LEGUME INNOVATION LAB FOR COLLABORATIVE RESEARCH ON GRAIN LEGUMES

FY 2013 – 2014 WORKPLAN

S01.A3 Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

Lead U.S. Principal Investigator
James D. Kelly, MSU, East Lansing, MI

Collaborating Scientists
Wayne Loescher, Dept. Horticulture, MSU
James Steadman, Carlos Urrea, - University of Nebraska, Lincoln and Scottsbluff
Eduardo Peralta – INIAP, Ecuador
Stanley Nkalubo – NaCCRI, Uganda
Kennedy Muimui – ZARI, Zambia
Karen Cichy, USDA-ARS, East Lansing, MI

I. Project Problem Statement and Justification:

Beans are the second most important food legume crop after ground nuts in Zambia and are a major source of income and cheap protein for many Zambians. Most of the bean crop (62%) is produced on 60,000 ha in the higher altitudes, cooler and high rainfall zones of the northern part of Zambia. Andean beans are predominant and land races are the most widely grown although a few improved cultivars are also grown as sole crops or in association mainly with maize. Bean production is constrained by several abiotic and biotic stresses that include diseases, pests, low soil fertility and drought. All the popular local landraces in Zambia are highly susceptible to pests and diseases that severely limit their productivity. This is reflected in the very low national yields ranging from 300 to 500 kg/ha that result in annual deficit of 5,000MT. To avert future food shortages and feed the growing population of 13M, there is critical need for increasing the productivity of most food crops including beans. Zambia ranks 164 out of 184 countries in the Human Poverty Index.

Ecuador has the only active Andean bean breeding program and past advances made in combining different disease resistances in bush beans need to be transferred to the climbing beans that play a vital role in the farming system and livelihood of small producers, second only to maize in importance. The traditional intercropping system with maize predominates in Ecuador where 90% of the beans are grown in the highlands on landholdings that vary in size from 0.2 to 50 ha. Climbing beans are cultivated mainly in association with maize and partly under trellis systems. The area cultivated with climbing beans has fluctuated annually, but is currently estimated at 97,000 ha. It is estimated that 90% of the area is planted with landrace or local varieties and the majority are susceptible to foliar diseases such as rust, anthracnose (ANT), angular leaf spot (ALS), and Bean Common Mosaic Virus (BCMV), and seed borne diseases are particularly problematic. Improvements in climbing beans can easily be transferred to many African countries that grow similar seed types.

Beans are an important crop in Uganda and are grown on over 660,000 ha of land and consumed throughout the country. Beans are a major source of food and income for the rural smallholder farmers especially the women and children. As a non-traditional agricultural export crop, beans have gained a major dominance in terms of tonnage and monetary value among Uganda's exports. That beans are produced in every district illustrates the dependence on beans as a major food security crop and their importance in farmers' household incomes. The crop is ranked fourth in terms of export volume and eighth in terms of export value. The crop is also the most important source of protein for the Ugandan population providing 45% of the total human dietary protein and plays a significant role in ensuring food security. Beans provide a cheap source of protein to most vulnerable groups such as children below five years, pregnant mothers and AIDS patients. The majority of bean production in Uganda is dependent mainly on the use of inferior landrace varieties which are generally low yielding due to susceptibility to the major biotic (ALS, ANT, root rots, BCMV) and abiotic (drought, low soil fertility) stresses. These stresses gravely undermine the potential of the bean as a food security crop, a source of income, and as a main source of dietary protein for the majority of Ugandans.

Drought affects 60% of global bean production and the severity of yield reduction depends on the timing, extent, and duration of the drought stress. The presence of other stresses such as high temperature, root diseases, shallow infertile soils and climate change all contribute to intensify the problem. Improvements in current understanding of the physiology of drought and evapo-transpiration and the genetics of drought tolerance in common bean and the development of effective molecular and quantitative methods for the selection of drought tolerance are therefore needed. The development of improved varieties and germplasm with high yield potential, healthy root systems, improved BNF with resistance to multiple diseases, and sustained or improved water use efficiency under limited soil water conditions are needed to increase profit margins, lower production costs. The project will use QTL analysis and SNP-based genome-wide association mapping to uncover regions associated with drought tolerance, disease resistance, enhanced BNF and faster cooking time. 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.

II. Planned Project Activities for FY 2013-14

Objective 1: Integrate traditional and marker-assisted selection (MAS) approaches to combine resistances to economically important foliar diseases, drought and improved biological nitrogen fixation (BNF) and assess acceptability of fast cooking, high mineral content in a range of large-seeded, high-yielding Andean bean germplasm for the Eastern Africa highlands (Zambia and Uganda), Ecuador and U.S.

Collaborators
Jim Steadman, Carlos Urrea, - Nebraska
Eduardo Peralta - Ecuador
Stanley Nkalubo - Uganda
Kennedy Muimui – Zambia
Karen Cichy, USDA-ARS, Michigan

Approaches and Methods

1. Assemble a common nursery across participating countries of about 80 lines considering the differential information for ANT, ALS, CBB, and rust. Collaboration with S01.A4 will be explored.
2. Assemble a drought nursery of 60 lines and develop the drought screening protocol to be used. Collaboration with S01.A4 will be explored.
3. Seed increase in each country. Each participant country will receive 100 seeds of each line and increase them.
4. Screen the disease nursery to different pathogens in greenhouse in Zambia. The races to be used will be determined from objective 2.
5. Initiate selection for disease resistance under screenhouse inoculation condition in Zambia.
6. Screen the disease nursery to different pathogens in greenhouse in Uganda. The races to be used will be determined from objective 2.
7. Initiate selection for disease resistance under screenhouse inoculation condition in Uganda.
8. Ecuador will screen elite lines/cultivars to ALS, ANT, CBB, and rust in greenhouse facilities.
9. Screen the disease nursery to CBB in North Platte, NE.
10. Screen a subset of the Andean panel and Andean Bean-CAP lines to terminal drought in Scottsbluff, NE. 06/13-08/13.
11. Screen the drought nursery in Zambia to intermittent drought stress.
12. Screen the drought nursery in Uganda to intermittent drought stress.
13. Screen the drought nursery in Michigan to intermittent drought stress.
14. Screen the drought nursery in Ecuador to terminal drought stress.
15. Screen the drought nursery in Nebraska to terminal drought stress.
16. Cross sources of resistance for angular leaf spot (ALS), rust, anthracnose, common bacterial blight, and drought tolerance into large seeded lines with contrasting colors in Ecuador, Uganda, Zambia, Nebraska and Michigan.
17. Few selected climbers in each country will be crossed to sources for ALS, ANT, CBB, and rust resistance.
18. Use of markers identified in objective 3 to make selections in each country
19. Increase seed of the BNF RILs in Ecuador.
20. Evaluate BNF RIL population (Puebla/Zorro) in Ecuador in low N soils.
21. Screen Andean lines for cooking time using a pin drop (Mattson cooker) method.
22. Canning of advanced Andean lines in Ecuador.
23. Evaluation of Andean elite lines for micronutrient bioavailability in MI and NE.
24. Conduct sensory evaluation of elite lines with superior cooking time and mineral bioavailablity in Michigan, Uganda, and Zambia.
25. Identify non destructive, high throughput methods to measure cooking time and seed chemical composition.
26. Cross lines with superior disease resistance to those with shorter cooking time and high mineral bioavailability.

Objective 2: Characterize pathogenic and genetic variability of isolates of foliar pathogens collected in Uganda, Zambia and Ecuador and identify sources of resistance to angular leaf spot (ALS), anthracnose (ANT), common bacterial blight (CBB), bean common mosaic virus (BCMV) and bean rust present in Andean germplasm.

Collaborators

Jim Steadman, Carlos Urrea - Nebraska
Eduardo Peralta - Ecuador
Stanley Nkalubo - Uganda
Kennedy Muimui – Zambia

Approaches and Methods

1. Initiate the collection of isolates of ANT, ALS, CBB, and Rust in different bean production regions of Zambia.
2. Initiate the collection of isolates of ANT, ALS, CBB, and Rust in different production regions of Uganda.
3. Continue the collection of isolates of ANT, ALS, CBB, and Rust in Ecuador from diverse agro-ecological zones for race typing and compile a data base of all previously characterized pathogenic races for publication.
4. Increase seed of the differentials for ANT, ALS and rust in Zambia and Uganda
5. Race characterization of ANT, ALS and Rust in Zambia.
6. Race characterization of ANT, ALS and Rust in Uganda.
7. Update race characterization of same pathogens from different regions in Ecuador.
8. Utilize the mobile nursery protocol to determine the effectiveness or rust resistance genes in genotypes.
9. Leverage the NIFA nurseries and collect information on foliar pathogens on the ADP and UNL drought tolerant germplasm nurseries for reaction to different foliar pathogens on surviving lines in Zambia and Uganda.
10. Ship to and increase seed of ADP and UNL nurseries in Ecuador.
11. Follow up with evaluation of the two nurseries for reaction to foliar pathogens in Ecuador.
12. Select the most informative genotypes for each country/location to include in future mobile nursery evaluations in individual countries and /or locations.
13. Increase seed of these selected genotypes for inclusion in the mobile nursery.
14. Choose the most relevant races of ANT, ALS and rust and strains of CBB for screening breeding nurseries in Zambia.
15. Choose the most relevant races of ANT, ALS and rust and strains of CBB for screening breeding nurseries in Uganda.
16. Choose the most relevant races of ANT, ALS and rust for screening breeding nurseries in Ecuador.
17. Partner with S01.A4 project to characterize isolates of web blight in different host countries to use in search for an improved screening method for resistance. The only current control methods are use of chemicals, so alternative control methods are needed.
18. The project will actively collaborate with MSU and UNL NIFA projects in Zambia and Uganda and with the S01.A4 project to address issues with a variety of pathogens that are not being directly addressed in current workplan.
19. Seed health will be addressed in the second phase in different countries.

Objective 3: Use single nucleotide polymorphism (SNP)-based genome-wide association mapping to uncover regions associated with drought tolerance, disease resistance, cooking time and BNF to identify QTLs for use in MAS to improve Andean germplasm.

Collaborators

Jim Steadman, Carlos Urrea, - Nebraska
Eduardo Peralta - Ecuador
Stanley Nkalubo - Uganda
Kennedy Muimui – Zambia
Karen Cichy, Michigan
Kelvin Kamfwa, Michigan

Approaches and Methods

1. Conduct Association Mapping (AM) of the Andean Diversity Panel (ADP) for improved BNF on nurseries grown in MI and Zambia using 6K SNP chip from BeanCAP project.
2. Conduct field phenotypic evaluation of the ADP for BNF in Zambia.
3. Conduct greenhouse phenotypic evaluation of the ADP for BNF at MSU.
4. Develop populations of RILs for linkage mapping of BNF.
5. Conduct greenhouse phenotypic evaluation of RIL populations for BNF at MSU.
6. Collect DNA from RIL populations.
7. Genotype RIL populations using 6K SNP Chip from BeanCAP project.
8. Conduct Association Mapping of the ADP for improved mineral bioavailability on nurseries grown in MI and Zambia using 6K SNP chip from BeanCAP project.
9. Develop tightly linked SNP markers for major anthracnose resistance genes in collaboration with S01.A4 project that will develop markers for other resistance genes.
10. Sequence information from the bean genome will be used to focus on specific genomic regions where major anthracnose resistance genes have been mapped -MSU.
11. Phenotypic evaluation of specific mapping populations will be conducted in Ecuador for anthracnose and the DNA shipped to MSU to genotype and identify tightly linked markers.
12. Bean bioinformatic sources such as Bean Genes at UCD will be used as sources to identify new sequence based markers that are located near major resistance genes for mapping in populations segregating for major foliar pathogens.
13. Emphasis will be given to identify agarose based markers that could be implemented in country in addition to using SNP based markers.
14. The program will access current published information on improved markers for ALS that has been developed by colleagues in Brazil for use in MAS in Uganda and Ecuador.
15. Panelists will be asked to rate the sensory characteristics of the beans with respect to appearance, color, flavor, mouthfeel, and overall likeability using a hedonic scale of 1-7 with 1 being highly undesirable and 7 being highly desirable.
16. The lines with the highest likeability will be grown in on farm trials and will be evaluated for farmer acceptability based on agronomic and cooking characteristics.

Objective 4: Develop phenometric approaches to improving the efficiencies of breeding for abiotic stress tolerance, especially drought

Collaborators

Wayne Loescher, Coordinator Obj 4, MSU
Carlos Urrea - Nebraska
David Kramer, Jim Kelly – MSU
Eduardo Peralta - Ecuador
Stanley Nkalubo - Uganda
Kennedy Muimui – Zambia
Idupulapati Rao – CIAT

Approaches and Methods:

We will extensively rely on new instrumentation and techniques now available at MSU (at the Center for Advanced Algal and Plant Phenometrics). These allow exposing lines of plants to a set of distinct dynamic environmental conditions that mimic those experienced under realistic field conditions, or allow sophisticated experimental manipulations. These also allow non-destructive and continuing measurements of photosynthetic properties (e.g., gas exchange and chlorophyll fluorescence), growth and plant architecture, and more detailed measurements of photosynthesis. These will contribute to identifying new traits based on relationships between genotype and drought and heat responses.

Initially for Stage 1 of this project, we will:
1. Assemble selected sets of physiologically contrasting genotypes from breeders (e.g., Urrea, Kelly, and Peralta).
2. Conduct initial phenometric measurements and evaluations of contrasting genotypes (e.g., Loescher, Kramer).
3. Identify differences among genotypes with contrasting responses to high light and high temperature stresses.
4. Extend methodology to include drought stress.

Objective 5: Institutional Capacity Building

MSU Doctoral student, Kelvin Kamfwa in plant breeding, genetics and biotechnology will conduct field research on BNF on genetic population(s) in Michigan and Zambia. A second doctoral student Grady Zuiderveen from the US will be involved in SNP marker development. In addition short-term trainings for collaborators in host countries will be designed to assist them to undertake the implementation of the project objectives and activities using the latest technologies that are existing at MSU and Nebraska. Also training will be provided by in country collaborators to graduate students, technicians on the use of new screening techniques in drought and diseases. Where applicable, extension staff and users (farmers) will be trained on the use of the new technologies developed.

1. Provide short-term training in the areas of bioinformatics, use and management of SNPs for PIs of participating countries (Uganda, Zambia and Ecuador).

2. Provide short term training in the use of various drought and diseases screening methods for PIs of participating countries and institutions personnel (technicians) and where applicable extension staff and users (farmers) in Uganda and Zambia.
3. Provide short term training of graduate students, collaborators, and visiting scientists on phenometrics at MSU.

III. Contribution of Project to USAID Feed the Future Performance Indicators: The "Performance Indicators – Targets" forms for each country have been completed for the project for FY 2013, 2014 and 2015 following FTF guidelines. One student is currently in doctoral degree training, and plans exist for short term training for other 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 Ecuador, Uganda and Zambia.

Target Outputs

1. The development and release of locally adapted, acceptable, drought and disease resistant bean cultivars for the major production regions in Ecuador, Uganda, Zambia and Michigan.

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 genomic and phenomic research methods on drought stress, major foliar diseases, enhanced fixation and nutritional quality will further improve bean productivity, long-term land management, and environmental risk, thus contributing to sustainability of bean production and agricultural communities and improved dietary patterns.

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 Ecuador, Uganda and Zambia.

IV. Outputs:

- Training of 6 staff (4 male and 2 female) at ZARI in disease and pest identification
- Seed of different nurseries increased in Zambia
- Angular Leaf Spot Nursery evaluated and source of resistance identified in sites in Zambia
- Common Bacterial Blight Nursery evaluated and source of resistance identified in sites in Zambia
- Anthracnose Nursery evaluated and source of resistance identified in sites in Zambia

- Rust Nursery evaluated and source of resistance identified in sites in Zambia
- Isolates of ANT, ALS, CBB, and Rust collected from different bean production regions of Zambia.
- Initiate crossing of landraces with resistant sources of ALS, ANT, CBB, and Rust in Zambia
- At least five nurseries assembled for drought, ANT, ALS, CBB, and rust
- Drought nursery established, evaluated and contrasting drought tolerant lines identified
- Anthracnose Nursery established, evaluated and source of resistance identified
- Angular Leaf Spot Nursery established, evaluated and source of resistance identified
- Common Bacterial Blight Nursery established, evaluated and source of resistance identified
- Rust Nursery established, evaluated and source of resistance identified
- Seed of different nurseries increased in country
- Isolates of ANT, ALS, CBB, and Rust obtained from different bean production regions of Uganda.
- ANT, ALS and Rust pathotypes/races characterized in Uganda.
- Crosses initiated between Ugandan landraces with tolerant/resistant sources of drought ANT, ALS, CBB, and Rust.
- Progeny screening for different for resistance (drought, ANT, ALS, CBB and Rust) initiated.
- At least 10 persons (6 male and 4 female) trained in disease and pest identification and screening in Uganda
- Compile information for an Andean variety release by MSU
- Assemble an elite trial by INIAP for future variety release
- Identification of Andean drought tolerant lines from a trial tested in Scottsbluff, NE
- Identification of Andean lines with superior mineral bioavailability and short cooking times from trials in MI and NE.
- Begin crossing for genetic improvement of Andean lines with superior mineral bioavailability, short cooking time and disease resistance.
- Develop high throughput/non destructive methods for determining cooking time
- Develop drought screening protocols (using both field and next generation phenometric based techniques) and assemble a drought nursery to be tested across locations in Africa and the US
- Assemble multiple disease resistance nurseries to be tested in Africa and Ecuador
- Assemble the rust mobile nurseries and deploy in Africa and Ecuador
- Seed multiplication and distribution to participant countries – work through PABRA
- Begin characterization of relevant pathogens in Ecuador and Africa
- Begin characterization of biophysiological (gas exchange and chl fluorescence) characteristics associated with drought
- Begin the improvement of both bush and climbing Andean beans introgressing sources of drought and multiple disease resistance

- Enhance country capacity building training 2 PhD students for Africa and one MS for Ecuador
- Conduct FieldBook training in Ecuador and disease nursery workshops in Uganda and Zambia
- SNP data available to initiate the Association Mapping at least in BNF
- Identified more robust markers for major anthracnose gene(s)

V. Engagement of USAID Field Mission(s). The project PI plans to visit field missions in each country to inform them of the research being undertaken

VI. Partnering and Networking Activities:

- Collaborate with S01.A4 Legume Innovation Lab Project to collaborate on regional nursery and disease screening to improve Mesoamerican beans – Beaver et al.
- Collaborate with BeanCAP project in accessing SNP Markers developed through that program.
- NGOs in Uganda include: Community Enterprise Development Organization (CEDO), Farm Africa, VEDCO, World Vision, CARE, ADRA, SHUPO., SASAKAWA Global 2000; Nyakatozi Growers Cooperative Union, Appropriate Technology (Uganda); Seed companies such as (Pearl, Victoria, NASECO, East African Seed, Green Nile Agrotech Limited; FICA seed).
- NGOs in Ecuador: Technical Committee of Beans. Agricultural Organizations; Ecuadorian Cooperation of Legume Producers and Industry (Corporación Ecuatoriana de Productores y Comercializadores de Leguminosas), 17 CIALs, CORPOCIALs, (Chota, Mira, Salinas, Intag, Pallatanga), Grupo de Evaluadores de Frijol de Bolivar, Assoc. de Productores de Frejol de INTAG. Government Organizations; MAGAP, MIES, INIAP, Univ. Private companies: involve in purchase and sale of bean seed, companies involved in canning industry.
- African Farm Radio Research Initiative (AFRRI) for radio broadcast delivery of new information being implemented by Farm Radio International, and funded by the Bill & Melinda Gates Foundation, to communicate with farmers in remote areas overcoming geographic, economic and literacy barriers.
- Freshpkt-Food Canning Company in Lukasa works with farmers to increase bean production for the canning industry and would be a logical partner for this project.
- The bean program at ZARI is also interacting with the Foundation for Wildlife and Habitat Conservation (FWHC) in Mpika in an innovative project to help former poachers to turn to agriculture and conserve the Game Management Areas that they inhabit. This foundation supports sustainable agriculture by promoting new and improved bean varieties to diversify local diets and improve their nutrition through regional markets. It is expected that over 200,000 traditional and new bean growers can be reached through this diverse network.
- The Bean program in Zambia has strong partnership with a number of NGOs and CBOs who include Self Help Africa, World Vision, Shangila Seed Growers Association,

Concern World Wide, IITA Miracle Project, Action Aid to mention but a few. These are partners who are working with communities in disseminating improved technologies.

- In Uganda, funding was secured through AGRA – Alliance for a Green Revolution in Africa and PABRA network. Funding prospects from Kirkhouse Trust in NaCRRI with Annet Namayanja and Pamela Paparu.
- Root rot project Funded by BBSRC (UK): Pathogen Distribution, Characterization and Identification of Resistance Markers Associated with Root Rot Resistance in Common Beans in East and Central Africa –PI – Pamela Paparu, NaCRRI, Uganda.
- USAID funded Feed the Future Project: Development and dissemination of multiple pathogen and drought resistant/tolerant nutritionally enhanced bean varieties for the semi-arid and other regions of Uganda –PI-M.A. Ugen, NaCRRI, Uganda.
- Bean utilization project funded by ASARECA: Utilization of Bean Innovations for Food Security and Improved Livelihoods in Eastern and Central Africa - PI-M.A. Ugen, NaCRRI, Uganda.
- Bean value chain project funded by Maendeleo Agricultural Enterprise Fund: Enhancing women smallholder farmers' capacities to produce and market a "sugar bean" in domestic, regional and international markets, "The Sugar bean value chain" - PI Annet Namayanja, NaCRRI, Uganda.

VII. Leveraging of Legume Innovation Lab Resources:

- USDA-ARS FTF Dry Bean project which is genotyping and phenotyping the Andean Diversity Panel for numerous traits in multiple locations in the US and Africa.
- USDA- NIFA projects: To Develop Common Bean (*Phaseolus vulgaris*) Germplasm with Resistance to the Major Soil Borne Pathogens in Uganda with MSU
- USDA-NIFA: Genetic Approaches to Reducing Fungal and Oomycetes Soilborne Problems of Common Bean in Eastern and Southern Africa with UNL with partners USDA-ARS in Zambia and Mozambique
- PABRA/SABRN. This project will be in line with the PABRA agenda in Africa and will complement each other and provide opportunity to leverage resources. The choice of Zambia will be an entry point in sharing outputs with other countries as well as link with FTF projects in the region, where Zambia is partnering.
- Agricultural Productivity Program for Southern Africa (APPSA) under the Regional Centre of Leadership-Legumes is set to leverage the project in Zambia with research and capacity building.
- Leverage of out of country master degree program in Ecuador to support training of INIAP staff person in intensive English class to qualify for graduate program in plant pathology at UNL.
- Ugandan MS student in Food Science at MSU funded through MasterCard will work on the project.
- Uganda Ph.D. student in plant breeding, genetics and biotechnology at MSU to work on drought physiology funded through the BHEARD program will work in the project.

VIII. Timeline for Achievement of Milestones of Technical Progress: The "Milestones for Technical Progress" form for the workplan period for FY13 and FY14 have been completed for each objective listed in the workplan.

Training/Capacity Building Workplan for FY 2013 – 2014

Degree Training:
First and Other Given Names: Kelvin
Last Name: Kamfwa
Citizenship: Zambian
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: James D. Kelly
Degree Program for training: Doctorate
Program Areas or Discipline: Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: University of Zambia
Thesis Title/ Research Area: Genetic dissection of biological nitrogen fixation in common bean using genome-wide association analysis and linkage mapping.
Start Date: August 2008
Projected Completion Date: September 2014
Training Status: Active
Type of Legume Innovation Lab Support (full, partial or indirect): Full

Degree Training:
First and Other Given Names: Grady
Last Name: Zuiderveen
Citizenship: US
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: James D. Kelly
Degree Program for training: Doctorate
Program Areas or Discipline: Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: MSU
Thesis Title/ Research Area: SNP marker development for major resistance genes
Start Date: August 2013
Projected Completion Date: September 2017
Training Status: Pending
Type of Legume Innovation Lab Support (full, partial or indirect): Full

Degree Training:
First and Other Given Names: Jesse
Last Name: Traub
Citizenship: US
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: Wayne Loescher

Degree Program for training: Doctorate
Program Areas or Discipline: Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: MSU
Thesis Title/ Research Area: Physiological differences among *Phaseolus vulgaris* cultivars differing in drought tolerance.
Start Date: August 2013 on Legume Innovation Funding
Projected Completion Date: September 2017
Training Status: Current graduate student with University Distinguished Fellowship from MSU for his first and final years of study FY11 and FY15 at MSU.
Type of Legume Innovation Lab Support (full, partial or indirect): Partial – one year funding FY14

Degree Training:
First and Other Given Names: Isaac
Last Name: Dramadri
Citizenship: Uganda
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: James D. Kelly and Wayne Loescher
Degree Program for training: Doctorate
Program Areas or Discipline: Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: MSU
Thesis Title/ Research Area: Physiological studies on drought tolerance in Andean beans.
Start Date: August 2013 on Legume Innovation Funding
Projected Completion Date: September 2017
Training Status: BHEARD Fellowship from USAID Mission, Kampala.
Type of Legume Innovation Lab Support (full, partial or indirect): Indirect – research support

Short-term Training:

1. Type of training : Drought and Disease Screening methods
   Description of training activity: To orient staff that will be involved in the day to day data collection and monitoring of drought and disease nurseries so as to get reliable and common parameters
   Location: Kabwe Research Centre under ZARI, Kasama, Zambia
   Duration: One week (5 working days)
   When will it occur? October /November 2013
   Participants/Beneficiaries of Training Activity: Research Technicians and Professionals
   Anticipated numbers of Beneficiaries (male and female): 12 (5 females and 7 males)
   PI/Collaborator responsible for this training activity: James Kelly/Kennedy Muimui could seek CIAT/PABRA for resource person
   List other funding sources that will be sought (if any): PABRA/SABRN support will be sought

Training justification: Having good data collection and evaluation methods will is a pre-requisite for good research results. It is important that all those involved will have a common understating and methods of evaluation and data collection

2. Type of training :Drought and Disease Screening methods
   Description of training activity: Take staff through drought screening protocol, isolation and inoculation techniques for ALS, Rust, CBB
   Location: National Crops Resources Research Institute, Namulonge, Uganda
   Duration 7-10 days
   When will it occur: Between Oct-Dec 2013
   Participants/Beneficiaries of Training Activity: Research and technicians and Ugandan PI
   Anticipated numbers of Beneficiaries (male and female) 10 (6 males and 4 females)
   PI/Collaborator responsible for this training activity James Kelly/ Jim Steadman/Stanley Nkalubo
   List other funding sources that will be sought (if any) CIAT/AGRA
   Training justification: Understanding the different screening methods and how they are applied for the different stresses is important to avoid escapes