<td>$0.00</td>
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<tr>
<td>g. Total Direct Cost</td>
<td>$26,000.00</td>
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<td>$35,000.00</td>
<td>$49,930.00</td>
<td>$15,834.00</td>
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<tr>
<td>h. Indirect Cost</td>
<td>$6,500.00</td>
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<td>$8,820.00</td>
<td>$1,166.00</td>
<td>$1,341.00</td>
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<tr>
<td>l. Indirect Cost on Subcontracts (First $25000)</td>
<td>$6,500.00</td>
<td></td>
<td>$8,820.00</td>
<td>$1,166.00</td>
<td>$1,341.00</td>
<td>$0.00</td>
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<tr>
<td>j. Total Indirect Cost</td>
<td>$6,500.00</td>
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<td>$8,820.00</td>
<td>$1,166.00</td>
<td>$1,341.00</td>
<td>$0.00</td>
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<tr>
<td>Total</td>
<td>$32,500.00</td>
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<td>$43,820.00</td>
<td>$51,096.00</td>
<td>$17,000.00</td>
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<td>Grand Total</td>
<td>$178,250.00</td>
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**Cost Share**

<table>
<thead>
<tr>
<th>U.S. Institution</th>
<th>U.S. for Host Country</th>
<th>HC or U.S. Institution (1)</th>
<th>HC or U.S. Institution (2)</th>
<th>HC or U.S. Institution (3)</th>
<th>HC or U.S. Institution (4)</th>
<th>Total</th>
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<tbody>
<tr>
<td>In-kind</td>
<td>$24,412.00</td>
<td>$45,000.00</td>
<td>$10,700.00</td>
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<tr>
<td>Cash</td>
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<td>$10,700.00</td>
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<td>$10,700.00</td>
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<tr>
<td>Total</td>
<td>$24,412.00</td>
<td>$55,700.00</td>
<td>$10,700.00</td>
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<td></td>
<td>$81,112.00</td>
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**Attribution to IEHA Objectives**

<table>
<thead>
<tr>
<th>Percentage of effort</th>
<th>10.00%</th>
<th>100.00%</th>
<th>20.00%</th>
<th>100.00%</th>
<th>38.47%</th>
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</thead>
<tbody>
<tr>
<td>Amount corresponding to effort</td>
<td>$3,250.00</td>
<td>$35,000.00</td>
<td>$11,750.00</td>
<td>$0.00</td>
<td>$65,000.00</td>
</tr>
</tbody>
</table>

**Attribution to Capacity Building (Theme “D”)**

<table>
<thead>
<tr>
<th>Percentage of effort</th>
<th>25.00%</th>
<th>25.00%</th>
<th>50.00%</th>
<th>50.00%</th>
<th>30.16%</th>
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</thead>
<tbody>
<tr>
<td>Amount corresponding to effort</td>
<td>$8,125.00</td>
<td>$8,750.00</td>
<td>$29,375.00</td>
<td>$0.00</td>
<td>$53,750.00</td>
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</tbody>
</table>

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

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## 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

<table>
<thead>
<tr>
<th>Identify Benchmark</th>
<th>Abbreviated name of institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators by Objectives</td>
<td>UPR USDA EAP IIA Haiti</td>
</tr>
<tr>
<td>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</td>
<td></td>
</tr>
</tbody>
</table>

### 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 X X
- Breeding populations developed: 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 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 N soil: X X
- Developing advanced lines: X X X
- Release of a germplasm line with better adaptation to low N soil: X

### Objective 3: Develop molecular markers for disease resistance genes

- Development of molecular markers for ashy stem blight resistance: X X

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

- Lima bean landrace collection completed: X
- Characterize the phenological, morphological, and agronomic traits of P. lunatus (Haiti, PR): X
- Evaluation of cowpea breeding lines in Haiti and Central America for adaptation and disease and abiotic stress resistance: X 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 Mibube 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 Porch
- Juan Carlos Rosas
- Antonio Chicope
- Emmanuel Prophet

### Signature/Initials:

Date: ___________________________

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