IPM-omics: Scalable and Sustainable Biological Solutions for Pest Management of Insect Pests of Cowpea in Africa (SO1.B1)

Lead U.S. Principal Investigator and University

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I. Abstract of Research and Capacity Strengthening

Over the past 18 months of the project, we have pushed forward our understanding of and solutions for the major pests of cowpeas in four West African countries: Benin, Niger, Burkina Faso and Ghana. We have characterized pest populations both through field-level and molecular tools and explored coupling this with GIS tools. Solutions to these pest problems have been developed and pushed forward, including tangible solutions from our biocontrol agent pipeline, and a neem and *Maruca*-specific viral combined spray. We have also continued to develop and investigate the use of educational tools, involving animations voice overlaid into local languages, as a scalable system to deploy the outcomes of our research efforts to create and deploy locally sourced pest control solutions. Our capacity building efforts have included undergraduate and graduate training efforts in the host country programs and cross-training of technicians across countries. We have continued to test our animated educational approach, including holding multiple ICT training sessions to develop networks of collaborating organizations that can, in turn, use these materials in their educational programs. We continued to collaborate with Dr. Maredia's team at Michigan State University to address social science-oriented questions relating to scaling of our technologies and approaches for pass off to other groups.

II. Project Problem Statement and Justification

Insect pests of cowpeas dramatically reduce yields for cowpea farmers in West Africa, many of who live on less than $2 per day. Arguably, the greatest biotic constraints on cowpea (*Vigna uguiculata*

[L.] Walp.) production are insect pests. The major pests of cowpea in the fields in northern Nigeria, in Niger, and in Burkina Faso include the following:

- (1) the legume pod borer, *Maruca vitrata* Fabricius
- (2–3) the coreid pod-bugs, *Clavigralla tomentosicollis* Stäl and *Anoplocnemis curvipes* (F.)
- (4) the groundnut aphid, *Aphis craccivora* Koch
- (5–6) thrips, *Megalurothrips sjostedti* Trybom

Our program is focused on a three-step approach for (1) defining the pest problems, (2) developing appropriate pest control solutions and (3) exploring the scaling of these solutions. We have continued to develop an in depth understanding of the pest populations through a combination of field experiments and molecular tools to characterize and compare pest populations. We have developed solutions that will allow for the development of local cottage industries that can produce biopesticides for local sale and use—thereby facilitating the potential for local value chains that result in the development and sale of ecologically friendly pest control solutions. We have continued to investigate biological control agents in our biocontrol pipeline and we have promising candidates for scaling in the field, along with approaches to scale their release in a cost-effective manner. Additionally, we have (1) developed scalable educational solutions to train people in many of the pest control strategies in their own languages and for all literacy levels and (2) we are exploring pathways for passing these off to other groups that can deploy these in their educational programs. Finally, in terms of capacity building we (1) have been working with NGOs and local companies for pass off our of outcomes; (2) we have continued undergraduate and graduate training; and (3) we have developed a cross-country technician training program to facilitate capacity in biocontrol agent rearing and release, and biopesticide development, deployment and pass-off to local commercial and noncommercial entities.

III. Technical Research Progress

Over the past 18 months we have researched, developed, implemented and performed and analyzed datasets around determining the potential for impacts of our strategies for cowpea farmers in West Africa. We have continued to research and develop scalable solutions, with the potential and actualization of larger-scale impact through donor community buy-in. As part of that donor community buy-in the Bill and Melinda Gates Foundation has funded outcomes of our past efforts on *Maruca*—the objectives of that grant do not overlap with the current USAID Legumes Innovations Lab grant.

Our objects emerge from the following vision, with three critical major objectives, supported and intertwined with the fourth objective of capacity building. We term this approach IPM-omics—as a system to develop and deploy scalable solutions.

First, we define IPM-omics in the following equation:

IPM-omics = define the pest problems + appropriate solutions + scaling of solutions

In the below objectives and outcomes we outline how we are actualizing each of these steps with institutional capacity building being integral to this overall process. Below are given our four objectives and our accomplishments under those objectives.

Objective 1. Define the pest problems

1. scouting, field experiments, light traps
2. genomic markers to define pest and biocontrol agent populations—movement patterns and sources of the outbreaks
3. computational modeling
4. understanding the biology of pest populations to drive pest controls strategies

Scouting and field experiments

The IITA, INERA, INRAN, CRI, and SARI teams all continue to perform surveys of the pest populations during cowpea cropping cycles and outside of these cycles. Insects found on diverse alternative host plants are stored in RNAlater or 70 percent ethanol to be sent to UIUC for molecular analyses. Additionally, the INERA team has established experiments to understand the pest populations that occur in the dry season in places where an extra cycle of cowpea could occur where irrigation by some farmers is possible. All of these studies are continuing and will continue to contribute to our understanding of the cycles of pest populations on cowpeas.

For example, in Ghana (from the SARI team) the results were as follows:

- Field studies were conducted at the Savanna Agricultural Research Institute (SARI), Nyankpala, Tolon district, northern region, Ghana, between July and September 2014 to identify the major insect pests of cowpea. The cowpea variety used was IT90K-277-2. The results indicated that leafhoppers, Aphis, *Aphis craccivora* Koch; thrips, *Megalurothrips sjostedti* T.; *Maruca vitrata* F.; Pod sucking bugs such as *Clavigralla tomentosicollis*, *Anaplocnemis curvipes*, *Riptortus dentipes* are the major pests. The thrip population was found to increase with the season and peaked with the rain in September. Incidence of *M. vitrata* and pod sucking bugs were low.
- Diagnostic survey was conducted in farmers' fields in September 2014 and it was found that *M. sjostedti*, *M. vitrata* and *C. tomentosicollis* populations were high in Krachi West and West Gonja districts which are farther south of Nyankpala in Tolon District.
- So far the following have been identified as the alternative hosts of *M. sjostedti* and *M. vitrata*; *Grycine max* (L.), *Cajanus cajan* (L.), *Mucuna cochinchinensis* (Lour.), *Canavalia ensiformis*, L. and *Tephrosia* sp.

Our IITA, CRI, INERA and INRAN teams also continued to produce this type of important baseline data.

1.2 Molecular Analyses of pest populations

From IITA we have received pest populations for molecular analysis including thousands of insects have been collected from numerous host plant populations, for all species tested, across Benin,

Niger, Burkina Faso and Ghana. The specimens have been stored at -80^{o}C and the DNA extracts have been shipped to UIUC for further molecular analyses. Similar sample collections of insects have been received from our teams in Burkina Faso, Niger and Ghana. Molecular analyses (SNP and microsatellite analyses) are continuing at UIUC. One additional series of experiments include populations of aphids collected by the UCR on different lines of cowpeas. We have been comparing these populations of aphids to determine if they are distinct biotypes.

1.3 Computational Modeling, GIS systems and Online System

The UIUC and IITA teams have developed a flowchart system that will be used in predictive responses to when and where cowpea farmers can or should intervene in pest control strategies. The IITA team continues to use modeling approaches with the graduate students under Dr. Tamo's direction to better characterize pest populations. The IITA and UIUC teams are continuing to explore the use of GIS systems to couple our other datasets with GIS data. The UIUC team is continuing to build a database on all of these topics to go into an online database, which will go live in 2015, to make all our outcomes easily accessible to the cowpea community.

1.4 Insect biology—Sex and aggregation pheromones for pod sucking bugs

Preliminary data from olfactometry experiments involving adult female and male of the pod bug *Clavigralla tomentosicollis* revealed that the adult female egg parasitoid *Gryon fulviventre* responded to volatiles emitted by male pod bugs only.

A subsequent experiment using different densities of adult males of *C. tomentosicollis*, both on cowpea pods and without cowpea pods, confirmed the preferences of female *G. fulviventre* for volatiles emitted by males. The highest response was given when 10 males were confined together, showing that there is also a density limit (carrying capacity) beyond which males will stop emitting pheromones. The nature of these pheromones needs to be further elucidated, as both sex and aggregation pheromones could be involved, as known from other coreid insect e.g. in Asia. Hence, they will need to be characterized by more in-depth chemical analysis in collaboration with an advanced lab.

After these preliminary results, we have now the evidence that female egg parasitoids *G. fulviventre* use olfactic cues emitted by adult male *C. tomentosicollis* for locating egg masses in the field. We consider these results quite a break through as there has been no previous study involving this species. This could also explain why, in the field, there are no parasitoids attacking eggs oviposited by the first pod bugs generation, simply because the colonizing first generation might be female only, and hence not producing sex/aggregation pheromones. It is only males issued from the first generation that will emit these pheromones and hence attract egg parasitoids. This hypothesis is substantiated by the observed parasitism rates of second-generation egg masses, which can easily reach up to 95 percent. By manipulating this system, we might be able to increase rates of parasitism right from the first generation, thus substantially reducing the pod bug population.

<u>Objective 2. Appropriate solutions.</u> We have developed a biocontrol and biopesticide pipeline, in order to develop a series of environmentally and economically appropriate pest control solutions.

2.1. Novel Maruca parasitoids available for screening

Rearing colonies of the exotic parasitoids *Apanteles taragamae, Therophilus javanus, Phanerotoma syleptae* and *Nemorilla maculosa* are available at IITA–Benin as per schedule. We were requested by USAID to conduct a thorough environmental assessment of the biological control agents prior to any trials outside the isolation rooms. The environmental assessment has been conducted by Dr. Srinivasan of AVRDC and sent to the MO. The assessment, together with comments by the MO and USAID has been returned to us for responses, which were provided. We expect to receive approval soon to be able to move forward on the screening experiments.

<u>2.3 PCR techniques for detecting endophytic strains of Beauveria bassiana available</u>

PCR primers for *Beauveria bassiana* where obtained from Inquaba Biotech in South Africa and were used to detect the presence of the entomopahtogen from pure colonies in the lab. Inoculation trials are presently ongoing as scheduled, using sprouted cowpea grains, individually inoculated with *B. bassiana* conidia, and cut into the different plantule organs (leaves, stems, roots) for further PCR detection.

<u>2.3 Genetic improvement of cowpea to overcome biotic constraints to grain productivity (in collaboration with the UCR cowpea breeding team)</u>

This activity has taken place in Burkina Faso with the INERA team and in Niger with the INRAN team. Details of the activities are outlined as follows. Screening for resistance or tolerance to *Clavigralla tomentosicollis* occurred, as did screening for aphid attack. Aphids were collected in three agroecological: Sahelian zone (less than 600 mm), Sudano–Sahelian zone (600–900 mm), Sudanian zone (greater than 900 mm), to screen 10 cowpea varieties from Botswana, Burkina, Ghana, Nigeria, USA. Three varieties were recorded resistant or tolerant to aphid attack. F1s from the cross between susceptible plant (tiligre) x KVX 299-2-124-99 are ready to screen. The INRAN team in Niger screened more than 11 varieties of cowpeas thought to have some level of insect tolerance.

<u>Objective 3. Scaling of solutions.</u> When solutions have been developed we need mechanisms to effectively deploy them in a cost effective and sustainable manner. Discovering and testing such scaling pathways will be critical to determine which approaches will be most successful for scaling. Solutions, for scaling, fall into three categories: (3.1) direct release into the environment and natural establishment; (3.2) educational solutions; and (3.3) private sector and NGO involvement.

3.1 Direct Release into the Environment and Natural Establishment

<u>3.1.1. Maruca parasitoids (IITA)</u>

We have recovered for the first time since the last inoculative releases two years ago, pupae of the parasitoid *Apanteles taragamae* from *M. vitrata* feeding on flowers of the legume tree *Lonchocarpus sericeus*. This is a positive and unexpected event, as previous studies had revealed that *M. vitrata* feeding on the same substrate would not support parasitism by *A. taragamae*, possibly because of the (toxic) metabolites included in the flowers. This could have led to either encapsulation of the parasitoid egg inside the *M. vitrata* larva, or the death of the developing

parasitoid larva due to antinutritional or toxic metabolites. Discovering the establishment of the parasitoid on this host plant today suggests that *A. taragamae* must have been able to adapt to these conditions and possibly develop a coping mechanisms (e.g. detoxification). This paves the way for more in-depth studies on the genetic of this parasitoid, comparing original populations from Taiwan with the one that has now been found adapted to *M. vitrata* feeding on *L. sericeus*. IITA is currently working with UIUC to make the molecular comparisons of the insects that were released with those that have been recovered in the field.

3.1.2. Thrips parasitoid available for scaling up (IITA, INERA and INRAN)

Plots of *Tephrosia candida* have been established at Farakoba in Burkina Faso and Maradi in Niger, as well as in Benin. As soon as we have the go ahead from the environmental assessment, IITA will send pupae from first generation of field-collected individuals for inoculative releases on the nursery plots of *T. candida*. IITA will start collecting on patches of *Pterocarpus santalinoides* and *Lonchocarpus sericeus* in Southern Benin with the onset of flowering at the beginning of the dry season end of November/early December. Our team has decided to follow this approach based on earlier attempts to establish rearing colonies in each country, which proved technically and logistically very challenging. Even at IITA–Benin, we are not keeping any rearing colonies of this parasitoid anymore as too labor intensive (and hence not cost-effective), given that they can be recovered from the wild at any time and within a range of 60 km.

3.1.3. Feasibility of storing Maruca virus both as liquid and solid substrate (IITA)

We stored viral solutions both in the deep freezer at -18^{o}C and in a normal fridge at 4^{o}C, and after six months there was no significant difference of the activity in lab studies. Field studies with viral preparations from both cold treatments are still ongoing and will be harvested in about a month.

3.1.4 Scaling of the neem plus virus control strategies (IITA, INRAN and INERA)

A detailed experiment was set up during the second season, to further calibrate the dosage of emulsifiable neem oil products for aphid, thrips and pod bugs control, and to validate an intervention threshold for viral applications against the pod borer. Hence, different combinations of emulsifiable neem oil at dosage of 330, 660 and 1000 ml/ha with MaviMNPV sprayed at 40 percent flower infestation level were compared to virus alone and standard insecticides (with all the necessary biological replicates for these experiments). Unusually heavy rains resulted in our first season experiments not being useable. The second season experiment is currently in the field, plants have started podding and the experiment will be harvested in about three weeks. Similar experiments were performed by INERA and INRAN.

Most notably, the INRAN team also tested the use of neem seed oil and virus sprays in 16 villages in the region of Maradi and Zinder. The intent of this activity is to test the effectiveness of this approach in the hands of farmers. Data collection will be completed early in FY15.

3.1.5 Portable neem oil extraction system (CRI and SARI)

The CRI and SARI teams have and are continuing to explore the development of a low-cost portable neem oil extraction system for use at the village level. They are working with a local company to develop a prototype. A portable neem extraction system would be a game-changer in terms of local

groups being able to extract neem oil for local sale, thereby potentially facilitating local cottage industries around neem oil extraction and sale.

3.1.5 Studies on the potential for use of biopesticides in the pest control market in Benin (IITA, MSU–Maredia, INRAB, and UIUC)

The INRAB and IITA teams are working closely with Dr. Maredia of MSU to perform survey studies to understand the potential for biopesticides in the pest control market in Benin. A first-round survey has been conducted in FY14 and the outcomes were presented during a recent trip by Drs. Angela Records (USAID), Widders (MO), and Pittendrigh (UIUC) to Benin. The data are currently been assessed to determine the outcomes of this survey and what will be needed for follow-up surveys. This serves as both an important study for our program and a capacity building effort by Michigan State University to help our team gain the capacity to do such studies.

IITA is also continuing to work with a Benin-based company that is extracting neem oil for sale. Drs. Angela Records (USAID), Widders (MO), and Pittendrigh (UIUC) recently visited this company. They purchase neem seeds from hundreds of local women, process the neem oil and sell the oil regionally in Benin. IITA is continuing to explore pathways to work with this company to expand their operations across Benin.

3.2 Educational Solutions

As part of our "Educational Solutions" we have developed ICT training materials, online and in-country ICT training sessions available for testing with current partners and potential new partners, FFF program available for testing of impact leading to educational packages for scaling. Potential pathways for deployment of educational videos explored, and we have been testing pathways to deploy videos. We have also been exploring pass-off of our educational materials to NGOs and government agencies for scaling. Over the past 18-months all of these have occurred. Due to the Scientific Animations Without Borders (SAWBO) program we now have a significant amount of the required educational materials needed for educating farmers on cultural techniques that they can perform to reduce problems with insect attack. Our team is continuing to make more content and more language variants, so more groups in our target countries can be impacted by these educational materials.

We have ICT training packages and interfaces in development and ready for release to make our materials easily available to outside groups. An ICT training session occurred in Ghana in FY13 and was funded by an outside source with no costs to the Legumes Innovations Lab (funded by the Chancellor's office at UIUC) (ca. 30 participants), two ICT training sessions have occurred online through Skype with local NGO groups in Ghana (ca. 100 individuals) as well and the SAWBO team has done two ICT training sessions on campus for African librarians visiting campus (ca. 100 individuals). More than 2000 "Extension Systems in Your Wallet" have been created and distributed to educators, government officials, and NGOs globally (with about 500+ of these going out to groups in the four main countries we work in for our Legumes Innovations Lab program). The "Extension Systems in Your Wallet" is a credit card style USB card that holds SAWBO materials. Users can keep the USB drive in their wallet (save some of their own materials on it) and then share our educational

materials with others when and where they see fit. Pass off has occurred to country extension programs, FARA, and other West African intercountry institutions.

We have created two "Apps" for cell phones that allow for easy distribution of the SAWBO animations. Over FY14 we spent a great deal of time with the UIUC legal team to make sure all data that we keep track of with the Apps adhere to international standards and do not violate the privacy of those that are using the App. The necessary supporting legal documentation were created and integrated into the Apps. The Apple version of the App has been tested by multiple groups and the supporting instructional video on the App will be finalized early in the FY15 cycle. We expect to run the App through the university "smoke screening" before submitting to "App Store" where it can be downloaded for free by anyone that wants to use it. The Android version of the App is completely functional and we are completing the aesthetic aspects of the App. Once completed it will be made available for free of charge on Google Play and on the SAWBO websites.

Both aforementioned Apps are linked to a database where we can keep track of how many people download the videos and the place in the world where they download them (down to country or city). We will not keep track of any personal data from those using the App and we will purposely not pinpoint where they are using it in terms of the location. Thus, once we released we can gain a better idea of the use of these Apps. Essentially, these Apps allow people to choose the country, the language and the topic of educational materials that they need. If available they can download it into the App on their cell phone or their tablets when they are connected to WiFi. They can then take the cell phone or tablet out to the target audience (away from WiFi or Internet access) and show the video and in the case of the Android App animations can be transferred, by Bluetooth®, onto other's cell phones. In the case of the Apple App, Apple restricts Bluetooth® transfers to non-Apple products, so transfer can only be to other Apple products. However, Apple products can still be used as rapid download and portable screens for showing people the content. However, Android phones are far more common in the target countries, so we will focus on the testing and promotion of this App in the countries we are working in.

The fundamental point of these Apps will be to make SAWBO educational content easily available to the end users who can easily access and use these materials in educational programs and in the case of the Android App—easy to take content from our server onto their devices and then easy to share once one reaches the village. The Apps will also provide us with basic information on the use of the Apps and the content in a systematic manner.

We have also continued to collaborate with our in country teams to determine which NGO and other local groups become the logical ones for deployment. We have an ongoing "tagged" animation tests to determine which groups most effectively deploy the animations. These are animations that have a slight change on them, at the end of the animation, so that we can determine which group passed them out to others.

3.3 Private Sector and NGO Involvement

Interestingly, a significant amount of SAWBO materials have also being used by NGOs and government organizations outside our target countries. For example, animations funded by the

ADM Institute for the Prevention of Postharvest loss resulted in animations for the Ethiopian Agricultural Transformation Agency (ATA). ATA purchased 640 tablet computers that were distributed to Extension agents across Ethiopia—with an estimated coverage of 168,000 Teff growers (http://news.illinois.edu/news/14/0519sawbo_BarryPittendrigh.html). Other SAWBO animations have also been used in documentaries on TV (e.g., in the Republic of Georgia—http://www.youtube.com/watch?v=Gh2EhCZOlV8). Within the four target counties we work in we estimate the numbers of people that viewed the animations in tens of thousands during this past 18 months, based on the use by host country scientists in their educational programs and NGOs that have used these tools. Additionally, biocontrol animations on the pests of cowpeas have been used in Mozambique in farmer training sessions. Finally, we are exploring new technologies for the deployment of animations off small electronic devices that can be used as local "hotspots" for people to download animations onto their phones. Thus, an extension agent may be able to have a "hotspot" offline "WiFi/Bluetooth" system sitting in their vehicle, backpack or even pockets. When they go into a village the "hotspot" devices provide a centralized spot where people can download content. Many outside groups have been using our materials by downloading them and placing them on small projection systems that can be used at the village level during extension sessions.

This past year data analysis of an experiment performed by the MSU–Maredia, INRAN and UIUC team demonstrated that the animations were essentially as effective in promoting adoption of a new technology as tradition extension strategies. Although this only represents one experiment it does represent an encouraging result for this potentially highly scalable extension strategy

Our team has continued to explore the use of collaborating with and training of NGOs and other groups to perform farmer field flora. Both INERA and INRAN have used these strategies as a way to scale their technologies. For example, this past year INRAN was able to hold more than 16 FFF through this approach.

Objective 4. Capacity Building

Our capacity building efforts fall into four categories: (1) undergraduate and graduate student training, (2) technician training, (3) cross-institutional capacity building for biocontrol agents, and (4) systems to easily pass of our outcomes to other groups that can scale the pest control strategies.

4.1 Undergraduate and Graduate student training

Each team continues to play an active role in undergraduate and graduate training programs. The complete list of training efforts is under "degree training." However, we would like to note that Dr. Tolulope Agunbiade recently graduated from UIUC with a PhD and is a Postdoc at Yale University. She is actively collaborating with IITA with the long-term goal of seeking employment in West Africa. Dr. Agunbiade's PhD program was primarily funded by a Howard Hughes Doctoral Fellowship.

4.2 Technician Training

An INERA technician spend several weeks at IITA this year to further develop biocontrol agent rearing and deployment skills. Also, online cross-training has occurred (via e-mail, Skype and video exchanges based on IITA videos) among technical staff at INERA, INRAN, and IITA to share skill sets.

4.3 Cross-Institutional Capacity Building for Biocontrol Agents

IITA, INERA and INRAN, due to ongoing collaborative efforts are all well-positioned to rear and deploy biocontrol agents on a scale that we expect will significantly impact target pest populations in each of these countries. Additionally, all are also in a position to test, train, and scale the neem plus virus strategy for pest control. We have begun the process of transfer of this knowledge to our new partners in Ghana at CRI and SARI.

4.4 Systems to easily pass of our outcomes to other groups that can scale the pest control strategies

Our team has continued to build the necessary sets of networks (e.g., NGOs, companies, FFF organizations, women's organizations, etc.) with whom we can pass off (1) educational materials regarding pest control strategies (through a variety of online and offline systems), (2) neem or neem and virus control strategies, (3) direct deployment of biocontrol agents and (4) FFF training approaches.

IV. Major Achievements

1. Development of biocontrol agents useful for scaling for management of cowpea pests.
2. Neem and viral spray strategy brought forward into field-testing with farmers.
3. Experimental analyses of field data have shown animated educational approach to be as effectively as use of extension agent presentations. This strategy allows us the ability to significantly scale our educational content.
4. SAWBO has been able to demonstrate the potential for other organizations to scale their materials. For example, a "buy in" by the Ethiopian Agricultural Transformation Agency and the ADM Institute for the Prevention of Postharvest Loss has shown that SAWBO videos can be placed on tablet computers (640 in this case) and given out to extension agents across a given developing nation country for extension agents to deploy to end users (in this case an estimated 168,000 individuals) as part of their educational programs (http://news.illinois.edu/news/14/0519sawbo_BarryPittendrigh.html). SAWBO educational content has and can be scaled across borders beyond our initial target countries.
5. In FY13–14 Scientific Animations Without Borders was featured on The Big Ten Network (https://www.youtube.com/watch?v=zuKZNHihCpE) both part as a news program and as a one-minute ad (not shown) that was shown on TV and at football stadiums during UIUC football games and on TV during basketball games. We have not been given the viewership information, however, the numbers of people watching the one-minute version should be very similar to the number of people nationally who watch UIUC football and basketball games on national TV.

V. Research Capacity Strengthening

No supplemental Institutional Capacity Strengthening funds were received in FY13–14.

VI. Human Resource and Institution Capacity Development

Short-Term Training

Short-Term Training 1

1. **Purpose of Training:** Training of NGOs in the use of SAWBO materials
2. **Type of Training:** ICT training sessions
3. **Country Benefiting:** Ghana
4. **Location and dates of training:** Accra, summer 2013 and online training sessions in 2014
5. **Number receiving training (by gender):** ca. 75 males and 75 females
6. **Home institution(s) (if applicable):**
7. **Institution providing training or mechanism:** UIUC

Short-Term Training 2

1. **Purpose of Training:** Train farmers in IPM
2. **Type of Training:** FFF
3. **Country Benefiting:** Burkina Faso
4. **Location and dates of training: Multiple locations in Burkina Faso:** various dates on FY14
5. **Number receiving training (by gender):** 70 males and 50 females in Burkina Faso
6. **Home institution(s) (if applicable):** INERA
7. **Institution providing training or mechanism:** INERA

Short-Term Training 3

1. **Purpose of Training:** Train farmers in IPM
2. **Type of Training:** FFF
3. **Country Benefiting:** Niger
4. **Location and dates of training: Multiple locations in Niger:** various dates on FY14
5. **Number receiving training (by gender):** 70 males and 30 females in Niger
6. **Home institution(s) (if applicable):** INRAN
7. **Institution providing training or mechanism:** INRAN

Training Performed by Outside Groups as a Collaboration with INRAN

1. Training in collaboration with Mercy Corps NGO working in Maradi and Zinder area and implemented 28 FFS related cowpea production—Estimated impact of 500 or more farmers with an approximate 50:50 split of women and men.
2. 116 farmers were trained with Sahel Bio and HEKS.EPER a Swiss land NGO from 08–10 July 2014

Degree Training

Trainee 1

1. **Name of Trainee (First and Last Names):** Fuseini Abdulai
2. **Country of Citizenship:** Ghanaian
3. **Gender:** Male
4. **Host Country Institution Benefitting from Training:** Ghana
5. **Institution Providing Training:** University for Development Studies, Tamale, Ghana
6. **Supervising Legume Innovation Lab PI:** Stephen Asante
7. **Degree Program:** Undergraduate
8. **Field or Discipline:** Life Sciences
9. **Research Project Title:** Life history of the pests of cowpea in Northern Ghana
10. **Start Date:** October 2013
11. **Projected Completion Date:** September 2015 (tentative)
12. **Is Trainee a USAID Participant Trainee and Registered on TraiNet?** No
13. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active

Trainee 2

1. **Name of Trainee (First and Last Names):** Deborah Anobil AMOSAH
2. **Country of Citizenship:** Ghanaian
3. **Gender:** Female
4. **Host Country Institution Benefitting from Training:** Ghana
5. **Institution Providing Training:** Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi
6. **Supervising Legume Innovation Lab PI:** Haruna Braimah
7. **Degree Program:** Undergraduate
8. **Field or Discipline:** Agriculture
9. **Research Project Title:** Neem control strategies on the pests of cowpea in Northern Ghana
10. **Start Date:** October 2013
11. **Projected Completion Date:** September 2015 (tentative)
12. **Is Trainee a USAID Participant Trainee and Registered on TraiNet?** No
13. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active

Trainee 3

1. **Name of Trainee (First and Last Names):** Apolline SANOU
2. **Country of Citizenship:** Burkina Faso
3. **Gender:** Female
4. **Host Country Institution Benefitting from Training:** INERA
5. **Institution Providing Training:** INERA and University of Ouagadougou

6. **Supervising Legume Innovation Lab PI:** Dr. Clementine Dabire
7. **Degree Program:** PhD
8. **Field or Discipline:** Entomology
9. **Research Project Title:** Biological control of cowpea pod sucking bug *Clavigralla tomentosicollis* Stäl.
10. **Start Date:** 2011
11. **Projected Completion Date:** 2015
12. **Is Trainee a USAID Participant Trainee and Registered on TraiNet?** No
13. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed

Trainee 4

1. **Name of Trainee (First and Last Names):** DRABO Edouard
2. **Country of Citizenship:** Burkina Faso
3. **Gender:** Male
4. **Host Country Institution Benefitting from Training:** INERA
5. **Institution Providing Training:** INERA and University of Ouagadougou
6. **Supervising Legume Innovation Lab PI:** Dr. Clementine Dabire
7. **Degree Program:** MSc
8. **Field or Discipline:** Entomology
9. **Research Project Title:** Botanical extracts use for the management of cowpea pests at Sudan–Sahelian and Soudanian zones at Kamboinsé and Farako-ba stations
10. **Start Date:** 2015
11. **Projected Completion Date:** 2017
12. **Is Trainee a USAID Participant Trainee and Registered on TraiNet?** No
13. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** In progress

Trainee 5

1. **Name of Trainee (First and Last Names):** Mariam DERA
2. **Country of Citizenship:** Burkina Faso
3. **Gender:** Female
4. **Host Country Institution Benefitting from Training:** INERA
5. **Institution Providing Training:** INERA and University of Ouagadougou
6. **Supervising Legume Innovation Lab PI:** Dr. Clementine Dabire
7. **Degree Program:** PhD
8. **Field or Discipline:** Entomology
9. **Research Project Title:** New pests occurring in dry season on cowpea seed production plots
10. **Start Date:** 2014
11. **Projected Completion Date:** 2018

12. **Is Trainee a USAID Participant Trainee and Registered on TraiNet?** No
13. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** In progress

Trainee 6

1. **Name of Trainee (First and Last Names):** Élisée DABRÉ
2. **Country of Citizenship:** Burkina Faso
3. **Gender:** Female
4. **Host Country Institution Benefitting from Training:** INERA
5. **Institution Providing Training:** INERA and University of Ouagadougou
6. **Supervising Legume Innovation Lab PI:** Dr. Clementine Dabire
7. **Degree Program:** PhD
8. **Field or Discipline:** Entomology
9. **Research Project Title:** To be determined
10. **Start Date:** 2015
11. **Projected Completion Date:** 2019
12. **Is Trainee a USAID Participant Trainee and Registered on TraiNet?** No
13. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** In progress

Trainee 7

1. **First and Other Given Names:** Joelle
2. **Last Name:** Toffa
3. **Citizenship:** Benin
4. **Gender:** Female
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** PhD in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Fungal entomopathogens as biopesticides against the pod borer *Maruca vitrata*
12. **Start Date:** 2010
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 8

1. **First and Other Given Names:** Djibril Aboubakar
2. **Last Name:** Souna
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** PhD in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Bioecology of *Therophilus javanus*, a promising biocontrol candidate against *Maruca vitrata*
12. **Start Date:** 2014
13. **Projected Completion Date:** 2018
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 9

1. **First and Other Given Names:** Judith
2. **Last Name:** Honfoga
3. **Citizenship:** Benin
4. **Gender:** Female
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** MSc in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Detection and quantification of *Therophilus javaus* parasitism in *Maruca vitrata* larvae using species-specific qPCR primers.
12. **Start Date:** 2014
13. **Projected Completion Date:** 2015
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 10

1. **First and Other Given Names:** Hilaire
2. **Last Name:** Kpongbe
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** MSc in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Effect of aggregation pheromones of *Clavigralla tomentosicollis* on its egg parasitoid *Gryon fulviventre*
12. **Start Date:** 2013
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 11

1. **First and Other Given Names:** Ruth
2. **Last Name:** Afora
3. **Citizenship:** Benin
4. **Gender:** Female
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** MSc
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Testing dosage of biopesticide cashew apple oil (*Anacardium occidentalis*) against cowpea pests
12. **Start Date:** 2014
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 12

1. **First and Other Given Names:** Cossi Roland Maximilien
2. **Last Name:** Belogoun
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** MSc in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Biology and competitiveness of *Phanerotoma syleptae*, a novel parasitoid of the pod borer *Maruca vitrata*
12. **Start Date:** 2013
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 13

1. **First and Other Given Names:** Maryse
2. **Last Name:** Tossou
3. **Citizenship:** Benin
4. **Gender:** Female
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** BSc
8. **Program Areas or Discipline:** Entomopathology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Comparing spent grains and milled rice as substrate for mass production of *Beauveria bassiana*
12. **Start Date:** 2014
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 14

1. **First and Other Given Names:** Vincent
2. **Last Name:** Dandjinou
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** BSc
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Fine-tuning neem oil and *MaviMNPV* dosage in field applications
12. **Start Date:** 2014
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 15

1. **First and Other Given Names:** Lopez
2. **Last Name:** Akogninou
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** BSc in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Assessing competition between *Therophilus javanus* and *Phanerotoma syleptae*
12. **Start Date:** 2014
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 16

1. **First and Other Given Names:** Faisol
2. **Last Name:** Laleye
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** IITA
6. **Supervising Legume Innovation Lab PI:** Tamò
7. **Degree Program for Training:** BSc
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** Host range of the parasitoid *Therophilus javanus*
12. **Start Date:** 2014
13. **Projected Completion Date:** 2014
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Completed
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 17

1. **First and Other Given Names:** Maimouna
2. **Last Name:** Abdourahmane
3. **Citizenship:** Niger
4. **Gender:** Female
5. **Training Institution:** INRAN / University of Maradi
6. **Supervising Legume Innovation Lab PI:** Baoua / Amadou (academic supervisor Prof Saadou Mahamane, University of Maradi)
7. **Degree Program for Training:** PhD in Entomology
8. **Program Areas or Discipline:** Entomology
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?**
10. **Host Country Institution to Benefit from Training:** Niger
11. **Thesis Title/Research Area:** study on the incidence of *Clavigralla tomentosicollis* on cowpea yield and dissemination of one biopesticide for effective control of the pest in the region of Zinder et Maradi
12. **Start Date:** May 2014
13. **Projected Completion Date:** 2018
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Partial

Trainee 18

1. **First and Other Given Names:** Leonard
2. **Last Name:** Hinnou
3. **Citizenship:** Benin
4. **Gender:** Male
5. **Training Institution:** INRAB / University of Benin
6. **Supervising Legume Innovation Lab PI:** Dr. Tamo
7. **Degree Program for Training:** M.S.
8. **Program Areas or Discipline:** Social Sciences
9. **If Enrolled at a U.S. University, will Trainee Be a Participant Trainee as Defined by USAID?** No
10. **Host Country Institution to Benefit from Training:** Benin
11. **Thesis Title/Research Area:** TBD
12. **Start Date:** 2014
13. **Projected Completion Date:** TBD
14. **Training Status (Active, Completed, Pending, Discontinued, or Delayed):** Active (move from HC–PI to student status)
15. **Type of Innovation Lab Support (Full, Partial or Indirect) for Training Activity:** Support for INRAB

VII. Achievement of Gender Equity Goals

Throughout all aspects of our efforts we attempt to meet gender equity goals, from undergraduate, graduate student and technician training to field training of female farmers.

VIII. Explanation for Changes

There were no major changes in our workplan.

IX. Self-Evaluation and Lessons Learned

One fundamental issue that we have observed is there is a considerable amount of potential for cross-collaboration between projects. We have passed educational content on to other projects for use in other countries and we have successfully worked with other Legumes Innovation Lab projects on both research and social science assessment.

X. Scholarly Accomplishments

Theses

Agunbiade, T. 2014. *A Genomic Analysis of the Insect Pest Populations of Cowpea in West Africa.* PhD Thesis, University of Illinois at Urbana–Champaign.

Akpoffo, M. A., 2014. *Evaluation de quelques paramètres biologiques et de l'efficacité de Therophilus javanus Bhat et Gupta (Hymenoptera: Braconidae), parasitoïde larvaire de Maruca vitrata Fabricius (Lepidoptera: Crambidae), foreuse des fleurs et des gousses du niébé (Vigna unguiculata (L.) Walp).* MSc thesis, Université Africaine de technologie et de management UATM/GASA, Cotonou, Benin.

Hounsa, P. M. G., 2014. *Etude des interactions entre Trichogrammatoïdea eldanae Viggiani (Hymenoptera: Trichogrammatidae), et Phanerotoma syleptae Zettel (Hymenoptera: Braconidae); deux parasitoïdes de Maruca vitrata Fabricius (Lépidoptera: Crambidae), ravageur du niébé (Vigna unguiculata (L.) Walp).* MSc thesis, Université Africaine de technologie et de management UATM/GASA, Cotonou, Benin.

Selected Presentations

Bello-Bravo, J. 2014. Scientific Animations Without Borders. *Expert Consultation on Facilitating the Convergence of ICT*, Rhenen, The Netherlands, October 29–31, 2014.

Bello-Bravo, J. and B. Pittendrigh. 2014. Scientific Animations Without Borders: Working with the Crowd for International Development. *Center for Culturally Responsive Evaluation and Assessment Conference*, Chicago, Illinois, September 18, 2014.

Bello-Bravo, J., S. Miresmailli, and B. Pittendrigh. 2014. Scientific Animations Without Borders and crowdsourced emergency relief knowledge in local languages. *12th Annual International Conference on Communication and Mass Media*, May 12–15, 2014, Athens, Greece.

Bello-Bravo, J. and B.R. Pittendrigh. 2014. Scientific Animations Without Borders: A High Throughput System for Sharing Educational Content in Developing Nations. *Humanities, Arts, Science and Technology Alliance and Collaboratory (HASTAC)*, Lima, Peru, April 24–27, 2014.

Maredia, M., B. Reyes, M. Niango, B. Pittendrigh, and J. Bello-Bravo. 2014. Can Animated Educational Materials Induce Learning and Adoption Among Low-Literate Farmers? A Field Experiment on the Dissemination of Cowpea Grain Storage Technologies in Burkina Faso. Sokoine University of Agriculture, Tanzania, June 25, 2014.

Invited presentations

"Scientific Animations Without Borders" an INIA in Las Brujas, Uruguay (trip paid for by INIA). November 2013.

"Scientific Animations Without Borders" at the Ministry of Agriculture, Montevideo, Uruguay. November 2013.

"Scientific Animations Without Borders" at the Ministry of Education, Montevideo, Uruguay. November 2013.

"Scientific Animations Without Borders" at the Dirección de Innovación, Ciencia y Tecnología para el Desarrollo. November 2013.

Publications

Agunbiade, T., Steele, L., Coates, B. S., Gassmann, A., Margam, V. M. , Ba, M., Dabire, C., Baoua, I., Bello-Bravo, J., Seufferheld, F., Sun, W., Tamò, M., Pittendrigh, B.R. IPM-omics: from genomics to extension for integrated pest management of cowpea. In: Boukar, O., Coulibaly, O., Fatokun, C., Lopez, K., Tamò M. (eds.). 2013. Enhancing cowpea value chains through research advances. Proceedings of the 5th World Cowpea Research Conference, 26 September–1 October 2010 Saly, Senegal, pp. 231–248.

Agunbiade, T.A., W. Sun, B. S. Coates, R. Djouaka, M. Tamo, M. N. Ba, C. Binso-Dabire, I. Baoua, B. P. Olds, and B.R. Pittendrigh. 2013. Development of reference transcriptomes for the major insect pests of cowpea: A toolbox for insect pest management approaches in West Africa. *PLoS ONE*, 8(11): e79929

Bello, J., Seufferheld, F., Steele, L. D., Agunbiade, T., Guillot, D., Cutz, G., Pittendrigh, B.R. Scientific Animations without Borders: an international collaborative approach for building applicable scientific educational materials for use on cell phones, and the Internet in developing nations. 2013. In: Boukar, O., Coulibaly, O., Fatokun, C., Lopez, K., Tamò M. (eds.). Enhancing cowpea value chains through research advances. *Proceedings of the 5th World Cowpea Research Conference*, 26 September–1 October 2010 Saly, Senegal, pp. 369–380.

Bello-Bravo, J., and B.R. Pittendrigh. 2014. Scientific Animations Without Borders: Entomological origins and cross-discipline impact. *Entomology Society of Canada Bulletin*, 46(1): 31–36.

Bello-Bravo, J., T. Agunbiade, E. Dannon, M. Tamo, and B.R. Pittendrigh. 2013. The prospect of animated videos in agriculture and health: A case study in Benin. *International Journal of Education and Development using ICT*, 9(3): 4–16.

Ihm, J., M. Shumate, J. Bello-Bravo, N. Ba, C. Dabire-Binso, and B. Pittendrigh. 2014. Variance of cognitive social structures between farmers and extension agents in Burkina Faso. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*, 25(5). Digital Object Identifier (DOI) 10.1007/s11266-014-9515-5

Sokame, B. M., A. K. Tounou, B. Datinon, E. A. Dannon Elie, C. Agboton, S. Ramasamy, B.R. Pittendrigh, and M. Tamò. 2014. Combined activity of the *Maruca* multinucleopolyhedrovirus, *Mavi*MNPV and oil from neem, *Azadirachta indica* Juss and *Jatropha curcas* L., for the control of cowpea pests. *Crop Protection*. In press

Toffa Mehinto, J., Atachi, P. , Douro, K., Tamò, M. 2014. Pathogenicity of entomopathogenic *fungi Metarhizium anisopliae* and *Beauveria bassiana* on larvae of the legume pod borer *Maruca vitrata* (Lepidoptera: Crambidae). *ARPN Journal of Agricultural and Biological Science*. 9: 55–6.

Toffa Mehinto, J., Atachi, P. , Douro, K., Dannon, E., Tamò, M. 2014 Mortality of *Maruca vitrata* (Lepidoptera: Crambidae) larval stages induced by different doses of the entomopathogenic fungi *Metarhizium anisopliae* and *Beauveria bassiana. International Journal of Advanced Research*, 2: 273–285.

Traore, F., C.L. Dabire-Binso, N.M. Ba, A. Sanon and B.R. Pittendrigh. 2014. Annual cycles of the legume pod borer *Maruca vitrata* Fabricius (Lepidoptera: Crambidae) populations in southwestern Burkina Faso: Host-plants and natural enemies. *Arthropod–Plant Interactions*, 8(2): 155–162.

Wetro, E., A. K. Tounou, C. Agboton, B. Datinon, R. Srinivasan, B.R. Pittendrigh and M. Tamo. 2014. Bionomics of the parasitoid *Apanteles taragamae* as influenced by different diets fed to its host, *Maruca vitrata*. *BioControl*, 59: 55–65.

XI. Progress in Implementing Impact Pathway Action Plan

Objective 1

We performed steps one and two in our impact pathway for "1—defining pest problems." In terms of "Program Logic" also worked on Step 4.1: Collection of pest populations using scouting throughout the year on cowpea crops and wild alternative host plants in Ghana, Burkina Faso, Niger, and Benin. Insects were genotyped at UIUC to determine pest movement patterns within regions (on cowpeas and alternative host plants). We also worked on developing interfaces to summarize our findings and present our educational steps for implementation in a visual format.

Objective 2

We worked on Steps one to four in our impact pathway for "2: Discover, document, and set the stage for scaling of appropriate solutions." In terms of "Program Logic" we worked on Step 4.1 for this section: (a) Novel *Maruca* parasitoids from Asia introduced to the IITA laboratories for initial screening; (b) scale-up of the rearing and future release of the thrips parasitoid in all participating countries; (c) sex and aggregation pheromones for pod sucking bugs was investigated; (d) PCR techniques developed for detecting endophytic strains of *Beauveria bassiana* in the different tissues of cowpea; and, (e) feasibility of storing *Maruca* virus both as liquid and solid substrate investigated (IITA).

Objective 3

Steps one to three, in the impact pathway, all occurred within this past cycle. In terms of Program Logic, step 4.1 we: 1) developed everything necessary for the releases of biocontrol agents to be scaled out; 2) educational solutions—ICT training materials, online and in-country ICT training sessions available for testing with current partners and potential new partners, FFF program available for testing of impact leading to educational packages for scaling. The potential pathways for deployment of educational videos were explored, and begin testing of pathways to deploy videos; and, 3) private sector/NGO involvement.

XII. Milestones

Feed the Future Innovation Lab for Collaborative Researchon Grain Legumes

Report on the Achievement of "Milestones of Progress"

(For the Period: April 1, 2014 -- September 30, 2014)

This form should be completed by the U.S. Lead PI and submitted to the MO by October 1, 2014

Project Title: **cowpea in Africa**

	Abbreviated name of institutions																				
	UIUC			**IITA**			**INERA**			**INRAN**			**INRAB**			**CRI**			**SARI**		
	Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved		Target	Achieved	
Milestones by Objectives	**10/1/14**	**Y**	**N ***	**10/1/14**	**Y**	**N ***	**10/1/14**	**Y**	**N ***	**10/1/14**	**Y**	**N ***	**10/1/14**	**Y**	**N ***	**10/1/14**	**Y**	**N ***	**10/1/14**	**Y**	**N ***
	(Tick mark the Yes or No column for identified milestones by institution)																				
Objective 1	**Characterize Smallholder Farmers' Motivations, Current Knowledge and Practices**																				
Objective 1: Define the pest problems																					
1.1 Insect scouting				X	X		X	X		X	X					X	X		X	X	
1.2 Molecular analysis	X	X																			
Objective 2: appropriate solutions																					
2.1 novel natural enemies of the pod borer				X	X																
2.2 rearing / releases of thrips parasitoids				X	X		X	X *		X	X *					X	X *		X	X *	
2.3 novel release devices for egg parasitoids				X	X																
2.4 endophytes				X	X																
2.5 production of bio-pesticides				X	X		X	X		X	X					X	X		X	X	
2.6 Work on resistant/tolerant varieties				X	X		X	X		X	X										
* Comment - We are completely prepared for these releases. However, actual releases will only occur pending USAID approval (environmental assessment).																					
Objective 3: Scaling of solutions																					
3.1 Inoculative release of natural enemies				X	X*		X	X *		X	X *					X	X *		X	X *	
3.2 Development&Investigations of Education	X	X																			
3.3 Involving private sector and NGO				X	X								X	X							
3.4 Understanding the potential for scaling	X	X											X	X							
* Comment - We are completely prepared for these releases. However, actual releases will only occur pending USAID approval (environmental assessment).																					

Milestones, continued

Objective 4: Capacity building																				
4.1 graduate training	X	X		X	X		X	X		X	X		X	X		X	X		X	X	
4.2 ICT training tools	X	X		X	X		X	X		X	X					X	X		X	X	
4.3 technician training				X	X		X	X		X	X					X	X		X	X	
4.4 Short course online ICT training and in co		X	X																		
Name of the PI responsible for reporting on milestones	Barry Robert Pittendrigh			Manuel Tamo			Clementine Dabire			him Baoua/Amadou Lao			Eustache Biaou			Haruna Braimah			Stephen Asante		
Signature/Initials:																						
Date:	30-Sep-14			30-Sep-14			30-Sep-14			30-Sep-14			30-Sep-14			30-Sep-14			30-Sep-14		

XIII. Performance Indicators

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 13 (Second Semester only), FY 14, FY 15, FY 16 and FY 17

Project Name:SO1.B1 IPM-omics: Scalable and sustainable biological solutions for pest management of insect p

Summary of all institutions

Indic. numbe	Output Indicators	FY 13 Target (only April 1, 2013 - September 30, 2013)	FY 13 Revised	FY 13 Actual	FY 14 Target (October 1, 2013 - September 30, 2014)	FY 14 Revised	FY 14 Actual	FY 15 Target (October 1, 2014 - September 30, 2015)	FY 15 Revised	FY 15 Actual
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	1	0	1	9	0	12	9	0	0
	Number of women	1	0	1	6	0	7	6	0	0
	Number of men	0	0	0	3	0	5	3	0	0
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	219	0	219	5444	0	5519	11354	0	0
	Number of women	77	0	77	2692	0	3092	5691	0	0
	Number of men	142	0	142	2752	0	2427	5663	0	0
	Numbers by Type of individual	221	0	77	5444	0	5519	11354	0	0
	Producers	122	0	122	5134	0	5134	10694	0	0
	People in government	35	0	35	58	0	833	153	0	0
	People in private sector firms	18	0	18	34	0	34	144	0	0
	People in civil society	46	0	46	218	0	219	363	0	0
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	5428	0	5428	12500	0	12500	34500	0	0
	New	28	0	28	6972	0	6972	22000	0	0
	Continuing	5400	0	5400	5528	0	5528	12500	0	0
	Gendered Household Type	5428	0	5428	12500	0	12500	34500	0	0
	Adult Female no Adult Male (FNM)	1050	0	1050	3230	0	3230	5130	0	0
	Adult Male no Adult Female (MNF)	1050	0	1050	3270	0	3270	5770	0	0
	Male and Female Adults (M&F)	2803	0	2803	4900	0	4900	21100	0	0
	Child No Adults (CNA)	525	0	525	1100	0	1100	2500	0	0

Performance Indicators, continued

4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization	57	0	27	144	0	144	238	0	0
	Private enterprises (for profit)	11	0	11	15	0	15	24	0	0
	Producers organizations	9	0	9	15	0	15	18	0	0
	Water users associations	0	0	0	1	0	1	1	0	0
	Women's groups	18	0	18	40	0	40	63	0	0
	Trade and business associations	5	0	5	10	0	10	14	0	0
	Community-based organizations (CBOs)	14	0	14	63	0	63	118	0	0
	New/Continuing (total)	56	0	50	144	0	144	238	0	0
	New	37	0	34	75	0	75	89	0	0
	Continuing	20	0	16	69	0	69	149	0	0
5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	48	0	48	62	0	62	78	0	0
	Agricultural production	23	0	23	30	0	30	42	0	0
	Agricultural post harvest transformation	22	0	22	30	0	30	35	0	0
	Nutrition	3	0	3	2	0	2	1	0	0
	Multi-focus	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	5160	0	10322	10010	0	10020	14100	0	0
	crop genetics	460	0	460	1070	0	1070	1070	0	0
	animal genetics	0	0	0	0	0	0	0	0	0
	pest management	4302	0	4302	7810	0	7810	11900	0	0
	disease management	0	0	0	0	0	0	0	0	0
	soil-related	200	0	200	200	0	200	200	0	0
	irrigation	0	0	0	0	0	0	0	0	0
	water management	0	0	0	0	0	0	0	0	0
	post-harvest handling and storage	200	0	200	2000	0	2000	3000	0	0
	processing	0	0	0	0	0	0	0	0	0
	climate mitigation or adaptation	0	0	0	0	0	0	0	0	0
	fishing gear/technique	0	0	0	0	0	0	0	0	0
	other	0	0	0	0	0	0	0	0	0
	total w/one or more improved technology	5160	0	5160	10010	0	10010	14100	0	0
	New/Continuing hectares	5160	0	5160	10010	0	10010	14100	0	0
	New	10	0	10	4850	0	4850	4100	0	0
	Continuing	5150	0	5150	5160	0	5160	10000	0	0
	Sex of person managing hectare	5160	0	5060	10010	0	10000	14020	0	0
	Male	2575	0	2575	4956	0	4956	7310	0	0
	Female	2575	0	2575	4537	0	4537	5685	0	0
	Association-applied	10	0	10	517	0	517	1025	0	0

Performance Indicators, continued

7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	36	0	34	38	0	34	36	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	22	0	21	19	0	16	15	0	0
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	13	0	12	16	0	15	14	0	0
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	1	0	1	3	0	3	7	0	0
8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs	0	0	0	0	0	0	0	0	0
	Outputs	0	0	0	0	0	0	0	0	0
	Macroeconomic	0	0	0	0	0	0	0	0	0
	Agricultural sector-wide	0	0	0	0	0	0	0	0	0
	Research, extension, information, and other public service	0	0	0	0	0	0	0	0	0
	Food security/vulnerable	0	0	0	0	0	0	0	0	0
	Climate change adaptation or natural resource management (NRM) (ag-related)	0	0	0	0	0	0	0	0	0
	Stages of development	0	0	0	0	0	0	0	0	0
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	0	0	0	0	0	0	0	0	0
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	0	0	0	0	0	0	0	0	0
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0	0	0	0	0	0	0	0	0
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0	0	0	0	0	0	0	0	0
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0	0	0	0	0	0	0	0	0

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf