LEGUME INNOVATION LAB FOR COLLABORATIVE RESEARCH ON GRAIN LEGUMES

FY 2016 WORKPLAN FORMAT

Project Code and Title: SO1.A1- Genetic Improvement of Middle-American Climbing Beans for Guatemala

Lead U.S. Principal Investigator (PI) and affiliated Lead U.S. University:
Juan M. Osorno, Dept. of Plant Sciences, North Dakota State University. Fargo-ND 58108

Host Country and U.S. Co-PIs and Institutions:
Phil McClean, Dept. of Plant Sciences, North Dakota State University. Fargo-ND 58108
Julio C. Villatoro, ICTA-Guatemala
Fernando Aldana, ICTA-Guatemala
Gustavo Mejía, ICTA-Guatemala

I. Project Problem Statement and Justification:

With approximately 11 million habitants, Guatemala is mostly a rural country, with 60% of the population living in farms and 50% of the population being indigenous. Maize is the main staple food in most households with a per capita consumption of ~100 kg per year, followed by beans with ~13 kg per year. However, consumption trends are different in rural vs. urban areas. Since few other sources of protein are available especially in rural areas, this amount is not enough to ensure an acceptable nutritional quality, especially within poor households. As expected, the lack of protein intake has reduced the nutritional quality in many households, and significantly affecting children.

Beans are grown on 31% of the agricultural land and mostly in the low to mid-altitude regions (0-1500 masl) in a monoculture system. Contrastingly, intercropping (locally known as Milpa) is the main production system in the highlands, where maize-bean is the most common crop association. The system uses climbing beans that grow around the corn stalks. Two main methods are used: direct planting, in which both maize and beans are planted simultaneously, and relay, in which the maize is planted first and the beans are planted at a later date in order to avoid strong competition between the two crops. Unfortunately, on-farm productivity of these climbing beans is approximately one third of their genetic yield potential, mostly due to the lack of improved cultivars that are able to withstand biotic and abiotic stresses. Fungal and bacterial diseases as well as pests are the main cause for yield reductions. In addition, production is made with almost no inputs of fertilizers and/or other chemicals. Historically, climbing beans worldwide have received less attention and breeding efforts in comparison with the bush-type beans commonly grown in the lowlands, as shown by the significant yield gap between regions. In addition, there are genetic and environmental interactions among species (maize, bean, squash, etc.) not well understood within the intercropping system that affect crop performance

and hence, seed yield. The legume Innovation Lab has been involved in collaborative bean breeding research targeting lowland agro-ecologies in Central America, but research for the highland bean production systems is still lacking. A significant seed yield differential between the lowlands and the highlands can be observed, especially in Guatemala.

There is an existing collection of approximately 600 accessions of climbing beans collected across all bean production regions in Guatemala. This collection is kept by ICTA and has been characterized morphologically and with few molecular markers (6 SSR primers). In addition, some field notes concerning disease resistance (natural pressure) and other agronomic traits of economic importance have been collected as well. Initial results suggest that ½ of the collection consist of duplicates. In addition, some initial crosses among climbing beans and selections have been made by Dr. Fernando Aldana (ICTA-Quetzaltenango) and the rest of the ICTA group. These lines will be used intensively in this project.

II. Planned Project Activities for the Workplan Period (October 1, 2015 – September 30, 2016)

Objective 1: Development of germplasm with improved disease resistance and agronomic performance.

Collaborators:

NDSU: Juan M. Osorno and Phil McClean.
ICTA: Julio Cesar Villatoro, Fernando Aldana, Edgardo Carrillo.

Approaches and Methods:

1.1: Farmer's field testing of 12 selected accessions (ICTA) and other early-generation genetic material (final testing year): The bean breeding program at ICTA has planted a selected a group of 12 genotypes that include accessions from the germplasm collection and crosses made by Dr. Fernando Aldana that offer agronomic traits of interest such as plant growth type, seed yield, disease resistance, earliness, and seed quality, among others. Field trials were planted in farmer's fields during the 2014 growing season and replanted again this year in April and May 2015 at 10 locations representing five departments where there is significant production of climbing beans (final report from 2014 trials is available under request). Most locations are tested under the common intercropping system (Milpa) and few under monoculture. A final third year of field testing during FY16 is needed in order to find the most appropriate genotype(s) to be considered as future varieties. The trials are planted using a Randomized Complete Block Design (RCBD) with 2 or 3 replications depending on space and resources at each location. The local variety commonly grown by the grower is used as the check.

An effort to collect all the following agronomic data will be made within each plot at all locations:

- Days to emergence: Bean seedlings counted 20 days after planting
- Vigor: Visual scale of 1-9 where 1 is best and 9 is worst.
- Early disease symptoms: CIAT scale 1-9 will be used for any disease naturally occurring at any of the locations.
- Days to Flowering: Number of days after planting in which 50% of the plants in a plot have at least 1 flower.
- Pod distribution: Classified either as columnar (even pod distribution across all plant) or pyramidal (uneven pod distribution with most pods around the higher part of the plant).
- Climbing aggressiveness: Classified as low, medium, or high depending on a visual estimate of plant biomass (leaf, stems, and pods)
- Disease symptoms (natural pressure): CIAT scale 1-9 will be used for any disease naturally occurring at any of the locations.
- Days to maturity: Days after planting when at least 50% of the plants within a plot are ready for harvest.
- Seed yield: Weight in g of seeds after threshing and converted to kg/ha.
- 100-seed weight: the weight in g of 100 seeds collected randomly for the seeds obtained from each plot.

Once all the data is collected at the end of the year, decisions will be made about selecting a smaller number of lines for testing in FY16 at farmer's fields across 10 locations again. The number of entries to be tested in the following year will depend on this year's results. The same field testing protocol will be applied for this new cycle of field testing. In addition, we'll keep monitoring the phenotypic heterogeneity of the lines tested (objective 1.3).

1.2: Breeding pipeline (ICTA/NDSU): a group of 28 F6 bolonillo lines and 23 selected accessions of climbing beans (bolonillo, piloy, piligua, etc.), were evaluated and harvested at the ICTA stations in Chimaltenango and Quetzaltenango last year (2014) and seed was increased during the off-season at San Jeronimo. Phenotypic evaluation of this material allowed the selection of 130 lines with potential. This number includes individual plant selections made within heterogeneous lines (based on overall disease resistance/tolerance, pod load, color, and seed type). An average of 3 individual plants was selected within lines of interest. This material was planted again in 2015 at ICTA-Quetzaltenango for field evaluation under Milpa conditions and phenotypic selection will be practiced again. Selected F9 lines will be planted and evaluated again in FY16 based on the same traits previously mentioned.

1.3: Genetic purification of selected material (ICTA): As explained Technical Project Description, phenotypic variation has been detected within accessions and breeding lines. Some individual plant selections were made last year within the 28 F_6 breeding lines and will be tested again this year for homogeneity at the ICTA-Chimaltenango and Quetzaltenango stations. In addition, visual evaluation for phenotypic heterogeneity will be made across all field testing locations in order to have a better estimate of genetic variability within each line tested. If genetic heterogeneity is visually detected, plants with apparent superior performance (e.g. disease resistance, seed yield, pod distribution, seed quality, climbing aggressiveness, earliness, etc.) will be tagged to be harvested as a single plant selection. The seed from each individual plant selected will be used in the future for: i) seed increase, and ii) further evaluations.

1.4: Field evaluation of Bolonillo-TEXEL (ICTA): One of the improved lines selected by Dr. Fernando Aldana at advanced breeding stages (known as Bolonillo-Texel) was planted in ~20 grower's fields during FY15 (final report available under request). Each field consist of ~400 m^2 planted with Bolonillo-Texel and growth next to or near the variety or varieties the grower normally uses. The same experiment will be repeated in FY16 in order to obtain robust data across years and location about the agronomic performance of Bolonillo-Texel. An attempt to measure the same traits mentioned above will be measured across all locations or at least, a subset of them. Seed yield and other traits will be compared with common varieties and landraces grown in the vicinity of the testing fields (similar to sentinel plots).

The resulting information coming from multiple locations will allow understanding if Bolonillo-Texel should be released or recommended for all the highland ecosystem or if the new variety seems to be more adapted to specific regions and/or ecosystems better than others. This validation step (locally known as "Ensayos de Validacion"), is crucial for the approval of a new variety under the Guatemalan seed system. If Bolonillo-Texel has good acceptability it could be released sooner, which would allow for a significant impact of this project earlier than planned by releasing an improved variety of climbing bean thanks to the previous efforts made by the ICTA bean breeding project.

1.5: Second crossing block (ICTA): A first set of 23 potential parents (see objective 2.3) were planted in the greenhouse at the ICTA station in Chimaltenango during the 2015 growing season. The use of an offseason growing cycle in the lowlands (e.g. San Jeronimo) was used to advance 2 generations per year. The first generation of single crosses during FY15 has encountered some difficulties in regards to flowering synchronicity in spite of planting the material at staggered planting dates. Therefore, some crosses planned initially won't be accomplished and will have to be attempted again during FY16. A minimum of 40 parental combinations are expected to be produced. All this material constitutes the first batch of genetic material towards the creation of breeding pipeline (objective 1.2) that will help to establish a long-term breeding program that will continue developing improved climbing beans adapted to the region in the future.

Objective 2: Characterization of the genetic diversity of this unique set of germplasm.

Collaborators:

NDSU: Juan M. Osorno and Phil McClean.
ICTA: Julio Cesar Villatoro, Fernando Aldana.

Approaches and Methods:

2.1 Evaluation of core collection with the 6k SNP chip (NDSU): The cold storage at ICTA-Chimaltenango where the climbing bean germplasm collection is kept is in very bad condition, mostly affected by bruchids and rodents. Because of this, and before embarking into the genotyping efforts, it was decided to do a field seed increase of the 600 accessions at ICTA-Chimaltenango during 2014 in order to obtain a fresh batch of seed for the molecular analyses and also to renovate the seed from the cold storage. Harvested seed has been cleaned and conditioned and will be shipped to NDSU once a phytosanitary certificate is obtained from the Guatemalan Ministry of Agriculture. Therefore, we are behind our proposed timeline in this regard. The phytosanitary certificate was finally obtained in Mid-July and seed is expected to arrive to NDSU during the last week in July 2015. Seed from each accession of the climbing bean collection will be processed for DNA extraction and SNP genotyping. The timing is actually perfect since it will coincide with the arrival of the three new students that will work with these accessions (Objective 4.1).

Initially, the core collection of approximately 300 accessions will be evaluated with the set of ~6000 Single Nucleotide Polymorphism (SNP) markers available from the BeanCAP project (www.beancap.org) funded by USDA-NIFA. This set of markers is highly precise, reliable, and allow higher resolution and differentiation among genotypes compared to SSR markers. With the goal of having a better understanding of the organization of the genetic diversity of this group, we will extract DNA of the core 300 accessions and screen them with the 6k beancap chip and do a genetic diversity study of possible genetic relationships among the accessions.

Monomorphic markers as well as markers with more than 50% of missing information will be discarded. Several parameters of population diversity and structure will be used to assess the organization of the genetic diversity in this group of germplasm. An attempt to do comparisons with other genetic groups/races previously analyzed by the BeanCAP project and others, will also allow having a better understanding of where this group of germplasm could fit into what it is known about bean genetic diversity (gene pools and race organization). As suggested in several previous studies, the climbing beans from Guatemala tend to cluster as a separate race (labeled as “Guatemala race”) within the Mesoamerican gene pool.

The genotyping and analyses will be part of the research topic for one of the M.S. students coming to NDSU from ICTA. The NDSU bean genomics lab under the direction of Phil McClean has a lot of expertise in this area and will be in charge of these analyses. In addition, a random group of 20 accessions previously identified as duplicates based on the SSR data will be also

screened in order to confirm these results or evaluate the need to include more of these duplicates in the screening. Some of the results found in this study will aid in the planning and designing of the crossing block during FY2016.

This core 300 collection could be used as a diversity panel that could be used for Genome Wide Association Studies (GWAS). This will allow identifying genomic regions associated with traits of agronomic/economic importance within this unique group of germplasm. This approach has been successful already in common bean, identifying regions associated with growth habit, seed color, seed size, days to flowering, among others. A similar approach could be used as a thesis topic to identify candidate regions associated with disease resistance genes for example.

2.2 Assessment of the intra-accession variability (NDSU): A Genetic assessment of variation within the 10 selected lines used in objective 1.1 and 1.2 will be made in order to account for the heterogeneity at the molecular level not only among but within accessions and possibly, extrapolate that information to the rest of accessions. In addition, this information will be compared with the data obtained from visual evaluation of the phenotypic heterogeneity in the field.

Preliminary phenotypic observations in the field suggest that there is a high amount of genetic heterogeneity (heterozygocity) within accessions. Therefore, 20 plants from 10 random accessions will be planted in the greenhouse at NDSU and DNA will be extracted, for a total of 200 DNA samples/individuals. These genotypes will be also screened with a subset of INDEL markers developed in the NDSU bean molecular genetics lab (Moghaddam et al., 2013). The INDEL markers were developed from polymorphic SNPs, but their advantage is that they can be easily reproduced by PCR and visualized in an agarose gel. Since the main goal is to assess intra-accession variability, this will be easily detected by looking at the bands in the gels. Polymorphic Information Content (PIC) and other genetic parameters will be estimated.

2.3 Field evaluation of the ICTA collection of climbing beans (ICTA/NDSU): As mentioned before, the entire collection of climbing beans from ICTA was grown during 2014 at the ICTA station in Chimaltenango to allow a re-evaluation of the material and also the production of a newer batch of seed. Each accession was planted in short rows (~2 m) mostly for phenotypic observation. The project director (Juan M. Osorno) and co-PI (Phil McClean) spent few days along with ICTA personnel (Julio Villatoro and Fernando Aldana) evaluating the entire collection. The following traits were recorded: disease reaction under natural conditions (Ascochyta, Rust, Anthracnose) and pod distribution (upper vs. homogeneous distribution). A total of 23 accessions were selected based on the best combination of all these agronomic attributes. These accessions are currently being grown in the greenhouse at ICTA-Chimaltenango and used for crosses. In addition, it was decided to do another seed increase of the entire collection at ICTA-Chimaltenango during the 2015 growing season in order to do a final round of phenotypic evaluation in case something was missed in the previous year.

All this information will allow a better understanding of the organization of the genetic

diversity within this core collection for future use and research. The results obtained in this first phase will allow making informed decisions about the potential parents for the following set of crosses.

Objective 3: A better understanding of the current socio-economic status and needs of bean production within the context of intercropping systems in the region.

Collaborators:

NDSU: Juan M. Osorno.
ICTA: Gustavo Mejia, Julio Cesar Villatoro, Fernando Aldana.
MSU: Mywish Maredia, David DeYoung, and Byron Reyes.

Approaches and Methods:

3.1 Tabulation of grower's survey data and statistical analyses (ICTA/MSU/NDSU):

As described in the technical project description and FY15 work plan, a grower survey was deployed during March 2015 in the main regions where climbing beans are produced. The survey activity was very successful thanks to a great collaboration established with the project lead by Mywish Maredia (SO4.1). They have far more experience with surveys than any person in our team, so we appreciate their willingness to help. Originally, Julio Martinez from ICTA was the social economist in charge of this. However, he decided to retire in January 2015 and ICTA quickly assigned Gustavo Mejia, another social economist at ICTA-Quetzaltenango to be in charge of this activity. His involvement and passion in this activity was crucial for the success of the survey. Considerable time was devoted to designing the survey instrument, with skype calls every week until completed. Survey instrument (Word or PDF format) is available under request.

We focused on the following departments based on some stratified analysis: Quiche, Huehuetenango, San Marcos, Totonicapán, and Quetzaltenango which represent most of the climbing bean production areas. Once approval for the survey was obtained from the Institutional Research Board (IRB) at NDSU, a group of ~15 surveyors was selected and trained by David DeYoung and Byron Reyes. Approximately 500 growers across 5 departments were surveyed during the 3-4 week period.

Collected data has been entered into a digital format (Excel) by ICTA personnel and is currently under revision and filtering of errors. Therefore, during FY16, data will be analyzed using the proper statistical tools and results will be summarized. Results of this survey will be shared not only within the project but with other projects currently working in Guatemala (e.g. Masfrijol) and government agencies interested. No field activities are planned for this objective during FY16.

3.2 Seed increase of samples collected during the survey (ICTA/NDSU): During the deployment of the survey, growers were asked to provide a small seed sample of the variety or varieties they commonly grow in their farms. Therefore, a seed increase has been planned

during the 2015 and 2016 growing seasons at the ICTA-Chimaltenango station. This will provide an opportunity to do a phenotypic evaluation of the germplasm collected during the survey and possibly to identify genetic material of interest for the breeding pipeline (Objective 1.2). In addition, the specific location from where each seed sample was obtained is available and therefore, some geographical diversity analyses are possible in the near future. Even more, the new germplasm collected during the survey could be compared with the original germplasm collection via SNP analysis (Objective 2.1) and try to establish some genetic similarities and hence, some possible geographical origin for the original germplasm collection since all the passport data was lost several years ago. We foresee this study as a good research topic for one of the students coming to do their M.S. training at NDSU (Objective 4.1).

Objective 4: Capacity building: training the next generation of plant breeders for Guatemala and establishing a long-term breeding plan to increase the productivity of climbing bean in the region.

4.1. Graduate Students:

Recruiting efforts during FY2014 and FY2015 at ICTA have allowed the identification of three candidates for M.S. at NDSU. Gabriela Tobar Piñon and Carlos Maldonado are ICTA employees initially identified through the CAPA project, which is an early career program at ICTA to identify outstanding individuals for future employment and ICTA. The third candidate is Luz de Maria Montejo who is a graduate from the Escuela Agricola Panamericana Zamorano and was working with the Guatemalan Ministry of Agriculture. Luz was highly recommended by Juan Carlos Rosas and Jim Steadman and therefore, she was transferred to ICTA. The 3 students will start their M.S. programs at NDSU in the fall of 2015. Given our inexperience with TraiNet and the process, we experienced multiple difficulties during the process, which caused the delay in having our first M.S. student (Gabriela) starting in January 2015. The process was reinitiated for this student plus the two new candidates so they all can start their M.S. degrees in fall 2015. Students have been approved by both NDSU graduate school and TraiNet, and they will receive their documents to request their US visa soon.

Research topics will be directly related to the research objectives described above. We foresee research projects focused on the analyses of genetic diversity, genetic resistance to diseases, and production systems, among others. The graduate students will be provided a broad range of training in conventional and molecular plant breeding techniques so that they can assume leadership roles in bean research programs in the target countries.

4.2. Bean workshop at NDSU for ICTA personnel:

As described in the technical project description, a bean workshop has been proposed for the third year of this project. The goal of this training/workshop will be to show the visiting group how bean production is made in North Dakota (the largest producer in the U.S.) and also

to receive training on plant breeding, plant pathology, molecular markers, and other genomic tools that could help in the breeding process. Activities will include field tours to breeding nurseries, commercial farming operations, and bean industries in the region. Priority will be given to ICTA personnel working on legumes, followed by other Guatemalan personnel from other government agencies and NGOs. Candidates from other bean programs from the region will be also considered if funds are available. We have budgeted funds to support 6 participants but additional funds could be sought to support additional participants (i.e. capacity strengthening grants). The workshop will be 1 week long during the month of August 2016. Other Legume Innovation Lab projects will be welcome to attend if they are willing to cover the cost for their participants.

III. Contribution of Project to USAID Feed the Future Performance Indicators:

See attached table with Future Performance Indicators.

IV. Outputs:

1. Objective 1:

1.1. Farmer's field testing of 12 selected lines (ICTA).
1.2. Breeding pipeline (ICTA/NDSU).
1.3. Genetic purification of selected material (ICTA).
1.4. Field evaluation of Bolonillo-TEXEL (ICTA).
1.5. Second crossing block (ICTA/NDSU).

2. Objective 2:

2.1. Evaluation of core collection with the 6k SNP chip (NDSU).
2.2. Assessment of the intra-accession variability (NDSU).
2.3. Second field evaluation of the ICTA collection of climbing beans (ICTA/NDSU)

3. Objective 3:

3.1. Tabulation of grower's survey data and statistical analyses (ICTA/MSU/NDSU).
3.2. Seed increase of samples collected during the survey (ICTA/NDSU)

4. Objective 4:

4.1. Three graduate students at NDSU (ICTA-NDSU).
4.2. Bean workshop for ICTA personnel at NDSU (NDSU).

V. Engagement of USAID Field Mission(s)

Local USAID Mission in Guatemala is always contacted when U.S. scientists visit. In most cases, briefing meetings are held in their offices. Host country scientists are also responsible of informing local USAID Missions about progress of the Legume Innovation Lab project toward research and training objectives. Opportunities will be sought to obtain USAID Mission support to expand activities in host countries.

VI. Partnering and Networking Activities:

The NDSU scientists responsible for this project (Osorno and McClean) are also involved in other projects from the Legume Innovation Lab (e.g. S01.A4). Therefore, some collaboration among projects is expected. The personnel from EAP-Honduras (J.C. Rosas) have also expressed their willingness to help in any way possible. Efforts will be made to travel around the same dates to the region in order to discuss the project's evolution. Close collaboration with project SO4.1 (Mywish Maredia) has been crucial for the success of the survey activities. In addition, P. McClean is directly involved with the project lead by Penn State (J. Lynch) on climate-resilient beans and also funded by USAID.

Several Legume Innovation Laboratory scientists participate in Regional Hatch Project W-3150 which is a multi-disciplinary network of U.S. bean researchers. The NDSU dry bean breeding program at NDSU conducts winter nurseries at Puerto Rico and this will allow for further discussion of the projects on a person-to-person base. In addition, most scientists involved in the project will meet every other year at the Bean Improvement Cooperative (BIC) meetings and other scientific meetings. Researchers in Central America and the Caribbean often make scientific presentations at the annual meeting of the PCCMCA. The meeting provides an opportunity for the Central American/Caribbean research network which includes national programs, CIAT and the Legume Innovation Laboratory scientists to meet to exchange results from research and plan activities for the upcoming year. Efforts will be made to participate at these meetings in Central America and share the project developments.

Last but not least, efforts will be made to have close collaboration with the Masfrijol project funded by the USAID Guatemala mission and lead by Luis Flores from Michigan State Univ. Advanced genetic material developed by our project will be shared with them for field testing and studies on consumer preferences. Efforts will be made to meet with members of this group whenever possible to keep both project updated on the current activities.

VII. Leveraging of CRSP Resources:

Germplasm exchange is still a common activity among dry bean breeders and even boosted up by some of the networks previously mentioned. The germplasm developed in this project could be useful in other regions growing climbing beans. In addition, the genetic material could have unique genes/sources of resistance/tolerance to production problems also present in the United States.

Some of the genomic resources and tools developed by the BeanCAP project funded by USDA-NIFA will be of great help to start these breeding platforms in Guatemala and other developing countries.

Legume Innovation Lab breeders and pathologists (Kelly, Steadman, Urrea, Osorno, Beaver, Estevez, and Porch) have an opportunity to meet at least once a year in Puerto Rico. This facilitates communication between the Legume Innovation Lab bean breeding projects. In addition, close collaboration with CIAT breeders will allow germplasm exchange and sharing of the scientific knowledge.

VIII. Timeline for Achievement of Milestones of Technical Progress:

See attached file with project Milestones.

Training/Capacity Building Workplan for FY 2016 – 2017 (use format below)

Degree Training:

Degree Training:
First and Other Given Names: Maria Gabriela
Last Name: Tobar Piñon
Citizenship: Guatemalan
Gender: Female
Training Institution: NDSU
Supervising CRSP PI: Phil McClean
Degree Program for training: M.S. in Plant Sciences
Program Areas or Discipline: Plant breeding/genomics
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: ICTA
Thesis Title/Research Area: Molecular characterization of germplasm collection of Guatemalan climbing beans.
Start Date: August 2015
Projected Completion Date: December 2017
Training status (Active, completed, pending, discontinued or delayed): Delayed
Type of CRSP Support (full, partial or indirect) g for training activity: Full

Degree Training:
First and Other Given Names: Carlos Raul
Last Name: Maldonado
Citizenship: Guatemalan
Gender: Male
Training Institution: NDSU
Supervising CRSP PI: Juan M. Osorno
Degree Program for training: M.S. in Plant Sciences
Program Areas or Discipline: Plant breeding/genomics
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: ICTA
Thesis Title/Research Area: Geographical comparison of 2 germplasm collections in Guatemala
Start Date: August 2015
Projected Completion Date: December 2017
Training status (Active, completed, pending, discontinued or delayed): Delayed
Type of CRSP Support (full, partial or indirect) g for training activity: Full

Degree Training:
First and Other Given Names: Luz de Maria

Last Name: Montejo
Citizenship: Guatemalan
Gender: Female
Training Institution: NDSU
Supervising CRSP PI: Juan M. Osorno
Degree Program for training: M.S. in Plant Sciences
Program Areas or Discipline: Plant breeding/genomics
If enrolled at a US university, will Trainee be a "Participant Trainee" as defined by USAID? Yes
Host Country Institution to Benefit from Training: ICTA
Thesis Title/Research Area: Disease resistance in Guatemalan climbing bean germplasm collection.
Start Date: August 2015
Projected Completion Date: December 2017
Training status (Active, completed, pending, discontinued or delayed): Delayed
Type of CRSP Support (full, partial or indirect) g for training activity: Full

Short-term Training:
Name of training program: NDSU Bean Workshop
Type of training: Informal Training
Description of training activity: Hands-on workshop on bean production, agronomy, breeding, genomics, and pathology.
Location: North Dakota State University, Fargo-ND.
Duration: 7 days (including travel)
When will it occur? August 2016
Participants/Beneficiaries of Training Activity: ICTA personnel, other Guatemalan government agencies, and NGOs, other bean programs from Central America and the Caribbean, other Legume Innovation Lab programs.
Anticipated numbers of Beneficiaries (male and female) 6 selected participants
PI/Collaborator responsible for this training activity: Juan M. Osorno and Phil MClean
Approximate budget allocation from USAID funds for training: $15,000
List other funding sources that will be sought (if any): Capacity Strenghtening Grants, other Legume Innovation Labs.
Training justification: North Dakota is the largest producer of dry beans in the U.S. and it is very important for bean researchers in developing countries to see and experience how bean production is accomplished in the region. In addition, the bean breeding program at NDSU has a lot of expertise that will be shared with the group as well. Many concepts and methods could be applied in their home countries in the future.

Equipment (costing >$5,000)**:**
None.