Integrated Pest Management
Collaborative Research Support Program (IPM CRSP)

Technical Workplan

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Integrated Pest Management: Science for Agricultural Growth in Latin America and the Caribbean

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Objective 1: Generate and transfer effective farmer-friendly IPM packages in vegetables and Andean fruits

Description: Research on IPM packages is at different stages across the LAC region. While the Ecuador and Honduras sites are fairly well along, having identified key pests and diseases and promising solutions, work in the Dominican Republic and Guatemala is less well advanced. In the former two countries, we are moving toward refinement of IPM packages, which is at various stages depending on the crop. In the latter two, we are still identifying key pest complexes and prioritizing research to meet pest control needs.

Activity 1: Conduct crop- and pest-specific research

Status: Continuing

US Scientists involved: Alwang, Norton (VT), Backman, Gugino (Penn State), Weller, Foster (Purdue), Brown (U of AZ), Tolin (VT)

Description: In Ecuador and Honduras, many experiments were initiated in year 1 and most of these will be carried over into the second year. In the Dominican Republic and Guatemala, we need to continue work on pest surveys and establish field trials for promising technologies and important pests of tomato, peppers and other horticultural crops. In all cases, we will collect information on costs and benefits of promising practices and this information will be used in impact assessment.

Progress to date: Trials set up on farmer fields in Ecuador (Andean Fruits and maize) and Honduras (peppers, tomatoes, onions and others).

Ecuador: Several varietal trials for diseases in naranjilla have been established. Means have been identified for managing *Fusarium oxysporum,* nematodes (*Melloidogine incognita*), late blight (*Phytophthora infestans*), anthracnose (*Colletotrichum acutatun*), bacterial cancer (*Clavibacter michiganensis*) and naranjilla fruit fly (*Neulocinodes elegantalis*). Minor adjustments to the IPM package are needed. Tree tomato and blackberry research is ongoing. The main pest problems are: anthracnose (*Colletotrichum* sp), late blight (*Phytophthora infestans*) and various leaf insect pests (tree tomato); and botrytis (*Botrytis cinérea*), mildew (*Peronosphora* sp) and scarab larvae in the plant's root system (blackberry). IPM packages for potato pests, developed and tested in earlier phases of the CRSP are being adapted to new environmental conditions in Guaranda, Ecuador. Key potato pests include: late blight (*Phytophthora infestans*), White Worm (*Premnotypes vorax),* Central American Tuber Moth (*Tecia solanivora*) and a specific nematode (*Globodera pallida*).

Guatemala: We have detected that the diseases that should be emphasized in the three regions (the highlands, principally in Sololá, the southern coast, principally Escuintla and Santa Lucía Cotzumalguapa

and Salamá; Progreso and Zacapa). For solanaceaus crops, these principally are viruses (begomoviruses, potyviruses, tospoviruses and Torrado virus and tobamoviruses for tomato). With virus vectors we have determined that we should emphasize control of whiteflies (*B. tabaci* and *T. vaporariorum*), cycadellids, thrips and aphids. With bacteria we need to focus on *R. solanacearum, C. michiganensis michiganensis* and *Candidatus Liberibacter solanacearum.* With fungi, we will concentrate on Fusarium and Phythopthora. With nematodes, the focus will be on *Pratylenchus* and *Meloidogyne*. In the first year, we also saw the need for implementing programs that include biological control or other ways of control and prevention, other than chemical. Growers are having very difficult time with pests and applying substantial quantities of chemicals. The economics and environmental/human health impacts of production under such circumstances are highly suspect. New pests and diseases are more problematic (such as zebra chip of potato and infection of tomato by *Liberibacter*, *Clavibacter michiganensis michiganensis* and others). Producers need safe technologies to address these problems.

Expected outputs: Pest complexes fully identified and IPM technology packages tested.

Task 1: (Guatemala, DR) Disease surveys in Guatemala and Dominican Republic. Status: ongoing. Scientists involved: Brown (AZ), Backman (Penn State), Arevalo and Palmieri (Guatemala), Martinez (IDIAF). Progress to date: survey in Guatemala has lagged behind plans to undertake it due to damage from 2 serious tropical storms/hurricanes. Description: in Guatemala, plants and vectors are going to be sampled, the plants are going to be tomato, potato, pepper and hosts close to crops. Vectors to be collected are Psyllids, whiteflies, aphids and/or thrips and, where possible, tested for pathogen presence. Also soil samples and root samples are going to be collected to analyze nematodes and look for mycorrhiza. Samples that could represent biological controls will be also collected. Symptoms to be sampled are for viruses, bacterias, fungi or nematodes. The three main regions to be sampled are the highlands, principally in Sololá, the southern coast, principally Escuintla and Santa Lucía Cotzumalguapa and Salamá; Progreso and Zacapa.

Task 2: (Guatemala, DR) Establish experiment-station and farmer field research activities in Guatemala (early 2011) and Dominican Republic (beginning in August/September 2010). Status: ongoing. Scientists involved: Weller (Purdue), Backman and Gugino (Penn State), Palmieri (Guatemala), Martinez (IDIAF). In Guatemala, at the start of 2011, we will start implementing test parcels in each of the three regions with different possible treatments. These will be selected from data gathered from the samplings and from the survey that will be done in November or December. The trials will be done in the highlands at Universidad del Valle station but also in the fields of two or three growers. In Salamá, Fasagua (a producer organization) will facilitate some two or three fields which will be selected in November and December. In Zacapa or Chiquimula and in El Progreso, two fields will be given by Fasagua growers to put the trials. Finally, in the southern coast, some trials will be done at Proesur and two fields from some growers will be used. The growers are going to be recommended by Proesur personnel. A growers meeting will be held at the end of the period of this year to show and discuss results.

Task 3: (Ecuador) Continue to refine and validate naranjilla pest management techniques in Ecuador. Status: continuing. Scientists involved: José Ochoa, Patricio Gallegos, Lucía Manangón, César Asaquibay (INIAP–DNPV); Wilson Vásquez, Aníbal Martínez (INIAP Fruit Program); Víctor Barrera, Luis Escudero,

Elena Cruz (INIAP-Programa RRNN); Paul Backman, Beth Gugino (Penn State). Description: validation trials for the grafted naranjilla (resistant to fusarium and, thus less susceptible to other problems) are being conducted. Trials for alternative fungicides are also being conducted (Captan, Copper Hydroxide, Copper Sulfate, Difenoconazol 250 g/l, Triadimefon 20 g/l , Azoxistrobina, Bacillus).

Task 4: (Ecuador) Development of IPM components for tree tomato IPM package. Status: continuing. Scientists involved: Ochoa, Gallegos, Manangón, Asaquibay (INIAP–DNPV); Vásquez, Martínez (INIAP Fruit Program); Barrera, Luis Escudero, Cruz (INIAP-Programa RRNN); Backman, Gugino (Penn State). Description: (i) establishment of a trial on farmer fields to evaluate laboratory-identified techniques for control of anthracnose with field sanitation procedures, (ii) trial for late blight and mildew control using low-toxicity fungicides (Captan, Copper Hydroxide, Copper Sulfate, Difenoconazol 250 g/l, Triadimefon 20 g/l , Azoxistrobina, Bacillus), and (iii) testing uses of bio-rational controls for insect (B.t, insect pathogens, etc.) and disease management (Bacillus, Trichoderma, etc.).

Task 5: (Ecuador) Development of IPM components for blackberry IPM package. Status: continuing. Scientists involved: Ochoa, Gallegos, Manangón, Asaquibay (INIAP–DNPV); Vásquez, Martínez (INIAP Fruit Program); Barrera, Escudero, Cruz (INIAP-Programa RRNN); Backman, Gugino (Penn State). Description: an experiment with three treatments has been established for blackberry IPM on farmer fields: (i) farmer practice; (ii) INIAP recommendations with reduced chemical inputs (IPM); and (iii) an organic production system. Components of each system will be evaluated. Validation tests will be conducted in the U.S. on fruits and vegetables.

Task 6: (Honduras and Guatemala) Detection of virus and virus-like pathogens in Honduras and Guatemala. Status: ongoing. Scientists involved: Brown (AZ), Palmieri (UDV Guatemala), several at FHIA (Honduras). Description: Liberibacter PCR (testing different primers for detection in plants and psyllids. Development of yellow sticky traps for psyllid and whitefly catches/dispersal times for IPM management/insecticide use when psyllids are dispersing (farmers currently spray throughout the growing season). Expected outputs: tools for identification and design of management practices.

Task 7: (Honduras) Developing/optimizing the diagnostics for the sweet potato viruses in Honduras. Status: ongoing. Scientists involved: Brown (AZ), several at FHIA (Honduras). Description: need to identify positive controls, design and test primers for PCR and RT-PCR (begomoviruses, RNA viruses).

Task 8: (Dominican Republic) Identify the effectiveness of botanical extract for the control of whitefly, aphids and thrips and its effect on natural enemies. Status: new. Scientists involved: Medrano, Foster, Gugino. Description: Team will select and prepare 5 botanical extracts with insecticidal effects (IIBI). We will rear colonies of whitefly, thrips and aphids. We will then conduct a laboratory evaluation of the effectiveness of the botanical extracts on nymphs and adults of whitefly, thrips, and aphids.

Task 9: (Dominican Republic) Explore the efficiency of natural enemies of the San Jose de Ocoa Valley and their potential for reproduction. Status: new. Scientists involved: Medrano, Foster, Gugino . Description: We will identify, collect and rear natural enemies, and then conduct a laboratory evaluation of the effectiveness of natural enemies found in San Jose de Ocoa Valley.

Task 10: (Dominican Republic) Research on the use of associated flowering plants as attractive hosts for natural enemies. Status: new. Scientists involved: Medrano, Foster, Gugino. Description: Reproduce 6 aromatic, cereal and ornamental plants to be used as hosts for natural enemies (most of which will be identified in task 9). Subsequently we will conduct an open field evaluation of the effectiveness of the plants used to attract natural enemies and their impact on the cropping system.

Task 11: (Dominican Republic) Identification and management of nematodes using organic mulch on oriental vegetables (long bean, bitter melon and hot pepper). Status: new. Scientists involved: Medrano, Mendez. Description: Visit the production areas and establish monitoring and sampling methods. Following identification of the nematodes, we will install a trial in an experimental plot.

Task 12: (Dominican Republic) Evaluate the effectiveness of solarization on bacterial wilt caused by *Ralstonia solanacearum* in tomato. Status: new. Scientists involved: Halpay, Backman. Description: experiment will be established in an open field.

Task 13: (Dominican Republic) Evaluate different biological products for the control of *Ralstonia solanacearum* under laboratory conditions. Status: new. Scientists involved: Halpay, Backman. Description: experiment will be established in IDIAF's laboratory.

Task 14: (Dominican Republic) Characterization of species and races of main pathogen associated with tomato and pepper. Status: new. Scientists involved: Halpay, Martinez.

Task 15: (Dominican Republic) Evaluation of the antagonistic effect of Trichoderma spp. Against *Fusarium oxysporum* and *Rhizoctonia solani* on tomato and pepper. Status: new. Scientists involved: Halpay, Backman.

Task 16: (Dominican Republic) Evaluate the effectiveness of solarization in reducing soilborn pathogens on pepper. Status: new. Scientists involved: Halpay, Backman.

Task 17: (Dominican Republic) Evaluation of traps for forecasting fungal disease on tomato and pepper. Status: new. Scientists involved: Mendez, Halpay.

Task 18: (Dominican Republic) Evaluate the effect of agronomic practices on the aphid populations and the reduction of virus incidence on pepper. Status: new. Scientists involved: Medrano, Martinez, Tolin.

Task 19: (Dominican Republic) Examine the epidemiological relationship between aphids and tobacco etch virus in pepper. Status: new. Scientists involved: Medrano, Martinez, Tolin.

Task 20: (Dominican Republic) Identification of weed reservoir of tobacco etch virus and cucumber mosaic virus. Status: new. Scientists involved: Martinez, Tolin.

Task 21: (Honduras) Management of the complex Zebra-chip disease-psyllid of potato and like diseases of other solanaceous crops. Status: Continuing. Scientists involved: FHIA: H.R. Espinoza and J. C. Melgar. Purdue U.: R. Foster and S. Weller. U. of Arizona: J. Brown; Zamorano: A. Rueda, D. Sierra, R. Trabanino. Description: Because of their economic value and widespread consumption potato, tomato and peppers

have historically ranked as the most important vegetable crops of Honduras. In the last decade a pathological problem has gradually arisen that currently is responsible for yield losses of up to 90% in some of the potato cropping areas. The problem, named locally "Papa rayada' ("Striped potato"), was identified in 2009 as the same disease known in North America as "Zebra chip", caused by the fastidious bacteria *Candidatus* Liberibacter psyllaurous/solanacearum. The magnitude of the loss and the local importance of the crop are such that in the last year public and private institutions have initiated actions toward combating the problem. For the disease to occur the bacteria have to be necessarily transmitted to healthy plants by a vector, the Potato psyllid (*Bactericera cockerelli*). According to literature generated elsewhere, the control of this complex relies essentially on combating the vector. In addition, it has been reported elsewhere that tomato and pepper also are hosts of the complex, as well as some weeds; in Honduras the problem has been reported so far only on potatoes but, if also occurring on tomato and pepper, it would endanger production of these crops. Current year activities: Some activities will be continuation of those initiated the previous year and some are new ones, as follows:

a) Studies on the population dynamics of the vector *B. cockerelli* by means of continued year-long monitoring in the main potato growing areas. FHIA.
b) Validation of the most promising management strategies, mainly consideration to alternated use of insecticidal chemicals of different modes of action and improved spraying technology, crop-free periods, use of entomopathogens and natural enemies, i.e., *Orius*, etc. FHIA and Zamorano.
c) Characterization of the reaction of potato varieties of current use in Honduras to the complex Zebra chip-psyllid. At least two trials will be established in collaboration with individuals and associations of growers, seed providers and agrichemical companies. FHIA.
d) Prospection and diagnostic work on other plant species (solanaceous crops and weeds) to ascertain the presence, spread and importance of the problem, and simultaneously search for naturally occurring natural enemies. FHIA and Zamorano.
e) Validation of IPM package including multiple management alternatives for Psyllid control. Zamorano.

Progress to date: We confirmed the occurrence of the problem in the main potato growing areas of Honduras and monitoring studies of the dynamics of the populations of the vector have been initiated. Contacts have been made with importers and local producers of certified seed to source planting material for variety trials to be established in the next phase. Expected outputs: knowledge on the behavior of *B. cockerelli* and occurrence of Papa rayada under local conditions; collection of preliminary information required to support recommendations on chemical control, varietal reaction, biological control, alternative hosts control and other management practices.

Task 22: (Honduras) Management of the Late blight disease on potatoes. Status: Continuing. Scientists involved: FHIA: J. C. Melgar and J. Mauricio Rivera. Purdue U.: R. Foster and S. Weller. Description: The Late blight disease of solanaceous crops (caused by the Stramenopyle *Phytophthora infestans*) is regarded locally as the most important disease of potato. In the absence of resistant potato cultivars, in Honduras the control of this disease relies heavily on application of fungicides via foliar spraying. The most common fungicides utilized are i) preventative wide spectrum products of contact mode of action, based mostly on the active ingredients chlorothalonil and manzozeb, and ii) a group of site-specific

products of systemic/translaminar mode of action with curative effect, i.e. mefenoxam, propamocarb, cymoxanil, etc. Of the latter group mefenoxam has been and continues to be the most widely used though it has been reported elsewhere that continued use of mefenoxam (or products of like mode of action) has led to the loss of its effectiveness due to selection for resistance in the population of the pathogen. It has been found that in sites with the two known mating types of the organism the frequency and speed of development of mefenoxam-resistant strains are much higher than where only one mating type occurs. It is then evident that, under the current technological conditions of the crop in Honduras, if the two mating types occur there is a higher risk of crop losses due to Late blight. In fact, there are already anecdotal reports of failure of mefenoxam to control Late blight. Current year activities: The activities will be continuation of those initiated the previous year, as follows:

a) Isolation and in vitro laboratory assays to determine if resistance to mefenoxam occurs in local isolates obtained from the main potato cropping areas.

b) Exploratory determination of the status of the mating nature of isolates of the organism obtained from the main potato cropping areas.
c) Development of a pictorial guide to assist in decision-taking for spraying chemicals for Late blight control.

Progress to date: On 14 June 2010 a student from Universidad Nacional de Agricultura (UNA) started a 3-month internship focused testing the sensitivity to mefenoxam and to determine the sexual status of the pathogen. He has already initiated literature review, collection of diseased specimens and development of procedures to accomplish his objective, under supervision of Dr. José C. Melgar. Information from the literature has been gathered on spraying for Late blight control and a draft pictorial guide is in preparation. *Expected outputs:* A pictorial guide to be used for decision-taking on when and what to spray for chemical control of Late blight disease. Transfer to growers and field extension workers of information leading to improved management of the problem.

Task 23: (Honduras) Management of bacterial leaf and fruit spots of tomatoes and peppers. Status: Continuing. Scientists involved: FHIA: J. C. Melgar and J. Mauricio Rivera C. Purdue U.: S. Weller. Description: In order to provide the local market a steady supply of produce of tomatoes and peppers, producers must grow the crops throughout the year. During the rainy period (June thru October), these crops are field-grown under environmental conditions highly favorable for bacterial and fungal leaf and fruit diseases, forcing the growers to make a higher investment in chemicals. Based on historical records generated from specimens analyzed at FHIA's plant pest diagnostic clinic and also field observations by FHIA's scientists, it has been found that the field extension workers and growers have been misdiagnosing field symptoms of two different bacterial diseases and one fungal disease, namely: Bacterial speck, Bacterial spot, and Septoria leaf spot (caused by *Pseudomonas syringae* pv. *tomato*, *Xanthomonas campestris* pv. *vesicatoria*, and *Septoria licopersici*, respectively). This confusion has led to application of inadequate chemical control measures and provoked heavy losses to some growers. It is therefore necessary to provide the extension workers and growers with information leading to correct application of the right control measures.

Current year activities: Some activities will be continuation of those initiated the previous year and some are new ones, as follows: (i) Collection of field specimens representative of the leaf and fruit spots occurring in tomato and pepper fields to ascertain the identity of the causal organisms. (ii) Preparation of a recognition guide. (iii) Transfer information to growers and field extension workers. Expected outputs: An illustrated disease recognition guide. A technology transfer program to growers and field extension workers. Reduced field crop losses.

Task 24: (Honduras) Management of the root-knot nematode, *Meloidogyne* spp on solanaceous and other key crops. Status: Continuing. Scientists involved: FHIA: F. J. Díaz, D. Perla and J. Mauricio Rivera C.; Purdue U.: R. Foster. Description: In Honduras species of the root-knot nematode, *Meloidogyne* spp are very important common pests of warm climate solanaceous crops and of cucurbit crops grown in the same areas. Management is based on application of synthetic chemicals of nematicidal-nematostatic effect; because of the high cost of the chemicals, this option is usually prohibitive for smallholders. All synthetic chemicals for nematode control are highly toxic and their use poses a very high risk to the applicators and to the environment. Of the different options to chemicals cited in the literature, crop rotations seems to be one of the most promising from the point of view of biological efficacy and also of friendliness to the environment and humans. Using sweet potato as a model crop, between 2007 and 2009 FHIA performed field testing of several introduced lines of Cowpea (*Vigna unguiculata*), presumably resistant to species of the root-knot nematode, comparing their performance to local rotation crops (landraces of Cowpea and Sorghum) and application of chemicals. Some of the introductions were highly resistant to the species of the root-knot present in the Comayagua valley, main center of production of warm climate vegetables. In fact, on sweet potatoes rotation with the most efficacious Cowpea line increased yield of exportable roots up to 88% when compared to a combination of the local Cowpea and the nematicide oxamyl. In the literature it has been documented that the efficacy of the rotations for control of the root-knot may vary depending of the crop and the particular species of the root-knot nematode associated with it; thus, the efficacy of particular rotation crop can be limited depending on the species of root-knot that prevails locally.

Current year activities: Some activities will be continuation of those initiated the previous year and some are new ones, as follows: (i) Collection of field specimens of the root-knot nematode occurring on tomatoes, peppers, eggplant, cucurbits and other crops of importance to ascertain the identity of the causal organisms. (ii) Establish at least two validation plots with the two best-performing nematode-resistant Cowpea lines in grower's fields representative of tomato, pepper or export oriental vegetables in the Comayagua valley. (iii) Establish a seed production plot of the best two performing Cowpea lines at FHIA's research station in the Comayagua valley. (iv) Transfer to growers and field extension workers of information leading to improved management of the problem. Expected outputs: Information on species of the root-knot nematode associated with particular crops and confirmation of which species of the nematode are controlled by the nematode-resistant cowpea lines. Information on the efficacy of nematode-resistant Cowpea lines under the conditions representative of the oriental vegetable growers. Production of a small supply of seed which the following season will be offered to selected growers for their personal testing and promotion of the technology, with support from FHIA. Transfer to growers

and field extension workers of information leading to improved management of the problem. Reduction in field crop losses due to the negative effect of the root-knot nematode on vegetable crops.

Task 25: (Honduras) Integrated management of Bacterial wilt in solanaceous crops. Status: Continuing. Scientists involved: FHIA: J. C. Melgar, F. J. Díaz and J. Mauricio Rivera C. Purdue U.: R. Foster and S. Weller. U. of Arizona: J. Brown.. Description: At FHIA's plant pest diagnostic clinic the reporting of Bacterial wilt (caused by *Ralstonia solanacearum*) has been reported as the cause of plant wilting and death in tomato, pepper, eggplant and occasionally potato specimens analyzed in the plant pathology laboratory. These findings have been corroborated by observation in the field of crops affected in variable degree by the disease in different regions of the country. As in most cases in which the actual damage of the pathogen to the plant occurs at or under the soil line, growers and technicians have a hard time to diagnose the disease and, in general, they lack the knowledge required to clearly recognize and manage the disease; on the other hand, tools available for management of this disease are very limited, based essentially on preventive measures to avoid ingress of the pathogen in cultivated soil. Tools for management of this growing problem are needed to prevent it becomes more severe than currently is. The literature reports the use in several countries of South East, Taiwan and in Bangladesh of grafting (on wild Solanaceous relatives) as a very effective means to control bacterial wilt in eggplant and tomato. Current year activities: Some activities will be continuation of those initiated the previous year and some are new ones, as follows: (i) Finish preparing a growers guide for recognition and management of bacterial wilt. (ii) Initiate activities conducive to field evaluation of grafting of tomatoes and maybe peppers as a means to control the disease, using locally available wild relatives of solanaceous crops as rootstock on which to graft the scions. (iii) Transfer to growers and field extension workers of information leading to improved management of the problem. Progress to date: A body of literature on bacterial wilt has been gathered in anticipation to work in the preparation of the growers guide for recognition and management of the disease. Expected outputs: Generation of knowledge on recognition and management of bacterial wilt under local conditions. Transfer to growers and field extension workers of information leading to improved management of the problem. Reduction in field crop losses due to the negative effect of bacterial wilt on solanaceous vegetable crops.

Task 26: (Honduras) Integrated management of soilborne pests and viruses of sweetpotato. Status: Continuing. Scientists involved: FHIA: F. J. Díaz, José C. Melgar, J. Mauricio Rivera C.; Purdue U.: R. Foster; U. Arizona: J. K. Brown; Zamorano: M. Coccon, A. Rueda, R. Trabanino. Description: Soilborne problems and virus diseases appeared to be the main cause of low productivity of export quality roots. In the case of soil problems it has been clearly determined that primarily root-knot nematodes are a major problem that demands control, and research has been conducted by to that purpose using root-knot nematode-resistant Cowpea lines (See task 24), with great success. As for insect pests, light trapping has been implemented during part of the previous year in order to ascertain which pests are present and, accordingly, design/implement the most appropriate management measures. Regarding viruses, it is an activity implemented together with the project Global Theme on Insect Transmitted Viruses, with the goal of identifying which diseases prevail locally and initiate the production of virus-free propagative material. The former activity is implemented by FHIA and the latter one is executed by Zamorano. Current year activities: Some activities will be continuation of those initiated the previous

year and some are new ones, as follows: (i) Continuation of collection and analyses of plant specimens to identify the prevalent viruses. FHIA and Zamorano. (ii) Establish at least two validation plots with the two best-performing nematode-resistant Cowpea lines in growers fields in and outside of the Comayagua valley. FHIA. (iii) Establishment of a seed production plot of the best two performing Cowpea lines at FHIA's research station in the Comayagua valley. FHIA. (iv) Continuation of light trapping of insect pests. FHIA. (v) Trials to test entomopathogenic fungi for control of white grubs as part of an IPM package. Zamorano. (vi) Dissemination of information by various means, including transfer to growers and field extension workers of information leading to improved management of the problems, presentation of results in technical/scientific events. (vii) Preparation of a guide describing the nature and management appropriate for the locally prevalent virus diseases of sweet potato. FHIA and Zamorano. Progress to date: Collection and analysis of samples for virus identification was initiated; the analyses were performed at U. of Arizona (as part of the collaborative activities linking with the Global Theme on Insect Transmitted Virus) and also at the company AGDIA (Elkhart, IN, USA). Light trapping of insect pests was also initiated in the fields of the same collaborator in whose fields was initially carried out the evaluation of the nematode-resistant Cowpea lines. A cycle of seed multiplication of those lines was conducted at FHIA's CEDEH in the Comayagua Valley. Expected outputs: A report outlining the identification of prevalent virus diseases and design of management strategies utilizing as input the information on virus identity and prevalence. Production of a small supply of seed which the following season will be offered to selected growers for their personal testing, with support from FHIA. Conclusively determine if soil borne insects really are a problem and initial information on the effect on them of an IPM package stressing on entomopathogenic nematodes. Transfer to growers and field extension workers of updated information leading to improved management of the problem. Reduction in field crop losses due to the negative effect of the root-knot nematode on vegetable crops.

Task 27: (Honduras) Development of a technological package for production of onions in the rainy season. Status: Continuing. Scientists involved: FHIA: F. J. Díaz, José C. Melgar, J. Mauricio Rivera C., H. Aguilar; Purdue U.: S. Weller and R. Foster; Zamorano: R. Trabanino, A. Joya, A. Rueda. Description: In Honduras commercial production of onions is restricted to November thru May, coinciding with a dry season in which in general highly favorable condition prevail for onions cropping. During the rainy season (June thru October) production of onion is limited by field and postharvest diseases associated with prevalence of wet cropping conditions; as a result during this time the supply of produce is limited and, though imports are in order, the prices always go up. Current year activities: Continuation of field and initiation of storage studies to preserve the quality of produce produced during the rainy season. This is an interdepartmental activity and FHIA's Postharvest Department will become involved. FHIA. Progress to date: A field trial is being conducted in which the effect of soil bio-fumigation (with Brassicas) and solarization are being evaluated for their effect on the health of the crop in the field and eventually it is planned to also evaluate the effect of those treatments on post harvest quality of the produce. Expected outputs: Identification of practices leading to competitive production of onions during the rainy season with minimal losses. Transfer to growers and field extension workers of updated information leading to improved management of problem s during the rainy and dry seasons. Reduction in field crop losses of onion crops due to the negative effect of the conditions in the rainy season and of thrips during the dry season.

Task 28: (Honduras) Management of Thrips and mites in onions and other horticultural crops. Status: Continuing. Scientists involved: FHIA: H. R. Espinoza, F. J. Díaz; Purdue U.: R. Foster. Zamorano: A. Rueda, R. Trabanino, A. Joya. Description: Thrips and mites are important pest insects of different vegetable crops In Honduras. The damage they provoke to foliage results in yield reduction and, in the case of crops in which the fruit is attacked, like eggplants, their damage to the skin of the fruit renders them unacceptable for the market. This kind of damage is particular critical in fruit crops destined for the export market, like the different types of eggplants exported from Honduras to the American market. In the case of Thrips on onions, the damage is compounded with added susceptibility to Purple spot (caused by the fungus *Alternaria porri*), causing increased losses. Traditionally, management of these insects has relied solely on application of insecticides which, in the case of Thrips, pose a high risk of development resistance by the insect. Current year activities: (i) Continue field monitoring in eggplant fields interplanted with sunflower as a refuge/substrate for the beneficial *Orius* sp. FHIA. (ii) Evaluate the effect of spraying variable volumes of pesticidal mix on the control of thrips on onions. FHIA. (iii) Evaluation of the beneficial insect *Orius* and entomopathogens for control of Thrips in farmer fields. Zamorano. Progress to date: A field trial is being conducted in which the effect of interplanted sunflower plants is evaluated for their effect in reducing cosmetic damage provoked by mites on the skin of fruits of a crop of eggplant. Expected outputs: Identify environmentally friendly practices leading to successful control of mites and thrips. Reduce the use of pesticides for thrips control on onions. Transfer to growers and field extension workers of updated information leading to improved management of the problems. Reduction in field crop losses due to the negative effect of mites and thrips.

Activity 2: Identify results from other countries and regions that can be evaluated and incorporated into country-specific packages.

Status: Continuing

US Scientists involved: Alwang, Norton (VT), Backman, Gugino (Penn State), Weller, Foster (Purdue), Brown (AZ)

Description: Through scientist interactions as IPM CRSP and other meetings, and through literature, opportunities for sharing promising technologies are being identified. The regional project will support activities to evaluate and adapt promising technologies.

Progress to date: During first year of CRSP, several opportunities were identified for moving technologies from one region/country to another. For example, IPM controls for potato pests have been identified and tested during prior phases of the CRSP in Ecuador; these controls are being considered for use in Honduras. Most of the technology sharing takes place during annual meetings of the LAC group, but others (such as grafting for control of fusarium wilt in naranjilla) are brought in from other CRSP regions.

Expected outputs: Technologies shared across region and adapted for use in the region from other CRSP regions.

Task 1: Continue to identify opportunities for sharing technologies across countries and regions within countries. Identify opportunities from other IPM CRSP regions.

Task 2: Adaptation and development of an IPM package for potato pests in Ecuador. Status: continuing. Scientists involved**:** Ochoa, Gallegos, Manangón, Asaquibay (INIAP–DNPV); Barrera, Escudero, Cruz (INIAP-Programa RRNN); Backman, Gugino (Penn State). Description: technologies exist for the control of all major potato pests and diseases (developed under the prior CRSP for potato pests and diseases in the northern Ecuador province Carchi). This task will involve validation and adaptation for conditions specific to Guaranda where the IPM CRSP is now focusing its research activities. Two outreach publications will be produced.

Task 3: Identify bio-rational controls for pests that have the potential for establishment of local industries. Status: continuing. Scientists involved: Alwang (VT), Backman (PSU), Barrera (INIAP-Ecuador), Weller (Purdue), Rueda (Honduras-Zamorano). Description: the global IPM CRSP and the LAC regional project has identified and tested a number of bio-rational controls (e.g. controls for fungal diseases using trichoderma and bacillus). We would use these isolates as know bioactive isolates, and determine their potential for pest control in fruits and vegetables. In many regions of the world, such control technologies have led to indigenous industries for production of the bio-rational (especially South Asia). Opportunities will be explored for development of small-scale industries, beginning with *Rhizobium* production in Ecuador. Other opportunities will be explored as they arise. Previous research in cycle 3 identified several Bacillus spp. that showed excellent potential for biological control of diseases.

Task 4: Cross-reference our biological controls for pests to identify potential for use in other regions. Continue to identify successes in local production of bio-rationals.

Task 5: Present overview at annual meeting in DR.

Activity 3: Continue to coordinate activities with global themes

Description: Regional project allocates $10,000 annually to each of the four global themes with presence in LAC. Project scientists interact with global theme scientists to ensure that global themes are contributing to regional project objectives.

Status: Continuing

US Scientists involved: Alwang, Norton, Tolin, Christie (VT), Miller (Ohio State) Brown (AZ), Hamilton (Denver)

Progress to date: In the first year of the project, significant accomplishments have been achieved in coordinating with the global themes. All four global themes had representation at the annual meeting (May 2010 in Honduras). The impact assessment global theme is currently conducting a baseline survey in Ecuador and will follow up with a baseline survey in DR in the 2011 fiscal year. The gender network has been established and a gender/participatory methods training was held (April 2010 in Ecuador). The IPDN and virus global themes have active research and training programs in the LAC region.

Expected outputs: Impact and gender studies completed, IPDN established and functioning in LAC, technologies for virus diseases developed and integrated into IPM packages.

Task 1: Analysis of baseline survey for Ecuador. Status: beginning. Scientists involved: Norton, Alwang (VT), Barrera, Cruz (INIAP). Description: during current year, the impact assessment global theme together with partners in Ecuador, completed a baseline survey. A compilation of this data and a brief description will be produced. Expected outputs: report on baseline data.

Task 2: Baseline survey for DR. Status: beginning. Scientists involved: Norton, Alwang (VT), IDIAF scientists. Description: the impact assessment global theme together with partners in DR, will undertake a baseline survey (some funding from the gender global theme will also be used). A compilation of this data and a brief description will be produced.

Task 3: Complete analysis of gendered constraints to technology adoption in Ecuador. Status: continuing. Scientists involved: Alwang, Christie (VT), Hamilton (Denver) Barrera, Cruz (INIAP). Description: During current year, the gender global theme conducted a training for the region gender network participants in Ecuador (including representatives from Honduras, DR and Ecuador as well as US scientists). At this meeting a process was started for: a participatory assessment of pest constraints and perceptions of such constraints among women; a qualitative assessment of information networks and the role of women in them; and an assessment of gender-related obstacles to increased capture of value added in the blackberry market chain. In addition, the baseline survey (described above) contained several modules that were focused on women and a qualitative study was undertaken by an MS student (Meghan Byrne). These studies will be completed during the 2011 fiscal year. Outputs: MS thesis, two reports.

Task 4: Creation of a technique to identify “women’s crops” with an application to Honduras. Status: new. Scientists involved: Alwang (VT). Description: USAID is interested in understanding ex-ante the potential impacts of CRSP research on women. This information can help prioritize research. While it is possible to apply a comprehensive survey to gain this information, most countries where the CRSP works avail of alternative household data sources that might contain sufficient information to address the gender issue. We are working on a framework to summarize these impacts and identify key parameters. We are examining alternative national household surveys to gauge their appropriateness for such uses. Outputs: research paper.

Task 5: Coordinate virus work with virus global theme. Status: ongoing. Scientists involved: Brown (AZ), Tolin (VT). Description: coordination is being done on a regular basis. Tasks 6 and 7 in Activity 1 (above) are being coordinated by the global themes with support from the regional program. Activities in tasks 1, 18, 19, 20, and 26 will involve cooperation with virus global theme scientists, including Gilbertson (UC-D) and Deom (GA).

Task 6: (Dominican Republic) Conduct preliminary assessment of women’s roles in agricultural activities in San Josè de Ocoa. Status: new. Scientists involved: Cuevas (IDIAF), Hamilton (Denver), Christie (VT).

Task 7: (Dominican Republic) Conduct workshop about gender issues and the role of women in agriculture in different localities of Ocoa. Status: new. Scientists involved: Cuevas (IDIAF), Hamilton (Denver), Christie (VT).

Task 8: (Dominican Republic) Conduct training sessions on symptoms recognition of pests and diseases under protected crops leading by women in San Josè de Ocoa Valley. Status: new. Scientists involved: Cuevas and others (IDIAF).

Objective 2: Analyze and disseminate IPM information for enhanced profitability of targeted products through planning, pre-planting operations, pest management and value enhancement during production, processing and marketing

Activity 1: Conduct participatory analysis of constraints to production, market access and profitability in Dominican Republic

Status: new.

Scientists: Norton and Alwang (VT); several at IDIAF.

Description: this activity will be undertaken in conjunction with the baseline survey, which is being guided by the impact assessment global theme.

Expected outputs: 1 publication describing results of analysis.

Task 1: Bring multidisciplinary team to experiment station to evaluate ongoing IPM research.

Task 2: Bring multidisciplinary team to farmer fields, conduct interviews with extension agents, and conduct interviews with marketing agents to understand existing constraints to production and profitability (tasks 1 and 2 involve a small-scale PA).

Activity 2: Analysis and validation of proposed IPM packages.

Task 1: Validation of IPM package for naranjilla. Status: ongoing. Scientists involved: Barrera, Cruz, Ochoa, Gallegos, Martínez and Vásquez (INIAP); Robert Andrade (CIAT); Alwang and Norton (VT); Andrew Sowell and Gerald Shively (Purdue University). Description: A new naranjilla variety, produced as a part of the prior phase of the IPM CRSP, was released in August 2009 by INIAP in Ecuador. This variety, a graft of a common naranjilla on a fusarium-resistant rootstock, is being commercialized by two private firms. Anecdotal evidence shows widespread adoption, but evidence also exists of disease problems associated with the variety. Analysis of the spread and impact of the variety is needed to validate its use in other regions of Ecuador. Progress to date: A comprehensive survey of naranjilla producers was undertaken and analyzed under the prior phase of the IPM CRSP (Barrera and Andrade). This information serves as a baseline prior to introduction of the new technology. Sowell is currently undertaking a combination of quantitative and qualitative data collection. Analysis will occur in fiscal year 2011. Expected outputs: 1 MS thesis, draft publication.

Task 2: Validation of IPM packages for tomatoes and peppers (Honduras). Validation will include evaluation of the cost-effectiveness of each of the components of the package.

Task 3: Continue to collect information on costs of each IPM package.

Objective 3: Become a regional center of excellence by building human capacity, generating IPM knowledge, and promoting adoption of IPM packages

Activity 1: Continue with short-term training priorities.

Task 1: Identify priorities (demand for training) and supply of training during annual meeting in DR.

Task 2: Conduct at least 3 formal short-term trainings of regional project staff in first year (Purdue internships, bio-control training at Penn State, and impact training in US).

Task 3: Offer in Honduras a pilot regional workshop on "Management of Virus Diseases on Vegetable Crops", with an audience made up with participants from the Central America-Caribbean region and instructors from the American Universities (IPVDN global theme members) and institutions from Honduras involved in the project.

Task 4: Offer training on IPM to field extension workers, growers and staff of agrichemical companies in at least 20 training events in Honduras.

Task 5: Provide financial support to four (4) senior students from Zamorano involved in programs concerned with biological control and organic agriculture as main topics under an IPM program.

Activity 2: Design comprehensive long-term training plan for regional project

Description: this is a hold-over activity from project's first year. We have a prioritized long-term training program in place.

Task 1: Continue to work with graduate and undergraduate students. We currently have 7 students at US universities who are finishing their graduate degrees with IPM CRSP funding. We have identified additional training needs in weed science (Honduras—to study at Purdue), gender (Honduras-to study at VT), virus (Guatemala-to study at UAZ). In all countries, undergraduate researchers will be employed as funds permit and promising students are identified.

Activity 3: Identify opportunities for intra-regional learning and transfer of packages between countries

Task 1: Working group has been established to identify these opportunities. Group will report to full project during annual meeting.

Objective 4: Develop strong linkages between the Regional IPM project and Global themes to foster quicker development and use of effective IPM packages.

See description above. Linkages have been created and are currently quite strong. We have active participation by LAC regional project participants on the global themes. These include the following.

Impact assessment: Alwang and Norton (VA Tech), Barrera and Cruz (INIAP-Ecuador), (IDIAF-Dominican Republic). Gender: Hamilton (DU), Alwang (VA Tech), Cruz and Barrera (INIAP), Valenzuela (Zamorano—Honduras), Cuevas (IDIAF). IPDN: Palmieri and Arevalo (Guatemala). Virus: Tolin (VT), Brown (AZ), Palmieri (UDV-Guatemala), Rivera (FHIA-Honduras), Martinez (IDIAF).

In current year, these linkages will be continued by: engaging in jointly sponsored research (see above) and participation in the LAC annual meeting (early 2011 in DR).

Graduate Students and Post Doctoral Research Associates:

1. Name: Adam Sparger
Sex: Male
Nationality: US
Discipline: Agricultural Economics
Site/Country: Honduras and Ecuador
Degree: PhD
Start date: August 2009
Completion date: August 2012
IPM CRSP funds: 100%
Advisor/PI: Jeffrey Alwang
Thesis topic: Economics of IPM adoption and diffusion
University: Virginia Tech

2. Name: Amy Buckmaster
Sex: Female
Nationality: US
Discipline: Agricultural Economics
Site/Country: LAC
Degree: Masters
Start date: August 16, 2010
Completion date: August 1, 2012
IPM CRSP funds: 40%
Advisor/PI: Jeffrey Alwang
Thesis topic: Unknown
University: Virginia Tech

3. Name: Hillary Kessler Cheeseman
Sex: Female
Nationality: U.S.
Discipline: Plant Pathology/Microbial Ecology
Site/Country: Ecuador
Degree: Ph.D.
Start date: Aug. 15, 2010
Completion date: Dec. 30, 2015
IPM CRSP funds: 20% (Approx. $5K/yr)
Advisor/PI: P.A. Backman & Beth Gugino (Co-advisors)
Thesis topic: Alternative management strategies for vegetables
University: Penn State University

4. Name: Emily E. Pfeufer
Sex: Female
Nationality: US
Discipline: Plant Pathology
Site/Country: Ecuador
Degree: Ph.D.
Start date: Aug. 2010
Completion date: Dec. 2015
IPM CRSP funds: 30% (approx. $8K/yr)
Advisor/PI: Beth K. Gugino
Thesis topic: Interactions of Bacterial Pathogens with biocontrol agents in Onion
University: Penn State University

5. Name: Anna Testen
Sex: Female
Nationality: US
Discipline: Plant Pathology
Site/Country: Ecuador
Degree: M.S.
Start date: Aug. 2010
Completion date: Dec. 2012
IPM CRSP funds: 25% $8k/yr.
Advisor/PI: P. A. Backman/ Beth K. Gugino (co-Advisors)
Thesis topic: Biological control of plant diseases
University: Penn State University

6. Name: Andrew Sowell
Sex: Male
Nationality: US.
Discipline: Agricultural Economics
Site/Country: Ecuador
Degree: M.S.
Start date: Aug. 2009
Completion date: August 2011
IPM CRSP funds: 50%.
Advisor/PI: Shively/Alwang/Weller (co-Advisors)
Thesis topic: Spread and Impacts of IPM CRSP Naranjilla Research
University: Purdue University

7. Name: Meghan Byrne
Sex: Female
Nationality: US
Discipline: Public and International Affairs
Site/Country: Ecuador
Degree: M.S.
Start date: Aug. 2009
Completion date: Aug 2011
IPM CRSP funds: Regional project—support for field research (approximately $2,500)
Advisor/PI: Christie
Thesis topic: Pesticides, Gender and Opportunities for Development
University: Virginia Tech

8. Name: William Secor
Sex: Male
Nationality: US
Discipline: Agricultural Economics
Site/Country: Honduras
Degree: MS
Start date: June 2010
Completion date: Aug 2011
IPM CRSP funds: $3000—summer salary
Thesis topic: Gender
University: Virginia Tech

Short-Term Training planned:

Workshops: Dominican Republic, Ecuador, Guatemala and Honduras. Workshops will cover various topics, depending on needs.
Internship at Purdue University for UG students from Honduras
Annual meeting: Dominican Republic
Others: Individual short term training for person from Ecuador and DR in US.

Publications planned:

Graduate theses: 3
Research articles: 3
Books and book chapters: 1
Extension articles: 4
Posters: 6
Bulletins: 2

Travel Matrix:

Trip No.	Number of Individuals	Destination Country(ies)	Duration	Function (Site planning, workshop, symposium etc)
1	10	Dominican Republic	1 week	Planning meeting
2	10	Ecuador	1 week	Reviewing research progress
3	10	Honduras	1 week	Reviewing research progress
4	10	Guatemala	1 week	Reviewing research progress
4	2	Colombia	1 week	Impact assessment methods

*Proposed dates may change depending on changing circumstances

Performance Indicators for Monitoring and Evaluation:

ID	Description	Completion Date	Responsible Individual
Task 1.1.1	Surveys complete	Sept 2011	Brown
Task 1.1.2	Experiments established	Dec 2010	Weller/Gugino
Task 1.1.3	Trials established and running	Sept 2011	Barrera
Task 1.1.4	Trials established	Sept 2011	Barrera
Task 1.1.5	Trials established	Sept 2011	Barrera
Task 1.1.6	Experiments established	Sept 2011	Brown/ Palmieri/Rivera
Task 1.1.7	Controls identified, primers tested	Sept 2011	Brown/Rivera

Task 1.1.8	Experiment established, evaluation completed. Report produced.	Sept 2011	Medrano, Martinez
Task 1.1.9	Experiment established, evaluation completed. Report produced.	Sept 2011	Medrano, Martinez
Task 1.1.10	Evaluation complete. Report produced.	Sept 2011	Medrano, Martinez
Task 1.1.11	Identification completed, experiment established	Sept 2011	Medrano Martinez
Task 1.1.12	Evaluation complete. Report produced.	Sept 2011	Halpay, Martinez
Task 1.1.13	Evaluation complete. Report produced.	Sept 2011	Halpay, Martinez
Task 1.1.14	Characterization complete	Sept 2011	Halpay, Martinez
Task 1.1.15	Experiment established	Sept 2011	Halpay, Martinez
Task 1.1.16	Experiment established	Sept 2011	Halpay, Martinez
Task 1.1.17	Experiment established	Sept 2011	Halpay, Mendes, Martinez
Task 1.1.18	Experiment established	Sept 2011	Medrano, Martinez/Tolin
Task 1.1.19	Experiment established	Sept 2011	Medrano, Martinez/Tolin
Task 1.1.20	Experiment established	Sept 2011	Martinez/Tolin
Task 1.1.21	Experiments established and reports produced	Sept 2012	Espinoza, Melgar/Foster, Weller/ Brown/Rueda, Sierra,Trabanino
Task 1.1.22	Assays completed, report produced	Sept 2012	Melgar, Rivera/. Weller
Task 1.1.23	Identification finished, report and guide produced	Sept 2011	Melgar, Rivera/ Weller
Task 1.1.24	Collection finished and seed/validation plots established	Sept 2011	Díaz, Perla, Rivera/ Foster.

Task 1.1.25	Guide finished and experiments established	Sept 2011	Melgar, Díaz, Rivera/Foster, Weller/Brown
Task 1.1.26	Continue collection/analyses, light trapping, finish growers guide, established tests of entomopathogenic fungi	Sept 2011	Díaz, Melgar,Rivera/Foster; Brown/Coccon, Rueda,Trabanino
Task 1.1.27	Experiments established	Sept 2011	Díaz, Melgar,Rivera, Aguilar/Weller, Foster
Task 1.1.28	Experiments established	Sept 2011	Espinoza, Díaz/Foster/ Rueda, Trabanino, Joya
Task 1.2.1	Dialogue on opportunities for sharing conducted at annual meeting	June 2011	Alwang
Task 1.2.2	Validation complete	Sept 2012	Barrera/Backman
Task 1.2.3	Bio-rationals identified	Ongoing	Backman/Gugino
Task 1.2.4	Report to annual meeting	June 2011	Backman/Gugino
Task 1.2.5	Report to annual meeting	June 2011	Backman/Gugino
Task 1.3.1	Analysis complete: report written	Sept 2011	Alwang/Barrera
Task 1.3.2	Survey complete	Sept 2011	Norton
Task 1.3.3	Analysis complete: report written	Sept 2011	Alwang/Barrera/ Cruz
Task 1.3.4	Analysis complete: report written	Sept 2011	Alwang
Task 1.3.5	Coordination complete	Sept 2011	Brown/Backman
Task 1.3.6	Assessment complete	Sept 2011	Cuevas/Christie
Task 1.3.7	Workshop held	Sept 2011	Cuevas/Hamilton
Task 1.3.8	Training held	Sept 2011	Cuevas/Hamilton
Task 2.1.1	Assessment complete	Sept 2011	Alwang/Norton
Task 2.1.2	Assessment complete	Sept 2011	Alwang/Norton

Task 2.2.1	Validation complete	Sept 2011	Alwang/Barrera
Task 2.2.2	Validation complete	Sept 2011	Rivera/Weller
Task 2.2.3	Information collected	Ongoing	Alwang/Barrera
Task 3.1.1	Priorities identified	June 2011	Alwang
Task 3.1.2	Training complete	Sept 2011	Weller/Backman/ Norton
Task 3.1.3	Workshop offered	Sept 2011	Rivera/Brown/Tolin
Task 3.1.4	Training events completed	Sept 2011	Rivera/Rueda
Task 3.1.5	Students achieve graduation	Sept 2011	Rueda/Rivera
Task 3.2.1	NA		
Task 3.3.1	NA		

Regional IPM Program in East Africa: Kenya, Tanzania and Uganda

PI: *Mark Erbaugh, Ohio State University*

Objective 1: Continue building a <u>regional model</u> of collaborative IPM research, training and knowledge dissemination.

1) Facilitate and expedite project administrative activities. *Task:* Maintain and update subcontracts and expedite financial flows.

2) Strengthen the regional collaborative IPM research and development model. *Tasks:* Plan and implement third and fourth meeting of RTC in the region; Improve RP/EA website portal. URL – http:/www.aaec.vt.edu/ipmcrspuganda/IPMCRSPEA/

3) Improve IPM research and technology transfer in the region. *Tasks:* Approve research work plans for Year 2 that focus on IPM package development; integrate technology transfer strategies including farmer training programs into work plan; and integrate linkages between research and extension into work plan activities.

4) Ensure integration of Global Theme Programs into the regional program. *Task:* Plan program and dates for additional GTP workshops in region and integrate prioritized GTP activities into Year 2 work plan.

5) Strengthen regional capacity for performance monitoring. *Task:* Implement integrated plan for performance monitoring including the use and compilation of Activity Reporting Forms.

6) Build IPM human resource capacity in the region through advanced degree training. *Tasks:* Implement training plans for each country; Implement first year advanced degree training programs. (*See Training Descriptions*).

7) Support presentation and publication of research results. *Tasks:* Co-PIs and students present at RTC meetings; Review manuscripts at RTC meetings.

Objective 2: Implement a participatory and ecologically-based IPM <u>research program</u> focused on <u>developing IPM packages</u> that address priority pest constraints of selected, marketed horticultural crops in the region.

1) Develop IPM packages that address priority pests of tomato.

<u>Uganda:</u>

1. Potential of indigenous and introduced rootstocks in reducing losses caused by bacterial wilt and other key diseases of tomato

a. Co-PIs: R.N. Ssonko, J. Karungi, S. Kyamanywa; Matt Kleinhenz, Sally Miller

b. Priority pests to be addressed: Bacterial wilt (by *Ralstonia solani*)
c. **Tasks:** Assess effects of grafting using bacterial wilt tolerant rootstocks to reduce bacterial wilt.
d. Description: Assess and compare the effect of using MT56 (a variety found to be resistant to the disease in previous phases) as a root stock with imported rootstocks, Hawaii 7996 and EG 203 obtained from AVRDC, in reducing incidence/severity of bacterial wilt..
e. Current research status: Continuing on-station activity
f. Expected outputs: bacterial wilt tolerant rootstocks screened
g. Location: on-station, MUARIK
h. Farmer or NGO group identified: (to be confirmed after screening).
i. Budget total: $3000

2. Evaluation of improved tomato germplasm in the management of key insects and diseases of tomato

a. Co-PIs: J. Karungi, S. Kyamanywa, G. Tusiime, J. Namala (BSc. Student); Matt Kleinhenz, J. Kovach, Sally Miller
b. Priority pests to be addressed: Bacterial wilt (by *Ralstonia solani*) and Late blight (by *Phytophthora infestans*); tobacco yellow leaf curl virus, fusarium wilt, and gray leaf spot of tomato, fruit worm, leaf miners, spider mites and nematodes.
c. **Task:** Evaluate resistant/tolerant germplasm for management of key tomato diseases and insect pests.
d. Description: Resistant/tolerant germplasm is an IPM tactics that can have direct impact, as such, in collaboration with AVRDC we have acquired germplasm with reported resistance to BW, Late blight, tobacco mosaic virus, fusarium wilt, and gray leaf spot of tomato. This trial will therefore aim at screening these varieties against local checks for resistance to the diseases and insect pests. In the screening trials we will include mulching and staking and reduced spray as management strategies for a holistic IPM approach.
e. Current research status: One season of this study is being finalised on-station; the trial will be repeated once to confirm findings.
f. Expected outputs: Disease/insect pest tolerant tomato varieties confirmed and recommendations made for transfer to farming communities.
g. Location: on-station, MUARIK
h. Farmer or NGO group identified: (to be confirmed after screening).
i. Budget total: $3000

3. Conducting multi-location trials of MT56 for management of bacterial wilt in Uganda

a. Co-PIs: P. Rubaihayo, S. Kyamanywa; G. Tusiime, D. Asiimwe (MSc. Student); Matt Kleinhenz, S. Miller
b. Priority pests to be addressed: Bacterial wilt (by *Ralstonia solani*)
c. **Task:** Conduct multi-location trials of MT56 vs popular tomato varieties to further document its resistance/tolerance to Bacterial wilt as a required step to its official release.
d. Description: Previous phases of IPM CRSP confirmed that MT56 tomato variety is resistant to bacterial wilt. To officially release it to the farming communities; multi-location trials are a prerequisite. The variety will be screened alongside popular tomato varieties in a minimum of 3 diverse locations in Uganda for tolerance to bacterial wilt.

e. Current research status: Continuing activity; will be scaled up to include new zones
f. Expected outputs: MT56 cleared for official release to farming communities
g. Location: 3 diverse locations in Uganda
h. Farmer or NGO group identified: (to be confirmed).
i. Budget total: $5000 *(This activity is cost shared with the AFSI project)*

4. Project Title: Develop and promote novel techniques for management of boll worm, spider mites and leaf mining flies on tomato

a. Co-PIs: M. Otim; S. Kyamanywa, Z. Muwanga (MSc student), M. Kleinhenz, J. Kovach
b. Priority pests to be addressed: Bollworm (*Helicoverpa spp*), leaf miners (*Liriomyza spp*), spider mites (*Tetranychus spp*)
c. **Tasks:** Testing cultural practices for management and promotion of biological control of key pests of tomato; survey of natural enemies of *Helicoverpa, Liriomyza* and *Tetranychus* in farmers fields.
d. Description: Natural biological control is known to be key in keeping pest populations below those causing economic damage; in this trial use of mulching and well timed pesticide sprays will be assessed for effect on the named pests as well as their natural enemies.
e. Current research status: Continuing activity; one season completed.
f. Expected outputs: Cultural practices that promote biological control assessed
g. Location: on-farm; Busukuma Sub county, Wakiso district.
h. Farmer or NGO group identified: (progressive farmer).
i. Budget total: $3000.

5. Establishment of the effectiveness of seed/soil treatment with the arbuscular micorrhizal fungi (AMF) in the management of fungal, bacterial and nematode problems of tomato

a. Co-PIs: M.S. Rwakikara, S. Kyamanywa, Matt Kleinhenz, S. Miller, M. Kleinhenz
b. Priority pests to be addressed: Bacterial wilt (by *Ralstonia solani*) and Late blight (by *Phytophthora infestans*); fusarium wilt, and gray leaf spot of tomato; and nematodes.
c. **Tasks:** Evaluate use of naturally occurring soil micro-organisms (AMF) to improve tomato nutrition; assess whether AMF contributes to disease control.
d. Description: This is new idea of IPM and will involve AMF inoculum multiplication (bulking) in order to allow sufficient quantities for evaluation trials. Initial screening for effectiveness will be done in the screen house.
e. Current research status: AMF inoculum has been collected and bulking procedures are to follow in the laboratory thereafter, efficacy testing in the screen house will be implemented.
f. Expected outputs: AMF genera/spp identified; bulked and screened for efficacy
g. Location: On-station; MUARIK.
h. Farmer or NGO group identified: (to be included in year III).
i. Budget total: $4000.

<u>Kenya</u>

1. Tomato high tunnel and grafting trials

a. Co-PIs: Waiganjo M; Menza, M; Sylvia K; Gitonga, J; Amata, R; Erbaugh, M. Miller, S. Tusiime, G. Kyamanywa, S.; Kleinhenz, M..Kovach, J. Pauline Mueke (Msc. Student), Charity Gathambiri (Postharvest specialist at KARI-Thika).
b. Priority Pests: Tomato diseases (*Ralstonia solanacearum* and yellow leaf curl virus), arthropod pests (thrips, Thrips spp; whiteflies, Bemisia tabaci; Mites, *Tetranychus spp*; leafminers, *Liriomyza trifoli*, jassids and bollworms, *Helicoverpa armigera*
c. Tasks: Assess pest populations in high tunnel and open field tomato production systems; assess the effects of high tunnel and grafting on tomato plant development; determine the effect of high tunnel and grafting on the crop yield, fruit quality and shelf life of the tomato fruit.
d. Description: A student studying agricultural entomology at Kenyatta University has been attached to the project to carry out her field research for an MSc dissertation in assessing the pest population in high tunnel and open field tomato production systems. The participatory trial set up on-farm at a farmer's field was laid out in split plots consisting of two main plots (high tunnel and open field) in randomized complete blocks of 3 treatments replicated 4 times. The three treatments included, Onyx variety grafted on a wilt resistant MT56 rootstock, ungrafted onyx, and the commercial high tunnel variety (Anna F1) varieties as the sub plots. Data collection is in progress on biweekly basis on growth and yield parameters; pests and diseases infestation. Yield data to commence on 28th July, 2010.
e. Current Status: Continuing activities will include inviting farmers to demonstrate tomato production practices and for follow up training and demonstration onsite. Involve more farmers in the participatory research and demonstration. Preparation for repeat trials and disseminate results.
f. Expected Outputs: At least 200 farmers participate in training on tomato production practices, high tunnel tomato production and grafting. The researchers are expected to publish the research findings in a refereed journal, present in 2 local and at least one international conference. An MSc student is expected to complete her thesis research.
g. Location: Mwea
h. Farmer or NGO group identified: Identify women's group or NGO. BAYER tomato farmers groups at Mwea, Scotts Co. ltd.
i. Budget: $3000

2. Initiate *Trichoderma asperellum, Streptomyces spp.* and legumes soil amendments to control bacterial wilt, *Ralstonia solacearum*

a. Co-PIs: Sylvia K, Waiganjo M, G. Tusiime, M. Erbaugh, S. Miller, S. Kyamanywa.
b. Priority Pests: Soil fungal diseases and Bacterial wilt of tomato caused by *Ralstonia solacearum.*
c. Tasks: Initiate screen house and lab trials to identify effective inoculums; evaluate efficacy of bio-pesticides including (*Trichoderma asperellum, Streptomyces spp.)* soil amendmentsand legumes soil amendments at KARI-Thika/Mwea to control soil fungal diseases and bacterial wilt, *Ralstonia solanacearum.*
d. Description: The biopesticide *Trichoderma asperellum* has been tested effective against Fusarium wilt in passion fruit and is currently undergoing efficacy trials towards registration against root knot nematodes in French beans. However it has not been tested against bacterial wilt in tomato and the trials will provide useful information on its effect against tomato bacterial wilt which is a major constraint in tomato production in the region. *Trichoderma asperellum* will be compared with Streptomyces spp. The trials will be initiated in year two of the student MSc. Study.
e. Current Status: To be initiated in laboratory and on-station.

f. Expected Outputs: Screen house and laboratory trials are expected to have been initiated. The student is expected to have submitted a comprehensive proposal on the activities.
g. Location: Makerere University (Laboratory/screen house trials) and on-station and field trials at KARI-Thika/Mwea /Mwea farmer groups
h. Farmer or NGO group identified: attempt should be made to identify women's group or NGO-Mwea and Kangai tomato farmer groups.
i. Budget: $2200

Tanzania, tomato

1. Project Title: Impact of management practices on post harvest physiology and shelf life.

a. Co-PIs: A.P. Maerere and H. Mtui (Ph D student registered at SUA) Collaborating Co-PI from USA : M. Bennett
b. Priority Pests: Pests and diseases that can potentially reduce shelf life of tomato: Fruit rot pathogens, Early and Late blights; **Insects** leaf miner (*Liriomyza* sp.), aphids (*Aphis spp*), thrips (*Frankinnela occidentalis*) and bollworm (*Helicoverpa armigera*)
c. Objectives: Develop package for improving shelf life of tomato.
d. Tasks: Compare fruit produced under IPM technologies (seed treatment + reduced sprays + mulch) with those using farmer practices for presence of pests and diseases that can affect post harvest physiology and reduce shelf life of tomato; evaluate the effects of hot water and chlorine treatment on fruits from both production systems to examine impacts on post harvest physiology and shelf life.
e. Current Status: On station trial followed by laboratory studies for pathogen identification
f. Expected Outputs: Pathogens causing fruit rot identified, increased marketable yield, improved fruit quality (size, colour, fruit rot incidences), increased shelf life, increased income
g. Location: SUA
h. Farmer/NGO group identified: Peco & Misegese farmer groups, Mvomero district
i. Budget: $4500

2. Develop IPM packages that address priority pests of passion fruit.

<u>Uganda</u>

1. Establish efficacy of grafting, cultural practices and biological control in the management of key diseases of passion fruit

a. Co-PIs: P. Sseruwagi, M. Ochwo-Ssemakula, J. Tumwiine, G. Tusiime, R. Amata, D. Kirunda (MSc student), S. Miller and S. Tolin
b. Priority pests: Brown spot, Collar rot, *Fusarium* wilt
c. IPM strategies to be tested: Grafting, nutritional amendments and biological control
d. Tasks: Assess and evaluate foreign passion fruit lines KPF4, KPF11 and KPF12 from Kenya with local yellow and sweet calabash types in Uganda for tolerance to collar rot and *Fusarium* wilt; graft tolerant types to popular commercial types in Uganda and evaluate in field trials; evaluate potential efficacy of

different soil fertility amendments and antagonistic *Trichoderma* species found effective in Kenya as a potential IPM strategy against the above-mentioned diseases of passion fruit.
e. Current status: The KP rootstock lines and *Trichoderma spp* have been confirmed to be effective against collar rot and Fusarium wilt in Kenya and will be verified in Uganda, in addition to the soil fertility amendments.
f. Expected outputs: Effectiveness of identified technologies for management of key diseases of passion fruit will be validated.
g. Location of trial: On-station (NaCRRI)
h. Farmer or NGO Group identified: (to be taken on-farm in year III)
i. Budget : USD 8,000

2. Identify environmentally-friendly management options for vectors of viral diseases of passion fruit

a. Co-PIs: M. Otim, M. Ochwo-Ssemakula, P. Sseruwagi, T. Kaweesi, G. Tusiime, J. Kovach
b. Priority pests: Aphids and viral diseases
c. Tasks: Identify predators and parasitoids that co-exist with aphids; evaluate the role of aphids in transmission of passion fruit viral diseases; and identify environmentally-friendly management options for aphids.
d. Description: Potential vectors of passion fruit viruses were determined in earlier trials. Subsequent trials will study the transmission mechanisms of these vectors as well as investigate potential environment friendly options, notably biological control and cultural practices such as mulching, use of cover crops/intercrops in management of the vectors and associated viral diseases.
e. Current status: An on-station field trial has been completed that determined the temporal and spatial spread patterns for the viral disease. This trial will be repeated in the coming season. In addition, transmission studies and evaluation of management options will commence in the coming season.
f. Location of trial: On-station (NACRRI)
g. Farmer or NGO group identified: (to be identified)
h. Budget total: USD 4,000

<u>Kenya</u>

1. Development and validation of diagnostic protocols for purple passion fruit viruses

a. Co-PIs: Miriam Otipa; Ruth Amata; M. Waiganjo, Juster Gitonga; Eliud Wakoli, Erbaugh, M and Miller, S.
b. Priority Pests: Passion fruit woodiness virus and other viruses affecting passion fruits in Kenya.
c. Tasks: Evaluate virus diagnostic protocols / kits earlier developed in Year 1, in the determination of viruses affecting passion fruits in Kenya; work with passion fruit nurseries in ensuring production of virus free seedlings.
d. Description: Development of virus detection tools that will enable proper virus identification and facilitate proper management have been done in Year 1 of the project at Ohio State University. Sequences of eight strains of the Kenya Passion fruit virus (KPFV) particles have been determined. Sequencing of more samples is ongoing.

Primers are being designed based on the sequence information being generated. These primers will be useful in diagnostics of viruses affecting passion fruit in Kenya and determination of virus free seedlings at farmer nurseries.
e. Current Status: On-farm / farmer nurseries
f. Expected Outputs: Diagnostic tools developed will be tested at seedling nurseries for their effectiveness in determination of passion fruit viruses and virus free seedlings.
g. Location: Central Kenya
h. Farmer or NGO group identified: Mbari ya Mboche farmers group.
i. Budget: $2200

2. Farmer participatory (On - farm) evaluation and validation of technologies for the management of passion fruit diseases.

a. Co-PIs: Ruth Amata; Monicah Waiganjo, Gesimba Robert; Miriam Otipa; Juster Gitonga; R. Munene; Kamau; Eliud Wakoli (student), Mark Erbaugh, S. Miller.
b. Priority Pests: Fusarium wilt, collar rot, dieback, brown spot, *Alternalia passiflora*
c. Task: Develop and evaluate IPM packages that address management of major diseases of passion fruit diseases including Fusarium wilt, dieback, brown spot, viruses.
d. Description: There are two on farm trials at Juja farm (≈20km East of the Jomo Kenyatta University of Agriculture and Technology) addressing this objective. In the first trial, biocontrol agents *Trichoderma harzianum* and *T. asperellum* and Copper based fungicide (Kocide) are being evaluated for the management of brown spot at on farm site in Juja Farm on two passion fruit lines (KPF 4 and KPF12) and the purple passion fruit. In the second trial the same biocontrol agents *Trichoderma harzianum* and *T. asperellum* and carbendazim are being evaluated for the management of Fusarium wilt on two passion fruit lines (KPF 4 and KPF12) from KARI-Thika, and the purple passion fruit. The same activities will be replicated in another site in Rift valley (Uasin Gishu) to determine consistency of results under different climatic conditions.
e. Current Status: On-farm
f. Expected Outputs: Effectiveness of the treatments (bio-control agents and fungicides) in the management of brown spot and Fusarium wilt will be determined. Farmer participatory evaluation of the control strategies achieved. Viruses affecting the two passion fruit lines KPF4, and KPF12 and purple passion fruit documented.
g. Location: Juja farm and Uasin Gishu in Rift Valley
h. Farmer or NGO group identified: Juja Farmers group.
i. Budget: $2900

3) Develop IPM packages that address priority pests of coffee.

<u>Uganda</u>

1. Establish the action thresholds and disease development curves for key priority pests of coffee

a. Co-PIs: Rwomushana I, Kyamanywa S, Kucel, P., C. Ssemwogerere (MSc student), Kovach J

b. Priority pests: Coffee root mealybug (*Planococcus ireneus* De Lotto), common coffee mealybug (*Planococcus kenyae* Le Pelley), Antestia bug (*Antestiopsis spp*), coffee lace bugs (*Habrochila spp*) and the coffee stem borer (*Bixadus seirricola* White).
c. Tasks: Establish action thresholds and economic injury levels of key insect pests; validate on-farm in 2011.
d. Description: Action thresholds are diagnostic tools that assist in determining when to apply corrective interventions. This would help in promoting need based application and minimizing pesticide misuse and would be part of the overall IPM package.
e. Current Research status: On station evaluation of the action threshold is to be implemented in the second season of 2010 and validated on farm in 2011.
f. **Expected output:** Action thresholds and economic injury levels for key insect pests of coffee determined.
g. Location of trial: On station – Buguseke Coffee Resaerch Station
h. Farmer or NGO group: Bugusege coffee Farmer Association group.
i. Budget: $3982

2. Effect of pruning, stumping and burning in managing the coffee twig borer (CTB) and coffee wilt disease

a. Co-PIs: Kucel P, Rwomushana I, Kyamanywa S; Kovach, J
b. Priority pests: Coffee twig borer (*Xylosandrus sp*)
c. Tasks: Evaluation of community based phyto-sanitary interventions, trapping and *Beauveria bassiana* and *Metarhizium anisopliae* in management of the coffee twig borer.
d. Description: The phyto-sanitary interventions include pruning, stumping, burning of infested coffee plant parts and alternate host plants. The emphasis is on working as a group to solve community problems using farmers own tools. *Beauveria bassiana* and *Metarhizium anisopliae* will be evaluated as management option.
e. Current research Status: This activity was initiated in Year I (2009/2010) and will continue in Year II (2010/2011). Farmers groups have been identified and mobilized.
f. Expected outputs: Knowledge and skills in management of the twig borer transferred; farmer-led interventions initiated.
g. Location of trial Ntenjeru and Nakanyonyi sub counties in Mukono Districts
h. Farmer or NGO group: Kyagalanyi coffee farmers groups
i. Budget: $ 3753

Tanzania, coffee

1. Conduct on-station field trial to study effect of existing shade and open-grown coffee on key pests .

a. Co-PI: J.M. Teri, F. Magina
b. Priority pests: Insects: Coffee berry borer (*Hypothenemus hampei*), white coffee stem borer – WCSB (*Monochamus leuconotus*), Antestia (*Antestiopsis* spp.),**Diseases:** Coffee Berry Disease - CBD (*Colletotrichum coffeanum/kahawae*), leaf rust (*Hemileia vastatrix*) **Weeds**: Star grass (*Cynodon dactylon*), Couch grass (*Digitaria* spp), Wondering jew (*Commelina* spp).

c. Objectives: Comparative effect of shaded and open grown coffee on settling behavior of key coffee pests
d. Task: Conduct on-station field trials to assess the effects of shade on the infestation of key coffee pests
e. Status: On station
f. Expected Outputs: Behavior of key coffee pests under natural shade or open field described; damage levels documented; and impacts on yield and quality of coffee assessed.
8. Location: TaCRI Moshi
9. Farmer group/NGO identified: a name of the group
10. Budget: US$ 3,600

2. Coffee berry borer management using traps and parasitoids

a. Co-PI: J.M. Teri, F. Magina Collaborating Co-PI from USA : J. Kovach
b. Priority pests: Coffee berry bore (*Hypothenemus hampei***)**
c. Objectives: Management of coffee berry borer using traps and parasitoids (Hymenoptera: Bethylidae)
d. Tasks: Conduct on station field trials to assess (i) the efficacy of locally available/made traps (alcohols, methylated spirit and juices, red coloured materials) in trapping coffee berry borer in Robusta coffee; rear and release identified parasitoids on farm (suggested: ICIPE identified predatory thrips that feed on coffee berry borer larvae).
e. Status: On station (parasitoid rearing) followed by on farm (release of parasitoid)
f. Expected Outputs: Successful rearing of parasitoids; Parasitoids established in target areas; Damage by coffee bearer reduced; Yield and quality of coffee increased
g. Location: Kilimanjaro and Kagera region
h. Farmer group/NGO identified: N/A
i. Budget: US$ 3,150

4) Develop IPM packages that address priority pests of onions.

<u>Kenya</u>

1. Project Title: Baseline socio-economic survey in Kirinyaga, Bungoma and Loitokitok Districts and market survey in Karatina and Nakuru markets

a. Co-PIs: Waiganjo M; Amata, R; Menza, M; Sylvia K; Gitonga, J; M. Erbaugh, S. Miller, D. Taylor and Mtui, J. Kovach
b. Priority Pests: Thrips, *Thrips tabaci* and *Frankliniella occidentalis*, Downy mildew, *Peronospora destructor,* Purple blotch, *Alternalia porri.*
c. Tasks: Conduct socio-economic and diagnostic survey in Kirinyaga, Bungoma and Loitokitok; conduct a market survey in Karatina and Nakuru markets;
d. Description: A common questionnaire (Kenya, Tanzania) will be developed to collect information on onion production constraints among the smallholder onion growers in the major production areas including Kirinyaga, Bungoma and Loitokitok and pest diagnosis in selected farms to identify the major onion pests. Market survey will be carried in the major markets including Karatina and Nakuru.

e. Current Status: New.
f. Expected Outputs: Onion production constraints documented, Produce status in the markets and market constraints documented, major pests (arthropod pests and diseases and weeds) of onion documented and locality GPS coordinated.
g. Location: Kirinyaga, Bungoma and Loitokitok, Karatina and Nakuru.
h. Farmer or NGO group identified: Kirinyaga farmers
i. Budget: $ 4,000

2. Development and Validation of IPM technologies for onion

a. Co-PIs: Waiganjo M; Amata, R; Menza, M; Sylvia K; Gitonga, J; M. Erbaugh, S. Miller, D. Taylor, Maerere, J. Kovach
b. Priority Pests: Thrips, *Thrips tabaci, Frankliniella occidentalis* (As per memo from Waiganjo: Frankliniella was recorded on onion farms in Kirinyaga District, 2002, however, its spread to other areas and current distribution is not known), Downy mildew, *Peronospora destructor,* Purple blotch, *Alternalia porri.*
c. Objectives: to carry out on-station and on-farm trials to test cost effective IPM options for onion crop.
d. Tasks: Determine effective options for onion pests and disease management; test these options on-station; test these options on-farm alongside the farmer conventional options for comparison and validation and farmer participatory demonstrations conducted.
e. Current Status: New. The study will be carried out on-station at KARI-Thika and later in farmers fields
f. Expected Outputs: Critical stages for thrips control using selected bio-pesticides identified, Cost effective IPM options for onion developed and disseminated. At least 20 farmers participate in IPM technologies for onion pests and diseases development.
g. Location: Kibirigwi, Kirinyaga District.
h. Farmer or NGO group identified: Kirinyaga farmers.
i. Budget: $6000

3. Participatory evaluation of onion accessions on bulb quality, yield and biotic stress and pest tolerance

a. Co-PIs: Waiganjo M; Amata, R; Menza, M; Sylvia K; Gitonga, J; M. Erbaugh, S. Miller and Mtui
b. Priority Pests: *Thrips tabaci,* Downy mildew, *Peronospora destructor,* Purple blotch, *Alternalia porri.*
c. Objectives: To determine susceptibility/tolerance of selected onion accessions to major onion pests and diseases; to assess the bulb quality and yield of the onion accessions
d. Tasks: Test seven onion accession of introduced and local cultivars for pest and disease tolerance/susceptibility, on-station at KARI-Thika and on-farm at Kibirigwi-Kirinyaga.
e. Current Status: New.
f. Expected Outputs: Onion accessions that are tolerant to biotic stresses (pests and diseases) identified
g. Location: Kibirigwi-Kirinyaga
h. Farmer or NGO group identified: Smallholder onion farmers in Kirinyaga District.
i. Budget: $5000

Tanzania

1. Conduct baseline socioeconomic and diagnostic survey on onion production

a. Co-PI: C. Msuya-Bengesi, K. Mwanjombe, A.P. Maerere, K.P. Sibuga, E.R. Mgembe, M.W. Mwatawala
Collaborating Co-PI from USA: D. Larson, M. Erbaugh
b. Priority pests: To be identified
c. Objectives: Effect of production practices on pest prevalence and management.
d. Task: Conduct baseline socioeconomic and diagnostic survey in Mvomero and Kilosa districts of Morogoro region to describe onion production practices and their influence on pest prevalence and management.
e. Status: New
f. Expected Outputs: Current status of onion production assessed; Biological constraints to onion production and post harvest handling determined; Socio economic constraints to onion production and opportunities for enhancing onion production
g. Location: Morogoro region
h. Farmer group/NGO identified: Women and other onion farmer groups for onion production
i. Budget: US$ 2,000

2. Conduct initial on-station trials to evaluate a wide range of onion Germplasm.

a. Co-PI: A.P. Maerere, K.P. Sibuga, R.E. Mgembe, M.W. Mwatawala, D. Mamiro
Collaborating Co-PI from USA: M. Erbaugh
b. Priority pests: Will base on findings from the baseline survey
c. Objectives: Develop an IPM package for onion pests
d. Task: Evaluate performance of a wide range of onion germplasm under the local (Morogoro) conditions in respect to adaptability.
e. Status: New -On station
f. Expected Outputs: Potential of adapted cultivars identified; Tolerance/resistance of onion varieties to pests documented
g. Location: SUA
h. Farmer group/NGO identified: Women and other onion farmer groups for onion production will participate in evaluation of on station trial
i. Budget: US$ 3,000

5) Develop IPM packages that address priority pests of scotch bonnet peppers.

Uganda

1. Exploiting host plant resistance to manage hot pepper root rot/wilt disease in Mubuku Irrigation and Settlement Scheme

a. Co- PI: Geoffrey Tusiime; Karungi J., Bonabana J., Kyamanywa S., Munyazikwiye D (MSc. Student), Sally Miller, J. Kovach
b. Priority pests to be addressed: Phytophthora root and wilt disease (*Phytophthora capsici*)
c. Tasks: Establish the range of fungal root rot and wilt pathogens on scotch bonnet; Screen hot pepper germplasm for resistance to root rot/wilt disease in Uganda.
d. Description: Phytophthora wilt disease is the main threat to irrigated hot pepper in Uganda. As such pathogen characterization is a priority after which management strategies can be focused. Several

imported hot pepper lines/germplasm (from Cornell University) will be screened for tolerance to the disease in Uganda.
e. Current research status: Characterization of the pathogen is complete. Seedlings of the imported hot pepper lines have been raised and are ready for screening for tolerance to Phytophthora wilt. Two seasons of screening will be done.
f. Expected outputs: Fungal species causing pepper rot/wilt identified; resistant hot pepper germplasm identified
g. Location: Makerere University (laboratory), Mubuku Irrigation and Settlement Scheme, Kasese (On-farm).
h. Farmer or NGO group identified: Abasaija Kweyamba Mubuku Farming Co-operative Society Limited. (AKMFCS Ltd.)
i. Budget total: $4000

2. Establishing the effect of soil water amount on hot pepper wilt incidence and severity in Mubuku Irrigation Scheme

a. Co-PIs: Geoffrey Tusiime; Karungi J., Bonabana J., Kyamanywa S., Munyazikwiye D (MSc Student), Sally Miller
b. Priority pests: Phytophthora root and wilt disease (*Phytophthora capsici)*
c. Tasks: Determine optimum ridge size; determine optimum irrigation frequency, for managing pepper root rot/wilt disease:
d. Description: Phytophthora root and wilt disease is transmitted through furrow irrigation water. Adjusting ridge size and irrigation frequency may reduce infection. Different ridge sizes and frequency will be studied to determine the optimum for reducing infection.
e. Current status: This is an on-going trial and will be repeated in year II
f. Expected outputs: Optimum ridge size established; optimum irrigation frequency established.
g. Location of trial: On station; on-farm - Mubuku Irrigation and Settlement Scheme.
h. Farmer or NGO Group identified: Abasaija Kweyamba Mubuku Farming Co-operative Society Limited. (AKMFCS Ltd.)
i. Budget : $4000

3. Establishing the diversity of hot pepper seed-borne viruses and developing a system for small-holder virus-free seed production in Uganda.

a. Co-PIs: Geoffrey Tusiime; P. Sseruwagi, Mukasa S. B., Karungi J., Bonabana J., Kyamanywa S., Munyazikwiye D; Sally Miller
b. Priority pests: Seed and vector-transmitted pepper viruses.
c. Tasks: Establish the range of seed-transmitted hot pepper viruses in Uganda; Evaluate an in-door (tunnel) production system for virus free hot pepper seed.
d. Description: Tunnel crop production is becoming very popular in horticulture production as management strategy against vector-transmitted diseases among other benefits. In this study the tunnel will be used as a source of virus-free seedlings for farmers.
e. Current status: the tunnel house has been constructed and seedling production has commenced

f. Expected outputs: Range of seed-transmitted viruses documented; small-holder virus-free seed production system verified**.**
g. Location of trial: on station; on-farm - Mubuku Irrigation and Settlement Scheme.
h. Farmer or NGO Group identified: Abasaija Kweyamba Mubuku Farming Co-operative Society Limited. (AKMFCS Ltd.)
i. Budget : $4000

Objective 3: <u>Transfer IPM knowledge and packages</u> to stakeholders using innovative approaches and short-term training to facilitate adoption.

1) Transfer IPM knowledge and packages to growers of tomato

<u>Uganda:</u>

1. IPM package Transfer to tomato farming communities

a. Co-PIs: R.N. Ssonko, J. Karungi, S. Kyamanywa; Matt Kleinhenz, M. Erbaugh
b. Priority pests to be addressed: Bacterial wilt (by *Ralstonia solani*) and Late blight (by *Phytophthora infestans*)
c. IPM objectives or Strategies to be disseminated: The IPM package developed in previous IPM CRSP phases which is to be disseminated includes use of grafting; a tolerant variety (MT 56); raised beds, mulching and staking as strategies to reduce incidence and severity of bacterial wilt of tomato; this package plus drastically reduced fungicide sprays was also sufficient to protect tomato from late blight.
d. Tasks: Scaling up dissemination of the package to Mukono district in Central Uganda where tomato growing is a thriving commercial enterprise.
e. Description: Demonstration plots and farmer training will be the transfer approach utilised. Prior to field work, organizational and baseline assessment of Mukono tomato growers will be conducted.
f. Current research status: The IPM package was disseminated in Busukuma Subcounty in Wakiso district in earlier phase and was well received.
g. Expected outputs: more farmers aware about the benefits of IPM in tomato; increase in tomato yields; two manuscripts on effect of i) grafting (S. Kyamanywa et.al and ii) cultural practices in the management of bacterial wilt of tomato (R.N. Ssonko et. al) will be drafted, internally reviewed and submitted for publication.
h. Location: Mukono district, Central Uganda
i. Farmer or NGO group identified: (to be confirmed in Mukono district).
j. Budget total: $9000 (over 2 seasons – including the $1000 for the baseline work)

<u>Kenya</u>

1. Tomato high tunnel and grafting trials (part of research activity 1)

a. Co-PIs: Waiganjo M; Menza, M; Sylvia K; Gitonga, J; Amata, R; Erbaugh, M. Miller, S. Tusiime, G. Kyamanywa, S.; Kleinhenz, M..Kovach, J. Pauline Mueke (Msc. Student), Charity Gathambiri (Postharvest specialist at KARI-Thika).
b. Priority Pests: Tomato diseases (*Ralstonia solanacearum* and yellow leaf curl virus), arthropod pests (thrips, Thrips spp; whiteflies, Bemisia tabaci; Mites, *Tetranychus spp*; leafminers, *Liriomyza trifoli*, jassids and bollworms, *Helicoverpa armigera*

c. Task: To train and demonstrate tomato high tunnel production and grafting as appropriate integrated pest management tools for the smallholder farmers.
d. Description: Participatory tomato grafting and high tunnel trials under smallholder production system were initiated in Mwea, Kenya. These trials are set up on-farm at a farmer's field laid out in split plots consisting of two main plots (high tunnel and open field) in randomized complete blocks of 3 treatments replicated 4 times. The three treatments included, Onyx variety grafted on a wilt resistant MT56 rootstock, ungrafted onyx, and the commercial high tunnel variety (Anna F1) varieties as the sub plots.
e. Current Status: the continuing activities will include, inviting the farmers to demonstrate tomato production practices for a follow up training and demonstration onsite. Involve more farmers in the participatory research and demonstration.
f. Expected Outputs: At least 200 farmers will have had a participatory training on tomato production practices, high tunnel tomato production and grafting.
g. Location: Mwea
h. Farmer or NGO group identified: attempt should be made to identify women's group or NGO. BAYER tomato farmers groups at Mwea, Scotts Co. ltd.
i. Budget: $3000

2. Validation of developed tomato IPM technologies through Farmer Field schools and development of a Tomato training handbook.

a. Co-PIs: Waiganjo M; Amata, R.; Gitonga, J; Sylvia K; Menza, M; M. Erbaugh, S. Miller, G. Tusiime, S. Kyamanywa, Kleinhenz, M; Kovach, J.
b. Priority Pests: Tomato production constraints including Pests (*Ralstonia solanacearum*, *Begomoviruses*, *Phytophthora infestans*, Physiological disorders-blossom end rot) Insect pests (*Liriomyza spp; Bemisia tabaci;* Thrips, *Helicoverpa armigera*, *Tetranychus* spp.
c. Tasks: Develop and disseminate appropriate crop and pest management technologies.
d. Description: This is a technology transfer activity. A step-wise learning process will be carried out highlighting the tomato production practices including plant nutrition, seed selection , nursery preparation, pest management to harvesting and postharvest handling. Technology transfer through field discussions will be supported by publications. Tomato handbooks to be developed include tomato arthropod pest management guide, tomato disease management guide, greenhouse tomato production and tomato grafting handbook. Tomato arthropod pest management draft completed.
e. Current Status: this is a new activity and will involve at least two women dominated groups in Mwea and Kangai area.
f. Expected Outputs: At least 30 farmers will have participated in a tomato farmer field school in Kirinyaga District. Preparation of tomato grafting and greenhouse production handbooks is on-going. Two handbooks will be developed and issued to the smallholder farmers and extension workers. The researchers are expected to publish the research findings and present in the findings in local and international conferences.
g. Location: Mwea and Kangai area, Kirinyaga District.
h. Farmer or NGO group identified: attempt should be made to identify women's group or NGO. BAYER tomato farmers groups at Mwea, Scotts Co. ltd, Kangai Tisa farmers group.
i. Budget: $4000

<u>Tanzania</u>

1. Disseminate recommended IPM package

a. Co-PIs: Co-PI: A.P. Maerere, K.P. Sibuga, E.R. Mgembe, M.W. Mwatawala, D. Mamiro; Collaborating Co-PI from USA: J. Kovach, M. Erbaugh
b. Priority Pests: Leaf spot (*Septoria lycopersi*) late blight (*Alternaria solani*), tomato yellow leaf curl. and root knot nematode (*Melodogyn*e spp.); **Insects** leaf miner (*Liriomyza* sp.), aphids (*Aphis spp*), thrips (*Frankinnela occidentalis*) and bollworm (*Helicoverpa armigera*); **Weeds [**Nutsedge **(***Cyperus rotundus*)*, pigweeds (Amaranthus spp)*, Wondering jew (*Commelina benghalensis) and* Mexican poppy *(Argemone mexicana*)
c. Objectives: Disseminate IPM package: Seed treatment + reduced sprays + mulch
d. Task: On-farm demonstration trials consisting of the IPM package and control will be implemented with 5 production communities in Mvomero district.
e. Current Status: Ready for scaling out
f. Expected Outputs: Farmer adoption of practices resulting in increased yield, improved fruit quality, reduced costs of production, and increased farmer income.
g. Location: Mvomero district (at least 5 tomato production communities)
h. Farmer/NGO group identified: MVIWATA**,** Peco and Misegese farmer groups, one women group in each community
i. Budget: $4500

2) Transfer IPM knowledge and packages to growers of passion fruit.

<u>Kenya:</u>

1. Farmer/Extension training on passion fruit pests and diseases and their management.

a. Co-PIs: Ruth Amata; Monicah Waiganjo, Gesimba Robert; Miriam Otipa; Juster Gitonga; R. Munene; Kamau; Eliud Wakoli (Student), Mark Erbaugh, S. Miller.
b. Priority Pests: Training on all passion fruit pests (diseases and arthropod pests) affecting the crop in Kenya including; Fusarium wilt, collar rot, dieback, brown spot, viruses, aphids, thrips, *Thrips spp*; mites, *Tetranychus spp*.and leaf miners, *Liriomyza spp*.
c. Task: Farmer training on pests and diseases affecting passion fruit and their management.
d. Description: Farmers will be taught on important strategies in managing diseases such as field sanitation, pruning, and destruction of diseased plant residues, use of biocontrol agents such as *Trichoderma* spp. and safe use of pesticides.
e. Current Status: A new activity; that will be conducted at KARI Thika and also visit two passion fruit farmers.
f. Expected Outputs: At least twenty farmers trained on pests and diseases affecting passion fruit and their management.
g. Location: The extension and farmer training will be a 3 day activity undertaken at KARI Thika. Farms visited will be in Central Kenya.
h. Farmer or NGO group identified: – Farmers to be trained will be selected from farmers groups in passion fruit growing areas close to the training centre (Central Kenya)
i. Budget: $3000

2. Farmer participatory (On - farm) evaluation and validation of technologies for the management of insect pests of passion fruit.

a. Co-PIs: Monicah Waiganjo, Ruth Amata; Miriam Otipa; Mwalimu Menza; Juster Gitonga; Joe Kahinga (student); R. Munene; Kamau; Eliud Wakoli (Student), Mark Erbaugh, S. Miller, Joe Kovach.
b. Priority Pests: Thrips, Leaf miner, *Liriomyza spp*., Aphids.
c. Tasks: Demonstrated on-farm use of bio-pesticides and soft pesticides (*Beauveria bassiana* (Biopower *r* and *Metarhizium anisopliae* to be supplied by ICIPE and Imidacloprid (Confidor *r*) in management of arthropod pests; Evaluation of improved passion fruit lines for tolerance / resistance to pests.
d. Description: Research work will be an on farm evaluation of the response of three passion fruit lines KPF4, KPF11, KPF12 and purple passion fruit to insect/arthropod pests.
e. Current Status: New activity, on-farm
f. Expected Outputs: At least 20 passion fruit farmers participate in passion fruit pest identification and management. Use of bio-pesticides and their safety and effectiveness demonstrated during the on-farm participatory exercises.
g. Location: Gatanga
h. Farmer or NGO group identified: Farmer groups in Gatanga
i. Budget: $1700

3) Transfer IPM knowledge and packages to growers of coffee.

<u>Uganda</u>

1. Demonstrating the effect of Conventional vs. IPM management system on priority insect pests and diseases.

a. Co-PIs: Kyamanywa S, Rwomushana I. and Kucel P. Kovach J., Erbaugh, M.
b. Priority pests: Coffee Stem borer (*Bixadus seirricola* White), coffee root mealybug (*Plannococcus ireneus*, De Lotto), Common coffee mealybug (*Planococcus kenyae*, Le Pelley) and coffee berry borer (*Hypothenemus hampei*)
c. Task: Dissemination of fertilizer application, Organic mulches, Stem wrapping, and Stem smoothing for control of root mealybugs and stem borers through use of modified farmer field schools.
d. Objectives/Description: In 2008/2009 when the conventional method of pest control in coffee, involving calendar chemical pesticide application (Furadan and Marshal), was compared with IPM management tactics (fertilizer application (CAN), Organic mulches, Stem wrapping, Stem smoothing), the IPM tactics were found to be more cost effective and are being transferred to the farming communities.
e. Current research Status: In the first season of 2010 the IPM options were advanced for on-farm evaluation (2 demonstration sites) in Bugusege Parish, Eastern Uganda. Dissemination of IPM options will be up-scaled in year II using the modified farmer field schools.
f. Expected outputs: Knowledge of IPM in coffee transferred to farming communities; brochures on Coffee pests and diseases and their management
g. Location of on farm trials: Sironko district
h. Farmer or NGO group: Kesemulira Farmer group (Bugusege Parish)
i. Budget: US$ 4165

Global Themes for East Africa:

IPDN and Virus GT

1. Activity Title: Workshop in the region to integrate virus diagnostics into the IPDN framework.

a. Co PIs: Kinyua, Z.M, R.L. Amata, M.J. Otipa, M. Waiganjo, S. Kyamanywa, P. Sseruwaji, M. Ochwo-Ssemakula, G. Tusiime, A. Maerere (and to be determined SUA pathologist), S. Miller, (to be determined PI from Virus GT), M. Erbaugh
b. Task: Host regional workshop**.**
c. Primary Objective: Refine work plans for IPDN and Virus Global Themes for remainder of project, with emphasis on: going from diagnostics to management protocols; developing disease ID, diagnostic, and management training programs for extension agents and growers; integrating low-cost disease diagnostics by cell phone. **Secondary objectives**: 1) Create roadmap for developing: (i) virus and other disease diagnostic tools and priorities for tomato and passion fruit; (ii) SOPs on viruses and major plant diseases; (iii) PRAs on vectors, viruses, and other plant diseases; (iv) for passion fruit specifically, SOPs/PRAs on major diseases & insects; develop management protocols; 2) Set date/plan for regional training program in virus diagnostics Year 3.
d. Description of activity: Project partners will share information on the economic importance and ease of diagnosing common diseases affecting tomato and passion fruit in East Africa. The diseases and their respective diagnostic techniques will then be prioritized and knowledge gaps identified. Information generated will then be consolidated and refined in a meeting. This will require strong linkages with the key contact persons in each of the countries in East Africa.
e. Expected outputs: Integration of virus diagnostics into IPDN framework.
Expected outputs by the end of Year 2 (September 30, 2011): a) Economically important diseases of tomato and passion fruit prioritized; b) Diagnostic techniques and tools for economically important diseases identified; c) Gaps in diagnostic tools and techniques identified.
f. Location: Kenya or Uganda
g. Date: December 10 or January 11.

Other IPDN activities emanating from meeting:

Countries: <u>Kenya, Uganda and Tanzania</u>

Crop(s): Tomato and passion fruit

2. Activity title: Developing diagnostic SOPs on prioritized diseases of tomato and passion fruit in East Africa

a. Co-PIs: Kinyua, Z., R. Amata, M. , Otipa, M. Waiganjo, S. Kyamanywa, P. Sseruwaji, M. Ochwo-Ssemakula, G. Tusiime, A. Maerere (and to be determined SUA pathologist), S. Miller, (to be determined PI from Virus GT), M. Erbaugh
b. Priority pests to be addressed: Fungal, bacterial, viral and nematode diseases
c. Tasks: Testing and dissemination of **s**tandard procedures for diagnosis of major diseases affecting tomatoes and passion fruit.
d. Description of activity: Information collated on the diagnostic techniques/tools available for major diseases of tomato and passion fruit, along with the identified knowledge gaps will form the foundation

upon which standard operating procedures (SOPs) will be developed. Additional literature search on diagnostic techniques/tools used in countries/laboratories outside the East African regional will be conducted by scientists assigned particular tasks on the basis of their comparative advantage. Potentially useful tools/techniques will be incorporated into draft SOPs, which will then be discussed and refined in a workshop.
e. Current research status: a) New; b) To be executed through email and telephone communications and refined in a workshop.
f. Expected outputs by the end of Year 2 (September 30, 2011): a) Draft SOPs for economically important diseases developed; b) Draft SOPs discussed and refined.
g. Location of trials: Kenya, Uganda, Tanzania (for selected diagnostic procedures), joint workshop in Kenya (for consolidation and consensus on draft SOPs)
h. Farmer or NGO group identified: Literature searches and visits/interviews with a selection of established laboratories in East Africa.
i. Budget total: US$ 3,500

Country: <u>Kenya</u>

Crop(s): Tomato and passion fruit

3. Activity title: Training farmers and extension staff on diagnosis and management of common diseases of tomato and passion fruit (joint training with E.A. Regional Project)

a. Co-PIs: Kinyua, Z.M., R.L. Amata, B.C. Langat, S. Miller, Waiganjo M. and M. Erbaugh.
b. Priority pests to be addressed: Fungal, bacterial, viral and nematode diseases
c. Task: Testing and dissemination of recognition and management options for various diseases affecting tomatoes and passion fruit.
d. Description of activity: Farmers and agricultural extension staff identified during field visits and trial establishment by the regional project team will be trained on the diagnosis of the main diseases affecting tomato and passion fruit in their localities. This will take the form of on-farm sessions and a joint workshop to systematically train them on the steps in diagnosis and management of the diseases. The tasks will be coupled with analysis of diseased samples obtained from farm sites hosting the regional project trials.
e. Current research status: a) New; b) To be undertaken through pre-arranged training sessions.
f. Expected outputs by the end of Year 2 (September 30, 2011): a) Farmers and extension staff in project areas trained; b) Samples from the Regional Project sites analyzed for diseases.
g. Location of trials/activity: A joint workshop at KARI Thika and on-farm sessions in Kirinyaga
h. Farmer or NGO group identified: Farmers and extension staff to be identified during field assessments.
i. Budget total: $2500

IMPACT ASSESSMENT GLOBAL THEME

<u>Uganda</u>

1. Activity Title: Baseline socioeconomic survey data for passion fruit in the major growing areas in Uganda

a. Co-PIs: Dr. J.Bonabana-Wabbi, Prof. D.B Taylor, Dr. M. Ochwo-Semakula, Prof. G. Norton, Dr. M. Erbaugh, Prof. S. Kyamanywa, Ms. R. Isoto, Dr. M. Otim, Dr. P. Seruwagi and MSc Student (To be identified).
b. Priority pest: Passionfuit viral diseases and Collar root rot
c. Task: Establish and conduct baseline conditions/research needs assessment for passion fruit as a tool for Impact Assessment
d. Description: Passion fruit IPM research needs assessment with aspects on production, processing and marketing conditions of passion fruit. Needs assessment will establish the current production and marketing aspects of passion fruit and identify key constraints of passion fruit production and marketing processes. The baseline will in addition establish the current socioeconomic and demographic characteristics of passion fruit growers.
e. Current research status: Biological research has in the past year established efficacy of cultural practices in management of pests and diseases, evaluated for plant resistance of passion fruit cultivars to collar rot, and identified environmentally-friendly management options for vectors of viral diseases of passion fruit on station. These activities were on-station in year 1 and are planned to move to on-farm.
f. Expected outputs: baseline instrument designed and implemented
g. Location of trial: Mpigi, Wakiso
h. Farmer or NGO Group identified: Najjembe Farmers' group and Kolerawamu Farmers' group
i. Budget totals: $2,000

2. Activity Title: Baseline socioeconomic survey instrument designed and survey implemented for onion in Kenya and Tanzania

a. Co-PIs:. J.Bonabana-Wabbi, D.B Taylor, M. Erbaugh, S. Kyamanywa, Monicah Waiganjo, Juster Gitonga, M. Menza, A. Maerere H. Mtui and to-be designated social scientist from SUA.
b. Priority pest: to be determined
c. Task: Establish and conduct baseline conditions/research needs assessment for onion as a tool for Impact Assessment
d. Description: Onion IPM research needs assessment with aspects on production, processing and marketing conditions of onions. Needs assessment will establish the current production and marketing aspects of onions and identify key constraints of onions production and marketing processes. The baseline will in addition establish the current socioeconomic and demographic characteristics of onions.
e. Current research status: Biological research begin this year. Need to initiate baseline activities.
f. Expected outputs: baseline instrument designed and implemented
g. Location of trial: Kenya: Kirinyaga, Bungoma and Loitokitok Districts and market survey in Karatina and Nakuru markets; Tanzania: Morogoro region.
h. Farmer or NGO Group identified:
i. Budget totals: $4000, Kenya; $1000, Tanzania

3. Activity Title:Impact Assessment Workshop

To be attended by impact assessment partners from TZ and Kenya. Other Ugandans willing and able to participate in IPM Impact assessment activities will be identified and facilitated to attend the training.

a. Co-PIs: Prof. G. Norton, Dr. J.Bonabana-Wabbi, Prof. D.B Taylor, Prof. S. Kyamanywa, Dr. J. Karungi. Dr. M. Waiganjo, Prof. A. Maerere, Dr. D. Kraybill, Dr. M. Erbaugh, Dr. M. Mangheni, Dr. C. Maria-Elisa
b. Priority pest: Cross cutting
c. Task: Conduct impact assessment workshop.
d. Location of trial: Uganda (Exact venue for workshop to be identified)
e. Budget totals: $6,000

4. Activity Title: Impact and Indicator monitoring for EA regional site

a. Co-PIs:. J.Bonabana-Wabbi, D.B Taylor, M. Erbaugh, S. Kyamanywa, Monicah Waiganjo, Juster Gitonga, M. Menza, A. Maerere H. Mtui and to-be designated social scientist from SUA.
b. Tasks: Develop instruments and reporting forms for monitoring impact assessment and measuring indicators including activity reporting forms and reporting forms for biological scientists.

GENDER KNOWLEDGE GLOBAL THEME

1. Activity Title: Producing and disseminating knowledge of gender issues in IPM

a. Co-PIs: Dr. M. Mangheni; Dr. J. Bonabana, Dr. M. Waiganjo, Ms. J. Gitonga, Prof. A. Maerere; Dr. Maria Elisa Christie
b. Gender Tasks: i) Integrate gender into base line and impact assessment data collection tools; ii) Support to baseline and impact assessment studies during data collection and analysis to ensure gender integration; iii) Write an article for publication from the Uganda gender baseline data and rapid assessment
c. Priority pest: Cross cutting
d. Overall budget for the GK GT: $10,000

West Africa Regional Consortium for IPM Excellence

Subtitle: Development of comprehensive IPM packages for key vegetable crops in West Africa: Building upon and extending previous IPM-CRSP research

Lead Principal Investigator:

Donald E. Mullins, Virginia Tech

Co-Investigators/Advisors and Institution Affiliation:

Robert Gilbertson, University of California, Davis
George Mbata, Fort Valley State University
Sally Miller, Ohio State University
Carlyle Brewster, Virginia Tech
Patricia Hipkins, Virginia Tech
Doug Pfeiffer, Virginia Tech
Jim Westwood, Virginia Tech

Institutional Collaboration:

AVRDC- W. Africa/global	DPV- Senegal
INSAH- W. Africa	ISRA- Senegal
IER- Mali	ANCAR - Senegal
ETQCL - Mali	CERES-Locustox-Senegal
OHVN-Mali	CSI-Ghana

Brief description of the project:

Vegetables are a critical source of nutrition and an important cash crop in West Africa. However, vegetable crop production in West Africa is subject to numerous constraints, including losses due to arthropod pests, diseases and weeds; lack of up-to-date technology and varieties; and misuse and lack of availability of pesticides. Previous IPM-CRSP research has made progress in addressing a number of these constraints, including pesticide safety training and residue analysis; identification and management of whitefly-transmitted viruses and identification of key weed species. Here, we propose to build upon and extend these results to develop comprehensive IPM packages for three major vegetable crops (cabbage, potato and tomato) in three West African countries (Ghana, Mali and Senegal). These packages will cover all aspects of production from seed selection to harvest. In the development of these packages, our team will build upon our extensive experience in vegetable crop production in West Africa, and our collective expertise in IPM and the related sub-disciplines (entomology, plant pathology and weed science). We will develop and implement these packages through a strong collaborative effort with our host country partners and focus our efforts on improving the livelihoods of farmers and their families in rural agricultural households. In cases where new efforts are proposed (cabbage and potato), surveys will be conducted in parallel with development of the IPM packages to help identify the key pests and to understand the specific crop production system(s) used. We will categorize pesticides currently used on these crops and assess whether they are being used according to current recommendations and whether they are being applied safely. Depending on the outcome of these surveys we may need to recommend new pesticides or emphasize farmer training for safe use of pesticides. This latter point builds on an existing strength of our project. Based on our previous experience, we expect to have special emphasis on a number of other problems including whiteflies and whitefly-transmitted viruses (tomato), bacterial wilt disease (potato and tomato), potato tuber moth (potato), diamondback moth (cabbage) and the role of weeds as reservoirs for viruses and

arthropod pests (all three crops). In the research on bacterial wilt and plant viruses, we will work closely with the International Plant Diagnostic Laboratory, International Plant Virus Disease Network. We also expect to greatly improve the overall diagnostic capacities of all three countries. In documenting the impact of the IPM packages, and compare farmers using the IPM package and those that do not. This will be carried out in collaboration with the Impact Assessment global theme. Female farmers have a unique role in production of these vegetable crops, often different from the male role. Consequently we will collaborate with the Coordination of Gender Knowledge and Application global theme project, in order that our IPM packages will have maximum impact with women farmers. Finally, we will disseminate the information generated in this project through various venues, so that it has the maximum opportunity to reach farmers and others involved in vegetable crop production. In this way we believe this work proposed will have maximum impact on the health and well-being of vegetable farmers and consumers in West Africa.

Objective-1: Develop and implement an IPM package for tomato in Ghana, Mali and Senegal

Activity 1a: Establish locations for implementation of tomato IPM programs

Country: Ghana
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Michael Osei/CSIR-CRI
Description: Identify locations for tomato IPM implementation
Progress to date: Near completion
Expected outputs: The locations will be set for this part of the project

Task 1: The geographical locations for the implementation of the IPM package for tomato will be established

Country: Mali
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Moussa Noussourou/IER
Description: Identify the locations for tomato IPM implementation
Progress to date: Near completion
Expected outputs: The locations will be set for this part of the project

Task 1: The geographical locations for the implementation of the IPM package for tomato will be established

Country: Senegal
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Samba Diao/ISRA-CDH
Description: Identify the locations for tomato IPM implementation
Progress to date: Ongoing
Expected outputs: The locations will be set for this part of the project

Task 1: The geographical locations **for the implementation of the IPM package for tomato** will be established

Activity 1b: Conduct surveys in each location for tomato production practices, yields and disease and pest problems

Country: Ghana

Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Michael Osei/CSIR-CRI
Description: Growers participating in the IPM project will be surveyed to gain an understanding of tomato production practices, yields and disease and pest problems
Progress to date: Draft survey complete
Expected outputs: An understanding of the issues associated with tomato production in the locations where the project will be conducted

Task 1: Conduct the surveys of the growers

Country: Mali
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Moussa Noussourou/IER
Description: Growers participating in the IPM project will be surveyed to gain an understanding of tomato production practices, yields and disease and pest problems
Progress to date: Draft survey complete
Expected outputs: An understanding of the issues associated with tomato production in the locations where the project will be conducted

Task 1: Conduct the surveys of the growers

Country: Senegal
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Samba Diao/ISRA-CDH
Description: Growers participating in the IPM project will be surveyed to gain an understanding of tomato production practices, yields and disease and pest problems
Progress to date: Draft survey complete
Expected outputs: An understanding of the issues associated with tomato production in the locations where the project will be conducted

Activity 1c: Sampling & Identification of SPW biotypes collected in the cropping systems in Mali, Senegal and Ghana

Country: Ghana
Status: Initiate activity
Scientists involved: Carlyle Brewster/VT; Michael Osei/CSIR-CRI
Description: The sweetpotato whitefly, *Bemisia tabaci*, is a major insect vector, which has been linked to the transmission of over 100 plant viruses, including viruses in tomato. Management of vector-borne diseases such as those caused by whitefly-transmitted viruses can be achieved by several means including a reduction in vector density and life expectancy, limiting contact between the vector and host plants, or by reducing the rate of infection of the virus. The aim of this activity is to gather information for managing whitefly populations in the West Africa region as another tool for managing whitefly-transmitted virus diseases in tomato.

Whitefly management tactics are organized around three key activities: sampling, effective chemical use, and avoidance. Sampling is central to the development of IPM programs and is the key to the understanding, implementation, and refinement of all management strategies. As such, in the previous IPM-CRSP project, we developed a standardized sampling protocol for whiteflies as a means for understanding and comparing whitefly population dynamics among cropping areas within and between countries. In addition, because *Bemisia tabaci* is a species complex consisting of 13 or more biotypes,

adequate population management requires knowledge of the species present in the countries of the study.
Progress to date: Planning
Expected outputs: Data on the long-term dynamics of whitefly populations and of the biotypes present in tomato cropping systems.

Task 1: Conduct spatial and temporal sampling of whitefly populations in cropping areas identified for implementation of IPM program in tomato.
Task 2: Collect adult whitefly for biotyping

Country: Mali
Status: Continuing
Scientists involved: Carlyle Brewster/VT; Moussa Noussourou/IER
Description: Same as above.
Progress to date: Extensive spatiotemporal sampling was conducted during 2007-2009 at geographically distinct vegetable cropping areas (Baguineda and Kati) using a specially designed sampling protocol that would allow for comparison of data among between areas. In addition, samples of whiteflies were collected and submitted for molecular identification by Judy Brown (University of Arizona). Whitefly population sampling and collection of adult samples of the insect for identification is continuing in the two cropping areas.
Expected outputs: Data on the long-term dynamics of whitefly populations and of the biotypes present in tomato cropping systems.

Task 1: Conduct spatial and temporal sampling of whitefly populations in the cropping regions identified for implementation of IPM program in tomato.
Task 2: Collect adult whitefly samples for biotyping

Country: Senegal
Status: Continuing
Scientists involved: Carlyle Brewster/VT; Kemo Badji/DPV + ISRA-CDH + Cs-Locustox
Description: Same as above.
Progress to date: Extensive spatiotemporal sampling was conducted during 2007-2009 at geographically distinct vegetable cropping areas (Gorom, Mboro, and Kolda) using a specially designed sampling protocol that would allow for comparison of data among between areas. In addition, samples of whiteflies were collected and submitted for molecular identification by Judy Brown (University of Arizona). Whitefly population sampling and collection of adult samples for identification will continue in selected cropping areas.
Expected outputs: Data on the long-term dynamics of whitefly populations and of the biotypes present in tomato cropping systems.

Task 1: Conduct spatial and temporal sampling whitefly of populations in the cropping regions identified for implementation of IPM program in tomato.
Task 2: Collect adult whitefly samples for biotyping

Activity 1d: Identify farmers for participating in the IPM program

Country: Ghana
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Michael Osei/CSIR-CRI
Description: Identify farmers willing to participate in the IPM project and fill out the survey
Progress to date: Most of the farmers have been identified

Expected outputs: Farmers that will participate in the project will be identified
Task 1: Identify farmers willing to participate in the project

Country: Mali
Status:
Scientists involved: Bob Gilbertson/UC-Davis; Moussa Noussourou/IER
Description: Identify farmers willing to participate in the IPM project and fill out the survey
Progress to date: Most of the farmers have been identified
Expected outputs: Farmers that will participate in the project will be identified
Task 1: Identify farmers willing to participate in the project

Country: Senegal
Status: Continuing
Scientists involved: Bob Gilbertson/UC-Davis; Samba Diao/ISRA-CDH
Description: Identify farmers willing to participate in the IPM project and fill out the survey
Progress to date: Farmers are being identified
Expected outputs: Farmers that will participate in the project will be identified
Task 1: Identify farmers willing to participate in the project

Activity 1e: Implementation of tomato IPM package: no host recommendations
Country: Ghana
Status: Ongoing
Scientists involved: Bob Gilbertson/UC-Davis; Michael Osei/CSIR-CRI
Description: The IPM package will be implemented in fields of the selected growers
Progress to date: We are working with farmers to begin implementation of the IPM package, including providing seeds and advice on how to carry out the IPM package
Expected outputs: IPM package implemented
Task 1: Continue working with farmers to implement the IPM package

Country: Mali
Status: Ongoing
Scientists involved: Bob Gilbertson/UC-Davis; Moussa Noussourou/IER
Description: The IPM package will be implemented in fields of the selected growers
Progress to date: We are working with farmers to begin implementation of the IPM package, including providing seeds and advice on how to carry out the IPM package
Expected outputs: IPM package implemented
Task 1: Continue working with farmers to implement the IPM package

Country: Senegal
Status: ongoing
Scientists involved: Bob Gilbertson/UC-Davis; Samba Diao/ISRA-CDH
Description: The IPM package will be implemented in fields of the selected growers
Progress to date: We are working with farmers to begin implementation of the IPM package, including providing seeds and advice on how to carry out the IPM package
Expected outputs: IPM package implemented
Task 1: Continue working with farmers to implement the IPM package

Activity 1f: Gather data on weed incidence and whitefly occurrence on weeds.

Country: Mali
Status: Continuing
Scientists involved: Jim Westwood & Carlyle Brewster/VT; Moussa Noussourou/IER
Description: Weeds have potential to harbor insects and diseases of tomato during periods when not crop is present in the field. This has potential to undermine the value of the "no-host-period" and contribute to rapid disease cycles.
Progress to date: Nearly completed first edition of Weed Guide. Collecting year 2 of whitefly data.
Expected outputs: 1. A practical Weed Guide that can be used by researchers and growers to identify common weeds that may act as disease reservoirs in tomato production. 2. Data on white fly incidence on weeds in tomato fields.

Task 1: Complete firs edition of weed guide and publish print and internet versions
Task 2: Continue surveying whitefly incidence on tomatoes and associated weeds throughout the year.

Country: Senegal
Status: Continuing
Scientists involved: Jim Westwood & Carlyle Brewster/VT; Souleymane Diallo/ISRA/CDH+DPV+Cs-Locustox
Description: Weeds have potential to harbor insects and diseases of tomato during periods when not crop is present in the field. This has potential to undermine the value of the "no-host-period" and contribute to rapid disease cycles.
Progress to date: Nearly completed first edition of Weed Guide; need to increase number of species from Senegal. Collecting year 2 of whitefly data.
Expected outputs: 1. A practical Weed Guide that can be used by researchers and growers to identify common weeds that may act as disease reservoirs in tomato production. 2. Data on white fly incidence on weeds in tomato fields.

Task 1: Complete firs edition of weed guide and publish print and internet versions
Task 2: Continue surveying whitefly incidence on tomatoes and associated weeds throughout the year.

Country: Ghana
Status: Starting
Scientists involved: Jim Westwood & Carlyle Brewster/VT; Michael Osei/CSIR-CRI
Description: Weeds have potential to harbor insects and diseases of tomato during periods when not crop is present in the field. This has potential to undermine the value of the "no-host-period" and contribute to rapid disease cycles.
Progress to date: This work has been underway in Mali and Sengal, but is just starting in Ghana.
Expected outputs: A practical Weed Guide that can be used by researchers and growers to identify common weeds that may act as disease reservoirs in tomato production. 2. Data on white fly incidence on weeds in tomato fields.

Task 1: Begin inventory of weeds associated with tomato in Ghana.
Task 2: Begin collecting data on incidence of whitefly on tomato and associated weeds in Ghana.

Activity 1g: Plan for technology transfer and short-term training

Country: Ghana
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Michael Osei/CSIR-CRI
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing
Expected outputs: Targeted training to support production package adoption and effective implementation

Task 1: Work with scientists developing IPM tomato packages to identify training needs; plan training as appropriate

Country: Mali
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Moussa Noussourou/IER
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing
Expected outputs: Targeted training to support production package adoption and effective implementation

Task 1: Work with scientists developing IPM tomato packages to identify training needs; plan training as appropriate

Country: Senegal
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Mody Gaye/DPV +ISRA-CDH +Cs-Locustox
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing
Expected outputs: Targeted training to support production package adoption and effective implementation

Task 1: Work with scientists developing IPM tomato packages to identify training needs; plan training as appropriate

Activity 1h: Plan for institutional capacity-building and long-term training

Country: Ghana
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Michael Osei/CSIR-CRI
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM tomato packages

Task 1: Begin to collect and assimilate materials and procedures for package development

Country: Mali
Status: Planning

Scientists involved: Don Mullins & Pat Hipkins/VT; Moussa Noussourou/IER
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM tomato packages

Task 1: Begin to collect and assimilate materials and procedures for package development.

Country: Senegal
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Mody Gaye/DPV +ISRA-CDH +Cs-Locustox
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM tomato packages

Task 1: Begin to collect and assimilate materials and procedures for package development

Objective-2: Develop and implement IPM strategies for diseases and arthropod pests of potatoes in Mali and Senegal

Activity 2a: Establish locations for surveys of potato production and implementation of the IPM package

Country: Mali
Status: ongoing
Scientists involved: Sally Miller/OSU, Bob Gilbertson/UC-Davis; Emile Coly/ISRA-CDH + DPV
Description: Identify locations for potato IPM implementation
Progress to date: near completion
Expected outputs: The locations will be set for this part of the project

Task 1: The geographical locations for the implementation of the IPM package for tomato will be established

Country: Senegal
Status: ongoing
Scientists involved: Sally Miller/OSU, Bob Gilbertson/UC-Davis, & George Mbata/FVSUis; Samba Diao/ISRA-CDH
Description: Identify locations for tomato IPM implementation
Progress to date: Ongoing
Expected outputs: The locations will be set for this part of the project

Task 1: The geographical locations for the implementation of the IPM package for tomato will be established

Activity 2b: Conduct surveys in each location for potato production practices, yields and disease and pest problems

Country: Mali
Status: Ongoing
Scientists involved: Sally Miller/OSU, Bob Gilbertson/UC-Davis, & George Mbata/FVSU; Seriba Katile/IER
Description: Growers participating in the IPM project will be surveyed to gain an understanding of tomato production practices, yields and disease and pest problems

Progress to date: A draft survey has been completed
Expected outputs: An understanding of the issues associated with tomato production in the locations where the project will be conducted

Task 1: Conduct the surveys of the growers

Country: Senegal
Status: Ongoing
Scientists involved: Sally Miller/OSU, Bob Gilbertson/UC-Davis, & George Mbata/FVSU; Emile Coly/ISRA-CDH + DPV
Description: Growers participating in the IPM project will be surveyed to gain an understanding of tomato production practices, yields and disease and pest problems
Progress to date: A draft survey has been completed
Expected outputs: An understanding of the issues associated with tomato production in the locations where the project will be conducted

Task 1: Conduct the surveys of the growers

Activity 2c: Identify farmers for participating in the IPM programs

Country: Mali
Status: Ongoing
Scientists involved: Sally Miller/OSU & Bob Gilbertson/UC-Davis; Seriba Katile/IER
Description: Identify farmers willing to participate in the IPM project and fill out the survey
Progress to date: Farmers willing to participate in the project are being identified
Expected outputs: Farmers that will participate in the project will be identified

Task 1: Continue to identify farmers willing to participate in the project

Country: Senegal
Status: Ongoing
Scientists involved: Sally Miller/OSU & Bob Gilbertson/UC-Davis; Emile Coly/ISRA-CDH + DPV
Description: Identify farmers willing to participate in the IPM project and fill out the survey
Progress to date: Farmers willing to participate in the project are being identified
Expected outputs: Farmers that will participate in the project will be identified

Task 1: Continue to identify farmers willing to participate in the project

Activity 2d: Train pathologists from Senegal in Mali in the use of diagnostic tools for the identification of the strains of *Ralstonia* and *Erwinia*

Country: Mali
Status: Ongoing
Scientists involved: Sally Miller/OSU & Bob Gilbertson/UC-Davis; Seriba Katile/IER
Description: Training of selected plant pathologists will be conducted in the use of diagnostic tools for these bacterial pathogens of potato
Progress to date: Pathologists have been identified in Mali for this training
Expected outputs: Improved capacity to diagnose bacterial wilt and soft rot diseases

Task 1: Develop a plan for this training and implement it

Country: Senegal
Status: Ongoing

Scientists involved: Sally Miller/OSU & Bob Gilbertson/UC-Davis; Samba Diao/ISRA-CDH + DPV + Cs-Locustox
Description: Training of selected plant pathologists will be conducted in the use of diagnostic tools for these bacterial pathogens of potato
Progress to date: A student has been identified in Senegal for this training
Expected outputs: Improved capacity to diagnose bacterial wilt and soft rot diseases

Task 1: Develop a plan for this training and implement it

Activity 2e: Investigate the use of PTM pheromones in the monitoring of PTM populations

Country: Mali
Status: Initiate
Scientists involved: George Mbata/FVSU; Seriba Katile/IER
Description: In Mali, potatoes are considered to be one of the most economically important vegetable crops and are becoming more important because their high nutritional value, a high value cash crop, and a potential export crop for Malian farmers. It appears that infestation by the potato tubermoth, *Phthorimaea operculella* Zeller, may pose a significant problem in potato production limiting both yield and storage potatoes. Traps baited with pheromone lures moth will be used in monitoring moth populations in Mali. This study will provide information on periods of peak infestation of potato by PTM, phonological stages of potato that are most susceptible and the effect of temperature/humidity on moth populations.
Progress to date:
Expected outputs: Develop a protocol for monitoring populations of PTM

Task 1: Determine the effectiveness of PTM pheromones in attracting laboratory reared males in a West African lab
Task 2: Determine catches of PTM males in potato plots in Mali
Task 3: Determine the effect of trap density on the number of male PTM trapped
Task 4: Correlate environmental temperature and humidity on the number of males trapped with pheromone-baited traps.

Country: Senegal
Status: Initiate
Scientists involved: George Mbata/FVSU; Kemo Badji/DPV + ISRA-CDH +Cs-Locustox
Description: In Senegal, potatoes are considered to be one of the most economically important vegetable crops and are becoming more important because their high nutritional value, a high value cash crop, and a potential export crop for Senegalese farmers. Infestation by the potato tubermoth, *Phthorimaea operculella* Zeller, is a major problem limiting both yield and storage potatoes. In Senegal, local potato production has decreased considerably for 17,044 metric tones in 1992 to 2006 level of 6,649 metric tones, while importation of table potatoes has increased from 3,394 metric tones in 1995 to 51,814 metric tones in 2006. The decrease in potato cultivation in Senegal is in most part due to the potato tubermoth. Traps baited with pheromone lures moth will be used in monitoring moth populations in Mali and Senegal. This study will provide information on periods of peak infestation of potato by PTM, phenological stages of potato that are most susceptible and the effect of temperature/humidity on moth populations.
Expected outputs: Develop a protocol for monitoring the populations of PTM

Task 1: Determine catches of PTM males in potato plots in Senegal

Task 2: Determine catches of PTM males in potato plots in Mali
Task 3: Determine the effect of trap density on the number of male PTM trapped
Task 4: Correlate environmental temperature and humidity on the number of males trapped with pheromone-baited traps

Activity 2f: Plan for technology transfer and short-term training

Country: Mali
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Seriba Katile/IER
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing
Expected outputs: Targeted training to support production package adoption and effective implementation
Task 1: Work with scientists developing IPM potato packages to identify training needs; plan training as appropriate

Country: Senegal
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Mody Gaye/DPV +ISRA-CDH
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing
Expected outputs: Targeted training to support production package adoption and effective implementation
Task 1: Work with scientists developing IPM potato packages to identify training needs; plan training as appropriate

Activity 2g: Plan for institutional capacity-building and long-term training
Country: Mali
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM potato packages
Task 1: Begin to collect and assimilate materials and procedures for package development

Country: Senegal
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; ISRA/CDH + DPV + Cs-Locustox
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM potato packages
Task 1: Begin to collect and assimilate materials and procedures for package development

Objective-3: Develop and implement an IPM package for cabbage in Ghana, Mali and Senegal

Activity 3a: Establish locations for surveys of cabbage production and implementation of the IPM package

Country: Mali
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Host country scientists will create a list of farms producing cabbage representative of production in Mali.
Progress to date: Almost complete
Expected outputs: A list of farms to serve as information sources and research sites will be available.

Task 1: A list of 30 farms for a cabbage pest management survey in Mali will be compiled.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Dieynaba Sall/ISRA-CDH + DPV + Cs-Locustox
Description: Host country scientists will create a list of farms producing cabbage representative of production in Senegal.
Progress to date: Almost complete
Expected outputs: A list of farms to serve as information sources and research sites will be available.

Task 1: A list of 30 farms for a cabbage pest management survey in Mali will be compiled.

Activity 3b: Conduct surveys in each location for cabbage production practices, yields and disease and pest problems

Country: Mali
Status: Pending
Scientists involved Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: A survey instrument will be compiled that will include questions on farmers' practices, cabbage yield, and their perceptions of pest pressure and injury. Male and female farmers will be compared in terms of farm roles and knowledge.
Progress to date: Almost complete.
Expected outputs: Knowledge of pest pressure and damage will provide a baseline against which to compare progress of our project's research. Understanding of the role and farm knowledge of both genders will facilitate appropriate technology transfer activities.

Task 1: Farmers in 30 locations will be surveyed for cabbage pest management practices in Mali, including gender disaggregated questions.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Dieynaba Sall/ISRA-CDH + DPV + Cs-Locustox
Description: A survey instrument will be compiled that will include questions on farmers' practices, cabbage yield, and their perceptions of pest pressure and injury. Male and female farmers will be compared in terms of farm roles and knowledge.
Progress to date: Almost complete.

Expected outputs: Knowledge of pest pressure and damage will provide a baseline against which to compare progress of our project's research. Understanding of the role and farm knowledge of both genders will facilitate appropriate technology transfer activities.

Task 1: Farmers in 30 locations will be surveyed for cabbage pest management practices in Senegali, including gender disaggregated questions.

Activity 3c: Identify farmers for participating in the IPM program

Country: Mali
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: A subsample of the survey forms will be selected that will be (a) representative of Malian cabbage production, and (b) practical for visit by CRSP scientists. These farms will serve as the base for our research projects and preliminary technology transfer efforts.
Progress to date: A partial list of research sites is in place.
Expected outputs: A practical set of research farms will be in place and consequently a nucleus of farmers to test appropriate IPM technology.

Task 1: Ten farmers from the survey list in Mali will be selected to participate in cabbage IPM field trials.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Dieynaba Sall/ISRA-CDH + DPV + Cs-Locustox
Description: A subsample of the survey forms will be selected that will be (a) representative of Senegalese cabbage production, and (b) practical for visit by CRSP scientists. These farms will serve as the base for our research projects and preliminary technology transfer efforts.
Progress to date: A partial list of research sites is in place.
Expected outputs: A practical set of research farms will be in place and consequently a nucleus of farmers to test appropriate IPM technology.

Task 1: Ten farmers from the survey list in Senegal will be selected to participate in cabbage IPM field trials.

Activity 3d: Establish pheromone trapping grid for determination of species presence and phenology

Country: Mali
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: A grip of 3-5 traps per species, depending of farm size, will be established for diamondback moth and *Spodoptera litura*. Traps will be serviced weekly by CRSP scientists in Mali.
Progress to date: Almost complete
Expected outputs: A clear understanding of phenology of flight activity will be allowed for the two most important lepidopteran pests of cabbage.

Task 1: A grid of pheromone traps for diamondback moth and *Spodoptera litura* will be maintained in the 10 Mali research farms, serviced weekly, to determine patterns of phenology.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kemo Badji/DPV + ISRA-CDH + Locustox

Description: A grip of 3-5 traps per species, depending of farm size, will be established for diamondback moth and *Spodoptera litura*. Traps will be serviced weekly by CRSP scientists in Mali.
Progress to date: Almost complete
Expected outputs: A clear understanding of phenology of flight activity will be allowed for the two most important lepidopteran pests of cabbage.

> **Task 1:** A grid of pheromone traps for diamondback moth and *Spodoptera litura* will be maintained in the 10 Senegal research farms, serviced weekly, to determine patterns of phenology.

Activity 3e: Conduct routine field scouting to make collections of lepidopteran larvae for identification.

Country: Mali
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Larvae feeding on cabbage in the field will be collected during weekly visits, and placed into ethanol for taxonomic evaluation.
Progress to date: Initial larvae have been collected.
Expected outputs: A proper systematic foundation will be in place to design modern control approaches, some of which are species-specific.

> **Task 1:** At each research site in Mali, 100 cabbage plants will be examined visually for injury by lepidopteran larvae; larvae will be preserved in ethanol for identification.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Baba Gadji/Ceres-Locustox +ISRA-CDH + DPV
Description: Larvae feeding on cabbage in the field will be collected during weekly visits, and placed into ethanol for taxonomic evaluation.
Progress to date: Initial larvae have been collected.
Expected outputs: A proper systematic foundation will be in place to design modern control approaches, some of which are species-specific.

> **Task 1:** At each research site in Senegal, 100 cabbage plants will be examined visually for injury by lepidopteran larvae; larvae will be preserved in ethanol for identification.

Activity 3f: Conduct small-scale field trials to determine efficacy of selective insecticides

Country: Mali
Status: Plan pesticide use patterns
Scientists involved: Doug Pfeiffer & Pat Hipkins/VT; Safiatou DEM/ETQCL; Kadidiatou Gamby & Issoufou Kollo/IER
Description: This activity will include relative comparisons of low-risk insecticides for management of the key lepidopteran species. These will include, but not be limited to, botanical and other bioinsecticides.
Progress to date: Initial trials are in place in 2010.
Expected outputs: Chemical control is often required because to date biological control has been insufficient. We aim to provide data to support chemical control using appropriate safe materials, of differing modes of action, to manage development of insecticide resistance, a common problem with diamondback moth.

Task 1: At each research in Mali, small scale field trial will be carried out to compare relative efficacy of several selective insecticides and bioinsecticides.

Country: Senegal
Status: Plan pesticide use patterns
Scientists involved: Doug Pfeiffer & Pat Hipkins/VT; Baba Gadji/Locustox; Kemo Badji/DPV + ISRA-CDH + Locustox
Description: This activity will include relative comparisons of low-risk insecticides for management of the key lepidopteran species. These will include, but not be limited to, botanical and other bioinsecticides.
Progress to date: Initial trials are in place in 2010.
Expected outputs: Chemical control is often required because to date biological control has been insufficient. We aim to provide data to support chemical control using appropriate safe materials, of differing modes of action, to manage development of insecticide resistance, a common problem with diamondback moth.

Task 1: At each research in Senegal, small scale field trial will be carried out to compare relative efficacy of several selective insecticides and bioinsecticides.

Activity 3g: Collect larvae and pupae for rearing of natural enemies

Country: Mali
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Larvae and pupae of diamondback moth and *Spodoptera litura* will be collected in the field, and reared individually in containers. Parasitoids that emerge will be preserved and identified taxonomically.
Progress to date: This work will start in 2011.
Expected outputs: Parasitoids that successfully control pests are often locally adapted. It will be helpful to identify those that are present in our trial areas, in order to develop other means to foster their presence.

Task 1: At each research site in Mali, lepidopteran larvae and pupae will be reared in small containers to determine presence of parasitoids. Parasitoids will be preserved in ethanol for later identification.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Dieynaba Sy Sall/ISRA/CDH + DPV + Cs-Locustox
Description: Larvae and pupae of diamondback moth and *Spodoptera litura* will be collected in the field, and reared individually in containers. Parasitoids that emerge will be preserved and identified taxonomically.
Progress to date: This work will start in 2011.
Expected outputs: Parasitoids that successfully control pests are often locally adapted. It will be helpful to identify those that are present in our trial areas, in order to develop other means to foster their presence.

Task 1: At each research site in Senegal, lepidopteran larvae and pupae will be reared in small containers to determine presence of parasitoids. Parasitoids will be preserved in ethanol for later identification.

Activity 3h: Evaluate intercropping with tomato as a control for diamondback moth in cabbage.

Country: Mali
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: This activity will employ alternating rows of tomato with cabbage as a measn of controlling population development of diamondback moth. These plots should have standard practice plots nearby to allow comparison.
Progress to date: This activity will start in 2011.
Expected outputs: If successful, this approach could allow management of diamondback moth without insecticides, using a crop that is economically profitable.

> **Task 1:** In five of the research sites in Mali, plots will be established and maintained with alternating rows of tomato and cabbage; population levels and injury by diamondback moth will be evaluated weekly.

Country: Senegal
Status: Pending
Scientists involved: Doug Pfeiffer/VT; Dieynaba Sy Sall/ISRA/CDH + DPV + Cs-Locustox
Description: Larvae and pupae of diamondback moth and *Spodoptera litura* will be collected in the field, and reared individually in containers. Parasitoids that emerge will be preserved and identified taxonomically.
Progress to date: This work will start in 2011.
Expected outputs: Parasitoids that successfully control pests are often locally adapted. It will be helpful to identify those that are present in our trial areas, in order to develop other means to foster their presence.

> **Task 1:** In five of the research sites in Senegal, plots will be established and maintained with alternating rows of tomato and cabbage; population levels and injury by diamondback moth will be evaluated weekly.

Activity 3i: Plan for technology transfer and short-term training

Country: Mali
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing
Expected outputs: Targeted training to support production package adoption and effective implementation

> **Task 1:** Work with scientists developing IPM cabbage packages to identify training needs; plan training as appropriate

Country: Senegal
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Mody Gaye/DPV +ISRA-CDH
Description: Identify information content growers need to know in order to follow production package protocols and recommendations
Progress to date: Ongoing

Expected outputs: Targeted training to support production package adoption and effective implementation

Task 1: Work with scientists developing IPM cabbage packages to identify training needs; plan training as appropriate

Activity 3j: Plan for institutional capacity-building and long-term training

Country: Mali
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM cabbage packages

Task 1: Begin to collect and assimilate materials and procedures for package development

Country: Senegal
Status: Planning
Scientists involved: Don Mullins & Pat Hipkins/VT; ISRA/CDH + DPV + Cs-Locustox
Description: Using research recommendations, produce training materials for field agents.
Progress to date: Ongoing
Expected outputs: Training materials and methods and techniques for field agents will facilitate adoption of IPM tomato packages

Task 1: Begin to collect and assimilate materials and procedures for package development

Activity 3k: Conduct initial weed surveys.

Country: Mali
Status: Continuing
Scientists involved: Jim Westwood/VT; Kadidiatou Gamby & Issoufou Kollo/IER
Description: Identification of weeds in cabbage production is an important aspect of managing the crops and evaluating weeds as alternate hosts for pests.
Progress to date: Activity is just starting
Expected outputs: Inventory of weed associated with cabbage production, photographs and descriptions of the weeds added to the Weed Guide.

Task 1: At each research site in Mali, the weeds occurring in and around cabbage fields will be recorded and photographed. This will be repeated periodically during the cabbage-growing season.

Country: Senegal
Status: Continuing
Scientists involved: Jim Westwood/VT; Souleymane Diallo/ISRA/CDH+DPV+Locustox
Description: Identification of weeds in cabbage production is an important aspect of managing the crops and evaluating weeds as alternate hosts for pests.
Progress to date: Activity is just starting
Expected outputs: Inventory of weed associated with cabbage production, photographs and descriptions of the weeds added to the Weed Guide.

Task 1: At each research site in Senegal, the weeds occurring in and around cabbage fields will be recorded and photographed. This will be repeated periodically during the cabbage-growing season.

Collaboration with Global Theme Projects:

Specifics regarding the Global Themes projects are not available, since communication with the host country units is incomplete. Once the work plan activities are confirmed, we will develop the Global theme projects with the host country units.

W A IPM CRSP Proposed Global Themes Allocations

Host Country	Virus GT	Diag GT	Imp A GT	Gend GT	TOTAL GT UNIT
Mali					
IER	2000	4000	$2,000		8000
IER Diag Lab	3000	3000			6000
OHVN				$3,800	3800
Senegal					
ANCAR				$1,200	1200
Ghana					
CRI	5000	3000	$8,000	$5,000	21000
TOTAL	10000	10000	10000	10000	40000

Virus GT = Plant Viral Disease Global Theme
Diag GT = International Pest Diagnostic Network Global Theme
Imp A GT = Impact Assessment Global Theme
Gend GT = Integration of Gender Knowledge and its Application Global Theme

Graduate Students and Post Doctoral Research Associates:

Name: Kemo Badji
Sex: Male
Nationality: Senegal
Discipline: Entomology
Site/Country: Senegal
Degree: Ph.D.
Start date: September 2010
Completion date: September 2013
IPM CRSP funds: 100%
Advisor/PI: C. C. Brewster
Thesis topic: Spatiotemporal Dynamics and Management of Whiteflies in Vegetable Cropping Systems in Senegal, West Africa
University: University of Bamako

Name: Djbril Badiane
Sex: Male
Nationality: Senegal
Discipline: Entomology
Site/Country: Senegal
Degree: Ph.D.
Start date: 2010/11
Completion date: 3 years
IPM CRSP funds: 100%
Advisor/PI: D. G. Pfeiffer
Thesis topic: TBA
University: University of Bamako ??

Short-Term Training planned

Workshops: Plant Pest Diagnosis for tomato, potato & cabbage (Location: IER- Sotuba for scientists from Mali, Ghana & Senegal)

Publications planned:

Research articles: 2 ?
Extension articles 4
Posters 5
Bulletins 2

Travel Matrix for West Africa Project*

Destination	Number of travelers/ trip	Number of trips
Mali,	1	15
Senegal	1	15
Ghana	1	15
USA	1	15
Total[1]		**60**

*No travel will be taken up beyond what is available in the FY 2010 West Africa budget.

[1] Includes scientists from U.S. traveling to host countries; and host country scientists traveling from one host country to other host countries.

Performance Indicators for Monitoring and Evaluation:

ID	Description	Completion Date	Responsible Individual
Activity - 1a	Establish locations for implementation of tomato IPM programs		
Task -1	The geographical locations for the implementation of the IPM package for tomato will be established	July 2011	B. Gilbertson
Activity-1b	Conduct surveys in each location for tomato production practices, yields and disease and pest problems		
Task - 1	The geographical locations for the implementation of the IPM package for tomato will be established	July 2011	B. Gilbertson
Activity – 1c			
Task - 1	Spatiotemporal dynamics of whitefly populations in Ghana	ongoing	C. Brewster
Task - 2	Information on whitefly biotypes in Ghana	ongoing	C. Brewster
Activity – 2a	Establish locations for surveys of potato production and implementation of the IPM package		
Task – 1	The geographical locations for the implementation of the IPM package for tomato will be established	July 2011	B. Gilbertson
Activity -2b	Conduct surveys in each location for potato production practices, yields and disease and pest problems		
Task - 1	Conduct the surveys of the growers	July 2011	B. Gilbertson
Activity -2e	Investigate the use of PTM pheromones in the monitoring of PTM populations		
Task - 1	Determine the effectiveness of PTM pheromones in attracting laboratory-reared males in a West African lab	July 2011	G. Mbata
Task - 2	**Task 2:** Determine catches of PTM males in potato plots in Mali and Senegal	September 2011	G. Mbata

Activity -3a	Establish locations for surveys of cabbage production and implementation of the IPM package		
Task - 1	A list of 30 farms for a cabbage pest management survey in Mali and Senegal will be compiled	July 2011	D. Pfeiffer
Activity - 3b	Conduct surveys in each location for cabbage production practices, yields and disease and pest problems		
Task - 1	Farmers in 30 locations will be surveyed for cabbage pest management practices in Mali and Senegal, including gender disaggregated questions.	September 2011	D. Pfeiffer

Integrated Pest Management: Science for Agricultural Growth in South Asia

PIs: *Ed Rajotte, Penn State University and George Norton, Virginia Tech*

Site Coordinators
Luke Colavito/B.K. Gyawali- Nepal
Rezaul Karim- Bangladesh
Nutan Kaushik/R. Samiyappan/S. Mohankumar

Site Chairs:
Ed Rajotte
George Norton
Doug Pfeiffer (India)

Participating Scientists
Sally Miller
Maria Elisa Christie
Naidu Rayapati

Bangladesh Site

1. Activity Title: Demonstration of IPM package for eggplant production.

Brief description: Farmers' practice of indiscriminate pesticide applications to control fruit & shoot borer, jassids, soil-borne diseases including bacterial wilt disease, and root-knot nematode is ineffective, highly uneconomical, and hazardous to human health and the environment. Several IPM component technologies (such as use of BW-resistant grafted seedlings, resistant varieties, Tricho-compost, NSKE, pheromone traps, and bio-control agents) have been developed in recent years, which are highly effective against most of the pests, and are also cost effective. Integrating the IPM technologies in to a package will not only solve the pest problems, but also reduce pesticide use.

Objectives: To demonstrate the performance of the eggplant IPM package in farmers' fields.

Scientists: Shahabuddin Ahmad, M. Nazim Uddin, Harunor Rashid, S. N. Alam, Mafruha Afroz, Ed Rajotte & Sally Miller.

Status: New

Progress to date: Not applicable

Expected outputs: Development of an IPM package for eggplant cultivation that will control the eggplant pests effectively and economically without the use of pesticides. Adoption of this package at the field level will ensure availability of healthy eggplant in domestic as well as export markets.

Budget: Total US$4,100 (Wage-2,000; Supplies-1,000; Vehicle-500; Travel-600)

2. Activity Title: Demonstration of IPM package for the production of cucurbit crops (bitter gourd, sweet gourd, ash gourd, teasel gourd).

Brief description: In Bangladesh, the cucurbit fruit fly (*Bactrocera cucurbitae*) attacks as many as 16 kinds of cucurbit crops causing 30-70% yield losses. Recently, a few Lepidopteran (e.g., *Spodoptera* & pumpkin caterpillars) have also been identified as causing considerable damage to bitter gourd. IPM packages (use of Tricho-compost, poultry refuse, mustard oil-cake, pheromone traps, bio-control and others) have been found to be highly profitable for effective control of various pests of the cucurbit crops. Demonstrations of IPM strategies with farmers' participation will allow them to know and learn about the IPM package. Adoption of IPM practices will help produce healthy cucurbit crops without pesticide use. Demonstrations will be set up in Gazipur, Jessore and Ishurdi (Pabna) during the summer season, and in Jessore & Ishurdi during the winter season.

Objectives: To demonstrate the performance of the IPM package at the farm level.

Scientists: S. N. Alam, Debasish Sarker, M. Kafil Uddin, Fatema Khatun, M. A. Goffer, M. S. Nahar, ANMR Karim & Ed Rajotte.

Status: Continuing

Progress to date: Demonstrations are on-going at two locations in Bogra (Sadar & Sherpur upazila) & another in Magura (Sadar upazila) district. Performance of the plots treated with IPM package treatments look better than the non-IPM plots.

Expected outputs: Development of an IPM package for production of healthy cucurbit crops without the use of pesticides, which will be more profitable and safe economically and environmentally.

Budget: Total US$ 4,100 (Wage-2,000; Supplies-1,000; Vehicle-500; Travel-600)

3. Activity Title: Demonstration of IPM package for cabbage/cauliflower production.

Brief description: Leaf-eating caterpillars of *Spodoptera litura* and the Diamond back moth (DBM-*Plutella xylostella*) are the most damaging pests of cabbage and cauliflower in Bangladesh. In an effort to control these and other pests, the farmers apply various toxic pesticides indiscriminately without achieving satisfactory control. A highly effective IPM package has been developed for controlling the leaf-eating caterpillars and other pests. The package consists of (a) use of Tricho-compost & poultry

refuse for controlling various soil-borne disease pathogens; (b) for July-August planting (early planting), use of pheromone trapping for *Spodoptera*, and use of *Trichogramma bactrae* and *Bracon hebetor*, destruction of Spodoptera and DBM caterpillars by hand-picking; and (c) for November planting (optimum planting), use of pheromone trapping for *Spodoptera* and destruction of *Spodoptera* and DBM caterpillars by hand-picking. Adoption of the IPM package will ensure production of healthy cabbage and cauliflower without pesticide use and bring about higher economic benefit to the farmers.

Objectives: To demonstrate IPM package for the production of healthy and profitable crops of a cabbage and cauliflower at the farm level.

Scientists: M. A. Rahman, M. S. Nahar, N. K. Dutta, Shahidul Islam, M. Golam Kibria, Mafruha Afroz, ANMR Karim & Ed Rajotte.

Status: Continuing

Progress to date: Demonstrations with farmers' participation are on-going in farmers' fields in Bogra district. Final harvests are expected in September.

Expected output: Availability of an effective IPM package for the production of pesticide-free, healthy cabbage/cauliflower crops that will bring about higher profits to the farmers.

Budget: Total US$2,700 (Wage-500; Supplies-800; Vehicle-500; Travel-900)

4. Activity Title: Demonstration of IPM package for production of country bean.

Brief description: Country bean (*Dolichos lab lab*), a very popular and high value vegetable in Bangladesh, is attacked by a number of highly damaging pests, such as *Maruca vitrata* and *Helicoverpa armigera* pod borers, aphids as well as bean yellow mosaic virus (BYMV) and bean common mosaic virus (BCMV) diseases. Farmers' practice of indiscriminate use of pesticides largely fails to control the pests successfully. An economically profitable IPM package has been developed to effectively manage these pests. The package consists of (a) use of Tricho-compost & poultry refuse for disease management; (b) use of soap water and botanicals for aphid control; (c) use of sanitation to destroy the pest-infested twigs and flowers; (d) use of *Trichogramma* and *Bracon* parasitoids, Chrysopa, lady beetles, spraying of HNPV and MNPV for controlling *Helicoverpa* and *Maruca* pod borers and other pest insects; and (e) roguing of plants infected with BYMV & BCMV. Adoption of this package will greatly reduce pesticide use and produce healthy crops of country bean that will be safe for the consumers as well as the environment. Demonstrations will be set up in Jessore & Ishurdi (Pabna) during the summer season, and in Gazipur, Jessore & Ishurdi during the winter season.

Objectives: To demonstrate the performance of the IPM package for production of country bean at the farm level.

Status: Continuing

Progress to date: Presently, a demonstration trial is on-going in farmers' fields in Jessore (Sadar upazilla) as well as at a BARI farm, Gazipur.

Expected output: Availability of a cost-effective IPM package for the production of healthy and pesticide-free country bean crops that will increase farmers' profits.

Budget: Total US$ 4,000 (Wage-2,000; Supplies-1,000; Vehicle 500; Travel-500)

5. Activity Title: Development of an IPM package for the production of cucumber and pointed gourd.

Brief description: Cucumber (*Cucumis sativa*) and pointed gourd (*Trichosanthes anguina*) are two very popular and high value cucurbit crops which are mainly attacked by the cucurbit fruit fly (*Bactrocera cucurbitae*) as well as by various soil-borne disease pathogens. Cucumber mosaic virus is also a very damaging virus disease of the cucumber. To offer alternatives to farmers' present practice of indiscriminate pesticide use, there is urgent need to develop an IPM package that can effectively manage the pest problems without pesticide use and also increase yield and economic returns. The IPM tactics that will be tested for developing the IPM package are: (a) use of Tricho-compost, poultry refuse, or mustard oil-cake for controlling soil-borne disease pathogens; (b) use of virus-resistant cucumber varieties or seeds collected from virus-free plants; use of healthy vines for pointed gourd (c) use of cuelure pheromone for cucurbit fruit fly control; (d) roguing of virus-infected plants; and (e) use of NSKE for mite control.

Objectives: To develop an effective and economically profitable IPM package for the production of cucumber and pointed gourd.

Scientists: G. M. A. Halim, M. S. Nahar, A. Muqit, M. S. Hossain, ANMR Karim & S. A. Miller.

Status: Continuing.

Progress to date: The trial for developing the IPM package is on-going at BARI farm, Gazipur. Final harvest may be completed in September.

Expected outputs: Development of an IPM package for the production of pesticide-free, healthy cucumber and pointed gourd crops that will produce higher yields and fetch higher profits to the farmers.

Budget: US$4,000 (Wage- 2,000; Supplies-1,000; Vehicle-500; Travel-500).

6. Activity Title: Development of an IPM package for the production of Tomato

Brief description: Tomato is an exportable high value crop in Bangladesh. Presently, it is grown in the winter (optimum season) as well as summer (off-season). Pest problems that cause low yields and less profit to the farmers include virus diseases, various soil-borne diseases including bacterial wilt (BW) disease, root-knot nematode (RKN) and fruit borer. A number of IPM tactics have been developed to manage the pest problems effectively and economically. The tactics include (a) use of virus-resistant varieties/lines, such as BARI Tomato-15, or TLB-182 for the winter season, and BARI Hybrid Tomato-3 or 4 for the summer season; (b) netting of seedbed for non-virus resistant varieties; (c) use of Tricho-compost; (d) use of grafted seedlings for BW & RKN; and (e) use of parasitoids. An IPM package will be developed by integrating the above IPM tactics. Use of an IPM package at the farm level will greatly reduce pesticide use and help produce healthy and better tomato crops with higher yields and economic returns.

Objectives: To develop a cost effective IPM package for the production of tomato crops in both winter and summer seasons.

Scientists: Shahabuddin Ahmad, Shahidul Islam, M. A. Goffer, N. K. Dutta, M. A. Rahman, Sally Miller & Ed Rajotte.

Status: Continuing

Progress to date: A trial for the summer tomato is on-going in Bogra district.

Expected outputs: Development of an IPM package that will be available to the farmers for growing tomato crops in both the winter and summer seasons, and farmers will be highly benefited with higher yields and higher economic returns.

Budgets: Total US$3,200 (Wage-1,000; Supplies-1,000; Vehicle-700; Travel-500)

7. Activity Title: Development of an IPM package for the production of okra

Brief description: Okra production in Bangladesh is seriously constrained due to infection by yellow-vein-mosaic virus (YVMV) that is transmitted by white fly, various soil-borne disease pathogens, root-knot nematode (RKN), aphids and jassids. Pesticide use is largely ineffective, and the farmers lose money due to poor yields. A few okra lines have been found to be moderately resistant or less susceptible to YVMV. Some IPM tactics, such as the use of Tricho-compost, have been highly effective for controlling soil-borne disease pathogens and RKN. Similarly, use of sanitation, bio-control agents, soap water, and botanicals are useful for controlling okra borers, jassids and aphids. Trials integrating the above IPM tactics are necessary for developing an effective IPM package that will increase yields of okra producing higher economic returns.

Objectives: Development of an IPM package for producing healthy and economically profitable okra crops.

Status: Continuing

Progress to date: Two field trials integrating the IPM tactics for controlling the diseases and the pest-insects are on-going at BARI farm, Gazipur. Crops on IPM treated plots appear healthier than the non-IPM ones.

Expected outputs: Development of an effective IPM package for the production of healthy okra crops with higher yields and higher economic returns.

Budgets: Total US$2,000 (Wage- 900; Supplies-600; Vehicle-200; Travel-300).

8. Activity Title: Production of Tricho-compost and Tricho-leachate for standardization of their application rates, effects on soil-brne pathogens, use of Tricho-leachate for production of Tricho-compost at farmers' level.

Brief description: BARI scientists associated with IPM CRSP programs have developed an organic compost fertilizer fortified with a strain of *Trichoderma harzianum* (a fungus bio-control agent) known as "Tricho-compost", which is highly effective for controlling various soil-borne fungus pathogens as well as bacterial wilt (BW) pathogen and root-knot nematode (RKN). Moreover it adds fertility to the soil and enhances plant growth. Tricho-leachate, which is a liquid by-product of Tricho-compost, is also effective for controlling various terrestrial fungus pathogens of vegetable crops.

In order to use Tricho-compost and Tricho-leachate effectively at the field level the following trials/experiments will be conducted both at the research station and farmers' fields: (a) replicated experiments for standardizing the application rates of the Tricho-products in sweet gourd, Indian spinach, cabbage, tomato, & eggplant crops; (b) in-vitro efficacy test tests of Tricho-leachate on *Sclerotium* & *Fusarium* patrhogens; and (c) use of Tricho-leachate as an alternative to Trichoderma suspension for production of Tricho-compost, so that the farmers can produce Tricho-compost in their farmyard by themselves. Moreover, enough quantity of Tricho-compost and Tricho-leachate will be produced for their use in different IPM trials and demonstrations.

Objectives: To produce Tricho-compost and Tricho-leachate for conducting experiments on (a) standardization of application rates on different crops; (b) in-vitro efficacy test of Tricho-leachate for controlling *Sclerotium* and *Fusarium* pathogens; and (c) use of Tricho-leachate as an alternative of Trichoderma suspension for production of Tricho-compost.

Status: Continuing

Scientists: M. A. Rahman, M. S. Nahar, M. Golam Kibria, Mafruha Afroz, Arefur Rahman (MCC), ANMR Karim, Ed Rajotte & Sally Miller

Progress to date: About three tons of Tricho-compost have been produced and supplied for conducting different demonstrations and trials. Tricho-leachate is commonly produced in farm villages, but could not however be produced in our project because of temporary technical difficulties.

Expected output: (a) Standardization of the production of Tricho-compost and leachate; (b) standardized application rates of the Tricho-products on major vegetable crops; and (c) development of a protocol for maintaining their quality and use of Tricho-leachate for production of Tricho-compost at the farm level instead of the use Trichoderma spore suspension.

Budget: US$1,500 (Wage-300; Supplies-1,000; Vehicle-100; Travel-100)

9. Activity Title: Development of mass-rearing protocol and field efficacy tests of larval parasitoids of Epilachna beetle and lady bird beetle and syrphid fly predators.

Brief description: Populations of different predators and parasitoids have decreased drastically in the vegetable fields due to injudicious use of pesticides by the farmers. Research has shown that pesticides applications can be avoided if populations of predators and parasitoids are conserved and augmented.

Lady Bird beetle and syrphid fly are the two important insect predators that can control different vegetable pest-insects effectively. Recently, techniques have been developed to rear lady bird beetle and syrphid fly on the eggs of *Corcyra/Sitrotoga* species. In the present activity, a protocol will be developed for mass production of the predators, and their effectiveness for controlling different vegetable pest-insects, such as aphids, jassids and white fly in eggplant, cucurbit, and bean crops will be tested in the greenhouse as well as in the field under micro-plot conditions.

Recently, *Ephilachna* beetle has appeared as a damaging pest of a number of cucurbit crops. Several *Ichneumonid* parasitoids have been found to parasitize the larvae of *Epilachna* beetle. In addition, the egg parasitoid Tetrastichus and the larval/pupal parasitoid Pediobius have been shown effective elsewhere. Arrangement for identification of the species of the parasitoids will be taken up. The parasitoids will be reared on its natural host and a technique will be developed for their mass production. After mass rearing, the parasitoid will be tested in the greenhouse and in micro-plots in the field for their efficacy to control the *Epilachna* beetle.

Objectives: (a) To develop a suitable protocol for mass production of lady bird beetle and syrphid fly predators, and parasitoids of *Epilachna* beetle; (b) To evaluate the efficacy of the predators and the parasitoids both in the greenhouse and field; and (c) determine the seasonal abundance of the natural hosts of the predators and parasitoids to understand the natural control systems.

Scientists: S. N. Alam, M. Mahamunnabi, Fatema Khatun, ANMR Karim & Ed Rajotte

Status: New

Progress to date: Some preliminary work for mass rearing of lady bird beetle and syrphid fly have been completed and several species in *Ichneumonid* parasitoids of *Epilachna* beetle have been collected and reared on its natural host.

Expected output: (a) Development of an easy and economical protocol for the mass production of lady bird beetle and syrphid fly predators, and parasitoid (s) of *Epilachna* beetle**;** and (b**)** Determination of the efficacy of the predators and parasitoids for their use in controlling the vegetable pest-insects.

Budget: Total US$ 2,000 (Wage-1,000; Supplies-1,000)

10. Activity Title: Assessment of the adoption and impacts of IPM technologies in vegetable crops at the farm level.

Brief description: A number of IPM technologies developed by BARI scientists through IPM CRSP project have become popular among the farmers in different areas mainly because of their excellent effectiveness for controlling pest-insects and diseases, higher crop yields and high cost-effectiveness. In several areas of the country, the farmers have switched over from their conventional use of pesticides to practicing IPM technologies for growing various vegetable crops. As a result, farmers are earning premium price by producing pesticide-free vegetables. Presently, a number of private firms are engaged in the production and supply of different bio-control agents, bio-fertilizers and sex pheromones. The Bangladesh government has also recently approved the commercialization of different bio-rationals (e.g., pheromones, bio-pesticides) ensuring their production, import and marketing at the local market. Assessment of these developments are necessary to record the impacts on the adoption and spread of IPM practices among the larger vegetable farming community, that has an important role to make healthy and pesticide-free vegetables available at the domestic and export markets.

Objectives: To identify the factors and assess the adoption and impact of IPM technologies in vegetable crops in different areas.

Scientists: Q. M. Shafiqul Islam, Mahmuda Akter, Sadique Rahman & George Norton.

Status: Continuing

Progress to date: Baseline surveys for assessment of adoption and impacts of IPM technologies have been targeted in three sites of three districts. Surveying in one site of Jessore district has been completed and the second one is on-going in Narsingdi district. The third one will be completed during the first week of August.

Expected output: (a) Identification of positive and negative factors responsible for adoption of IPM technologies; (b) determination of adoption rates of IPM technologies and assessment impacts at the farm level; and (c) identification of possible technology refinement and policy guidelines.

Budget: Total US$ 2,500 (Wage- 200; Supplies-400; Vehicle-600; Travel-1,300)

11. Activity Title: Survey and diagnosis of pest-insects and diseases of vegetable crops under the the International Plant Diagnostic Network (IPDN)

Brief description: Nearly 100 varieties of local and exotic vegetables are grown in Bangladesh. Because of the tropical and sub-tropical agro-climate of the country, which is highly conducive to the proliferation of numerous pest-insects, nematodes and diseases, all the vegetable crops are attacked by various damaging pests throughout their growing season. Records of all the pest species attacking all the vegetable crops are not available. A complete list of all the pests with their characteristics will be highly useful to (a) know their incidence and abundance patterns; (b) research and develop their management strategies and practices; (c) develop diagnostic laboratory and clinical services for the farmers; (d) develop a regional network on pest distribution and available management tactics; and (e) exchange technical information on pest diagnostic issues among the networking countries.

Objectives: To document a dependable list of different pest species attacking the vegetable crops with their diagnostic characteristics that can serve as a repertory for reference as well as for developing management strategies.

Scientists: M. A. Rahman, S. N. Alam, M. S. Nahar, N. K. Dutta, M. M. Islam, K. E. Jahan, Mafruha Afroz, M. Nabi, ANMR Karim & Sally Miller

Status: Continuing

Progress to date: Surveys for collection of samples and their diagnosis will be started soon.

Expected output: (a) Documentation of all the pest species (insects, disease pathogens and nematodes) attacking the vegetable crops with diagnostic characteristics; (b) development of a repertory for pest management research & development; and (c) establishment of a pest diagnostic and pest management network in the region.

Budget: Total US$2,000 (Wage-300; Supplies-1,000; Vehicle-600; Travel-1,000)

12. Activity Title: Survey and diagnosis of virus diseases attacking vegetable crops in Bangladesh under the International Plant Virus Disease Network (IPVDN)

Brief description: Many of the 100 varieties of vegetables grown in Bangladesh are infected by different species of viruses causing large crop losses. Unfortunately, only a few virus diseases of some vegetable crops have been identified and documented so far. Managing virus diseases is a formidable task all over the world. As a prerequisite, it is therefore highly important to document all the virus diseases of the vegetable crops with their symptomatic and molecular characteristics so that meaningful research programs can be developed for their management. Documentation of the virus diseases will help

establish diagnostic centers in order to help farmers with appropriate cultivation and management practices. It will also help establish a regional network for exchanging scientific information and probable solutions.

Objectives: To document the incidence and abundance of virus diseases attacking the vegetable crops in Bangladesh with their diagnostic characteristics and establish a network for virus disease management research & development.

Scientists: A. Muqit, Z. Karim, Mujahid-e-Rahman, Mahfuzur Rahman, Mafruha Afroz, T. K. Dey, ANMR Karim, Rayapati Naidu & Sally Miller

Status; Continuing

Progress to date: Surveys have been completed and virus infected samples have been collected from three districts. More surveys will be carried out in August and the diagnostic characteristics of the infected samples will be recorded based on symptoms and ELISA tests.

Expected outputs: (a) Documentation of virus diseases attacking vegetable crops with their symptomatic and molecular diagnostic characteristics; (b) establish a regional network for diagnostic as well as management purposes; (c) establish a repertory of virus diseases that can be used for research & development purposes.

Budget: Total US$2,000 (Wage-100; Supplies-2,000; Vehicle-200; Travel-600)

13. Activity Title: Role of women in vegetable cultivation and IPM technology adoption under the Global Gender Program

Description: In Bangladesh, gender plays an important role in agriculture and pest management. Farm activities are usually gendered based on their nature of tasks, which is also related to access to various resources that include land, labor, education and credit. Moreover, farm tasks are also gendered based on knowledge, aptitude and practice which influence the adoption of a particular agricultural practice or IPM strategy. Bangladesh is a multi-religious country having varied cultures. Muslim women as well as the women of the higher caste Hindu religion do not work in open fields, but they do cultivate and maintain vegetables in homestead gardens and take care of animals (mainly cattle & poultry). The women of lower caste Hindu religion and those of tribal sects sometimes work in open fields. In many cases of agricultural and IPM practices, based on the nature of the tasks, women play a leading part in decision making and execution of the tasks including handling financial aspects of household management. Earlier studies in some IPM CRSP sites showed that women played important roles in pest management issues. In recent years, IPM practices have become very popular in many districts of Bangladesh and many women have become involved in IPM practices. More studies however are needed to understand the present status of women's role in agriculture, particularly vegetable cultivation and adoption of IPM practices.

Objectives: To survey and document the role of women in vegetable cultivation and adoption of IPM practices.

Scientists: Shahnaz Huq-Hussain, Tahera Sultana, Umme habiba (DU), Sadique Rahman (BARI), K. A. Uma (TNAU, India) & Maria Elisa Christie

Status: Continuing

Progress to date: Two graduate students (Ms. Tahera Sultana and Ms. Umme Habiba) are carrying out the research survey at the field level at Jessore and Narsingdi sites under the supervision of Dr. Shahnaz Huq-Hussain (Professor of Geography & Environment, Dhaka University)**.** Ms. Tahera Sultana is working on "women's role in adoption of IPM inputs in vegetable cultivation", and Ms. Umme Habiba on "women's role in vegetable cultivation".

Expected output: A documented record of women's role in Bangladesh with regard to vegetable cultivation and IPM adoption that will depict various aspects including planning, decision making, nature of tasks including execution, marketing, handling of financial matters, and socio-economic impact**s.**

Budgets: Total US$ 3,400 (Tuition-400; Stipend-1,200; Wage-200; Supplies-300; Vehicle-100; Travel-1,200)

Total number activities=13 **Total activity budget = US$39,300** (Wage-12,500; Supplies-12,100; Vehicle-5,000 ; Travel-8100; Tuition- 400; Stipend-1,200) **Project management = $17,503** **Overhead = $5681** **Total Budget = $62,494**

Nepal Site

<u>Regional Project:</u>

Project Title : The South Asia Regional IPM CRS Program, Nepal
Names: PI(s) : Dr. Luke A. Colavito
Co PI(s) : B.K. Gyawali

<u>Brief description of the project</u>:
The project is aimed to device IPM technologies in Vegetable crops to reduce crop loss due to pests without any adverse effect on health, environment and bio-diversity.

Objective: IPM Package Development

Description: Development of effective IPM packages for 4 vegetable crops such as tomato, cucurbits, cole crop (cauliflower/cabbage), eggplant and 2 commercial crops such as tea & coffee produced by limited resource farmers

Activity - 1: Tomato IPM package Development
Country: Nepal
Status: Continuing

Scientists involved:

1. B.K. Gyawali,
2. Ram Bahadur K.C,
3. Ram Devi Timila,
4. K. P. Paudel, and
5. Him P. Pathak

Description: Management of major pests (Tomato fruit worm, Whitefly, Leaf minor, Thrips, Tobacco caterpillar, Aphids, Cutworm, Red ants, White grubs) and major diseases (Bacterial Wilt, RKN, TYLCV, Tomato Spotted Wilt Virus, TMV, CMV , anthracnose and Sclerotinia).

Progress to date: Bio-control agents such as B. t. k, N. P. V., *Verticillium lecanii, Beauveria bassiana* and *Metarhizium anisoplae* , Derisom, Anosom and Margosom, to manage insects, and *Trichoderma, Bacillus subtilis, Biomycin, Pseudomonas* and Margo N. F. to manage different diseases are being used. Similarly, eco-Friendly IPM tools such as Pheromone Trap is also evaluated for the management of tomato fruit worm. Evaluation of Bio-Fertilizers such as N-fixing Bacteria, Phosphorus solubilizing bacteria, Potash solubilizing bacteria and Agri-VAM are also in process.

Expected outputs: Increase of crop yield and beneficial organisms with minimum or no environmental/health hazards.
Task – 1: Technology verification for tomato IPM Package in Terai and Hill ecological regions of Nepal
Task – 2: Technology dissemination and scale-up for tomato crop IPM package in 80 households in each of 3 project districts
Task – 3: Training of tomato crop IPM package to technical staffs, service providers, interaction with stakeholders, farmer to farmer program in each project districts

Budget: $5000.

Activity 2: Cucurbit IPM package Development
Country: Nepal
Status: Continuing

Scientists involved:

1. B.K. Gyawali ,
2. Ram Bahadur K.C,
3. Ram Devi Timila,
4. K. P. Paudyal and
5. Him P. Pathak

Description: Management of major pests (Fruit fly, Red pumpkin beetle, Whitefly, Epilachna beetles and aphids) and major diseases (Damping off, Cucumber mosaic virus, Powdery mildew and Downy mildew).

Progress to date: Bio-control agents such as *Verticillium lecanii, Beauveria bassiana* and *Metarhizium anisoplae* to manage insects, and *Trichoderma, Bacillus subtilis, Biomycin, Downy care, Powdery care, Pseudomonas* and Margo N.F. to manage different diseases are being used. Similarly, eco-Friendly IPM tools such as Pheromone Trap is also evaluated for the management of fruit fly. Evaluation of Bio-Fertilizers such as N-fixing Bacteria, Phosphorus solubilizing bacteria, Potash solubilizing bacteria and Agri-VAM are also in process.

Expected outputs: Increase of crop yield and beneficial organisms with minimum or no environmental/health hazards.

Task – 1: Technology verification for cucurbit IPM Package in Terai and Hill ecological regions of Nepal
Task – 2: Technology dissemination and scale-up for cucurbit IPM package in 100 household in each of 3 project districts
Task – 3: Training of cucurbit IPM package to technical staffs, service providers, interaction with stakeholders, farmer to farmer program in each project districts

Budget: $5000.

<u>Activity 3: Cole crop (Cauliflower/Cabbage) IPM package Development</u>
Country: Nepal
Status: Continuing

Scientists involved:

1. B.K. Gyawali ,
2. Ram Bahadur K.C,
3. Ram Devi Timila,
4. K. P. Paudyal and
5. Him P. Pathak

Description: Management of major pests (Cabbage butterfly, Diamond backmoth, Tobacco caterpillar, Flea beetles, Aphids, Cutworm, Red ants, White grubs and Mole crickets) and major diseases (Damping off, Alternaria leaf spot, Sclerotima rot, Black rot, Downy mildew, Turnip mosaic and club root).

Progress to date: Bio-control agents such as B. t. k, N. P. V., *Verticillium lecanii, Beauveria bassiana* and *Metarhizium anisoplae* , Derisom, Anosom, Margosom, to manage insects, and *Trichoderma, Bacillus subtilis, Biomycin, Pseudomonas* and Margo N. F. to manage different diseases are being used. Similarly, eco-Friendly IPM tool such as Pheromone Trap is also evaluated for the management of diamond back moth. Evaluation of Bio-Fertilizers such as N-fixing Bacteria, Phosphorus solubilizing bacteria, Potash solubilizing bacteria and Agri-VAM are also in process.

Expected outputs: Increase of crop yield and beneficial organisms with minimum or no environmental/health hazards.

Task – 1: Technology verification for cole crop (cauliflower/cabbage) IPM Package in Terai and Hill ecological regions of Nepal
Task – 2: Technology dissemination and scale-up for cole crop IPM package in 50 household in each of 3 project districts
Task – 3: Training of cole crop IPM package to technical staffs, service providers, interaction with stakeholders, farmer to farmer program in each project districts

Budget: $5000.

Activity 4: Eggplant (brinjal) IPM package Development
Country: Nepal
Status: Continuing

Scientists involved:

1. B.K. Gyawali ,
2. Ram Bahadur K.C,
3. Ram Devi Timila,
4. K. P. Paudyal and
5. Him P. Pathak

Description: Management of major pests (Shoot and fruit borer, Epilachna beetles, Thrips, White flies, Aphids, Cutworm, Red ants, White grubs) and major diseases (Damping off, root knot nematode, Bacterial Wilt, Anthracnose and Sclerotinia).

Progress to date: Bio-control agents such as B. t. k, N. P. V., *Verticillium lecanii, Beauveria bassiana,* borer guard, *Metarhizium anisoplae*, Derisom, Anosom, Margosom, to manage insects, and *Trichoderma, Bacillus subtilis, Biomycin, Pseudomonas* and Margo N. F. to manage different diseases are being used. Similarly, eco-Friendly IPM tools such as Pheromone Trap is also evaluated for the management of shoot and fruit borer. Evaluation of Bio-Fertilizers such as N-fixing Bacteria, Phosphorus solubilizing bacteria, Potash solubilizing bacteria and Agri-VAM are also in process.

Expected outputs: Increase of crop yield and beneficial organisms with minimum or no environmental/health hazards.

Task – 1: Technology verification for brinjal IPM Package in Terai ecological region of Nepal
Task – 2: Technology dissemination and scale-up for brinjal crop IPM package in 40 households in Rupandehi project district
Task – 3: Training of brinjal crop IPM package to technical staffs, service providers, interaction with stakeholders, farmer to farmer program in Rupandehi project district

Budget: $5000.

Activity 5: Tea crop IPM package Development
Country: Nepal
Status: Continuing

Scientists involved:

1. B.K. Gyawali and
2. S. K. Pradhan

Description: Management of major pests (Tea mosquito bug, Red spider mite, Red coffee borer, Red ants, Termites and White grubs) and major diseases (Blister blight, Red rust and Canker).

Progress to date: Bio-control agents such as *Verticillium lecanii, Beauveria bassiana* and *Metarhizium anisoplae* , Derisom, Anosom, Margosom, to manage insects, and *Trichoderma, Bacillus subtilis, Biomycin, Pseudomonas* and Margo N. F. to manage different diseases are being used. Evaluation of Bio-Fertilizers such as N-fixing Bacteria, Phosphorus solubilizing bacteria, Potash solubilizing bacteria and Agri-VAM are also in process.

Expected outputs: Increase of crop yield and beneficial organisms with minimum or no environmental/health hazards.

Task – 1: Technology verification for tea crop IPM Package in Hill ecological regions of Nepal
Task – 2: Technology dissemination and scale-up for tea IPM package in 30 household in Orthodox tea growing district
Task – 3: Training of tea crop IPM package to technical staffs, service providers, interaction with stakeholders, farmer to farmer program in orthodox tea growing districts

Budget: $2700.

Activity 6: Coffee IPM package Development
Country: Nepal
Status: Continuing

Scientists involved: B.K. Gyawali

Description: Management of major pests (Coffee white stem borer, Red coffee borer, Mealy bug and Scale insects) and major diseases (Berry blocth, Cercospora leaf spot, Brown leaf blight and Die back disease).

Progress to date: Bio-control agents such as *Verticillium lecanii, Beauveria bassiana, Metarhizium anisoplae*, Derisom, Anosom and Margosom to manage insects, and *Trichoderma, Bacillus subtilis, Biomycin* and *Pseudomonas* to manage different diseases are being used. Similarly, eco-Friendly IPM tools such as Pheromone Trap is also evaluated for the management of coffee white stem borer. Evaluation of Bio-Fertilizers such as N-fixing Bacteria, Phosphorus solubilizing bacteria, Potash solubilizing bacteria and Agri-VAM are also in process.

Expected outputs: Increase of crop yield and beneficial organisms with minimum or no environmental/health hazards.

Task – 1: Technology verification for coffee crop IPM Package in coffee growing ecological regions of Nepal
Task – 2: Technology dissemination and scale-up for coffee crop IPM package in 40 household in Palpa district
Task – 3: Training of coffee crop IPM package to technical staffs, service providers, interaction with stakeholders, farmer to farmer program in each project districts

Budget: $2700.

Collaboration with Global Theme Projects:

1. Impact Assessment

Objective: To assess the economic impacts of the IPM packages in relation to global themes

Description: Baseline survey provides farmers adoption of IPM packages including input, output, and price data collection.

Activity: Monitoring and evaluation of IPM package in project districts (Lalitpur, Rupandehi, Palpa and Kaski) improved in awareness creation among stakeholders including leader farmers and neighbor.
Country: Nepal
Status: Continuing

Scientists involved:

1. Dr. Luke A. Colavito and
2. B. K. Gyawali

Description: IPM impacts on poverty reduction are improving. Nutrient balance using bio-fertilizers improved food security. It also minimized health risk and environmental pollution from the use of bio-pesticides on vegetable crops.

Progress to date: Improvements in ongoing IPM activities in project districts is improving as compared to the past. IPM package comprised of non-chemical approach seems to have wide scope for organic vegetable producers in local market and export.

Expected outputs: Increased in yield and profit from vegetables using eco-friendly IPM package

Budget: $1750.

2. Gender

Objective: To identify unique constraints facing women with respect to pest management in order to advance gender equity through research and extension.

Description: Baseline survey will provide women farmers constrain in adoption of IPM packages.

Activity: Monitoring and evaluation of IPM package in project districts (Lalitpur, Rupandehi, Palpa and Kaski) has improved in awareness creation among research scientists and extension specialists.
Country: Nepal
Status: Continuing

Scientists involved:

1. Ms. Ambika K. Rai,
2. Dr. Luke A. Colavito and
3. B. K. Gyawali

Description: Non chemical IPM approach has positive impacts on health since women and children are vulnerable to chemical pesticides. Imbalance use of nutrients using chemical fertilizers on vegetables not only produces deficiency or toxicity to plants but linked to misuse and overuse of chemical pesticide by agro-vets as service providers.

Progress to date: A Gender questionnaire on baseline survey is ongoing in IPM CRSP project districts. Based on the survey report, the women farmers' need in Nepal will be further elaborated. Expected

outputs: Increasing awareness of the gender issues with respect pest management helps to identify gender research team for further intensification in vegetable production and marketing.

Budget $1750.

3. IPDN:

Objective: To establish the network of researchers / diagnosticians in Nepal

Description: Expert list of diagnosticians will be prepared and documented in data management spread sheet.

Activity: Entomologist and plant pathologists will be surveyed for their capacity. Monitoring and evaluation of IPM package in project districts (Lalitpur, Rupandehi, Palpa and Kaski) has improved in awareness creation for diagnostic service.
Country: Nepal
Status: Continuing

Scientists involved:

1. Nagendra Subedi,
2. Dr. Luke A. Colavito and
3. B. K. Gyawali

Description: Non chemical IPM approach has positive impacts on plant and human health. Balance use of nutrients specially bio-fertilizers and bio-pesticides have shown not only positive impacts on vegetable crops but also helped to minimize the deficiency or toxicity to the selected vegetable crops ultimately affected misuse and overuse of chemical pesticide by the farmers.

Progress to date: Diagnostic services are available at Regional Plant Protection Laboratory, Harihar Bhawan (DOA) to the visiting poor farmers seeking for diagnostic service.
Expected outputs: Awareness of the diagnostic service among the farmers in the project district is increasing.

Budget: $3500.

4. Plant Virus Diseases Network

Objective: To monitor virus diseases in vegetables

Description: Samples of thrips and virus infected vegetables will be collected to document the distribution of virus species and their vector from the project districts (Lalitpur, Rupandehi, Palpa and Kaski). Virus samples as well as thrips vectors will be submitted to the Virus Global Theme project.

Activity: Monitoring and evaluation of IPM package in project districts (Lalitpur, Rupandehi, Palpa and Kaski) has improved in awareness creation among research scientists and extension specialists.
Country: Nepal
Status: Continuing

Scientists involved:

1. Mr. Nagendra Subedi, and
2. B. K. Gyawali

Description: Early detection of plant virus disease and timely control of vector needs improvement in awareness creation not only to our technical field staffs but also to disseminate management technique among the participating farmers.

Progress to date: Mapping and monitoring of viruses in vegetables has not progressed as expected due to lack of trained field staffs on plant virus disease. Nepal IPM CRSP is facing difficulty in IPM package development.

Expected outputs: Improved plant health by increasing awareness of the plant virus disease management among the participating farmers from the project districts.
Budget: $1750.

Graduate Students and Post Doctoral Research Associates:

Name: Mr. Naworaj Acharya
Sex: Male
Nationality: Nepalese
Discipline: Entomology
Site/Country: South Asia / Nepal
Degree; Ph D
Start date: F. Y. 2010-11
Completion date: 2014
IPM CRSP funds: 100%
Advisor/PI: Dr. Ed Rajotte
Thesis topic: TBD
University: Penn State University, US

Short-Term Training planned

Workshops:
Seminars:
Field days:
Mass media events
Annual meetings
Program Advisory body meetings 3
Experience sharing meetings 1
Review meetings 3
Program planning workshop 1
Monitoring and evaluation /SWC 1
Central level field monitoring visit 1
Others

Publications planned:
Research articles
Books and book chapters
Extension articles
Posters 3
Bulletins
Others

Travel Matrix:

Trip No.	Number of Individuals	Destination Country	Duration	Function (Site planning, workshop, symposium etc)
1	2	India	7 days	Virus training

Budget:

Activities and global themes = $34,544
Overhead = $3454
Project total = $37,992

India Site

Regional Project:

Project Title: The South Asia Regional IPM CRS Program, India
Names: PI(s): Dr. S. Mohankumar
Co PI(s): Dr. G. Karthikeyan, N. Kaushik
Administrative Co-PI(s): Dr. R. Samiyappan, E. I. Jonathan

Brief description of the project:
The project is aimed to device IPM technologies in vegetable crops to reduce crop loss due to pests without any adverse effect on health, environment and bio-diversity.

Objective 1: IPM Package Development
Description: Development of effective IPM packages for 8 vegetable crops (i.e. tomato, brinjal (eggplant), okra, cabbage, cauliflower, onion, chillies and gourds) produced by limited resource farmers

Activity - 1: Tomato IPM package Development
Country: India
Status: Continuing

Scientists involved:

6. G. Karthikeyan,
7. C. Durairaj,
8. S. Ramakrishnan,
9. S. Mohankumar, and
10. N. Kaushik

Description: Management of major pests (Tomato fruit worm (*Helicoverpa armigera*), Whitefly, Leafminer, Thrips, Tobacco caterpillar (*Spodoptera litura*), Aphids, Cutworm) and major diseases (Bacterial Wilt, RKN, TYLCV, Tomato Spotted Wilt Virus, anthracnose and Sclerotinia). TERI: Minimum 10 IPM trials on tomato in Meerut, Kolar, Chittoor.

Progress to date: Current work: The following IPM components as a package are being evaluated in farmers' fields:

- Seed treatment with *Trichoderma viride* @ 4g/kg of seeds or
- Seed treatment with *Pseudomonas fluorescens* @ 10g/kg of seeds
- Nursery application with *Trichoderma viride* or *Pseudomonas fluorescens* after multiplication with FYM
- Application of Neem cake @ 250kg/ha
- Soil application of *Pseudomonas fluorescens* @ 2.5kg/ha
- Selection of good and virus disease free seedlings for planting

- ❖ Roguing out of virus infected plants upto 45 days of transplanting
- ❖ Grow marigold as a border crop
- ❖ Set up *Helicoverpa* / *Spodoptera* pheromone traps @ 12 numbers / ha
- ❖ Release *Trichogramma chilonis* @ 50000/ha
- ❖ Install yellow sticky traps
- ❖ Spraying Neem formulations / Neem seed kernel extract
- ❖ Need based application of eco-friendly nematicide / insecticides/fungicide

Expected outputs: Validation of cost-effective IPM package, awareness for adoption of different components and reduction of pesticide usage is expected
Task – 1: Conducting IPM trial at different locations/seasons
Task – 2: Organizing field days

Budget: $7,100 ($4,600 TNAU, $2,500 TERI).

<u>Activity 2: Brinjal (eggplant), okra, cabbage and cauliflower IPM package development</u>
Country: India
Status: Continuing

Scientists involved:

6. C. Durairaj,
7. G. Karthikeyan,
8. S. Ramakrishnan,
9. S. Mohankumar, and
10. N. Kaushik

Description: Management of major pests (Fruit and shoot borer, Fruit fly, Whitefly, *Epilachna* beetles, aphids, Cabbage butterfly, Diamondback moth) and major diseases (Damping off, Cucumber mosaic virus, Powdery mildew and Downy mildew). TERI: Minimum 10 trials each of okra and eggplant and 5 trials of cabbage in Meerut, Kolar, Chittoor.

Progress to date: The following IPM Components as a package are being evaluated in farmers' fields:

<u>Brinjal:</u>

- ❖ Seed treatment with *Trichoderma viride* (4g/kg) or
- ❖ Seed + nursery + seedling dip treatment with *Pseudomonas* @ 10 g/ kg of seed / lit of water
- ❖ Soil application with Neemcake @250 kg/ha
- ❖ Maize as boarder crop against movement of whiteflies/ *Liriomyza*
- ❖ Use of yellow sticky traps against whiteflies and *Liriomyza*
- ❖ Clipping of shoot borer infested terminals
- ❖ *Leucinodes* adult monitoring with pheromone traps
- ❖ *Trichogramma* release after each brood emergence of *Lucinodes*

- ❖ Application of neem products (azadirachtin based formulations/ NSKE)
- ❖ In ash weevil endemic areas, soil drenching of eco-friendly insecticides
- ❖ Need based application of eco-friendly insecticides

Okra:

- ❖ Seed treatment with *Trichoderma viride*(4g/kg) or *Pseudomonas(*10 g/ kg).
- ❖ Soil application of *Pseudomonas* (2.5kg/ha).
- ❖ Soil application with Neemcake @250 kg/ha
- ❖ Maize as boarder crop against movement of whiteflies/ *Liriomyza*
- ❖ Use of yellow sticky traps against whiteflies and *Liriomyza*
- ❖ *Helicoverpa and Earias* adult monitoring with pheromone traps
- ❖ *Trichogramma* release after each brood emergence of *Helicoverpa* and *Earias*
- ❖ Application of neem products (azadirachtin based formulations/ NSKE)
- ❖ Need based Application of eco-friendly insecticides/fungicide/acaricide

Cabbage and Cauliflower:

- ❖ Seed / nursery treatment with *Pseudomonas* @ 10 g/ kg of seed / lit of water
- ❖ Seedling root dip with *Pseudomonas* @ 10 g/ lit of water
- ❖ Soil application of Neemcake @ 250 kg /ha
- ❖ Soil application of *Pseudomonas* @ 2.5 kg /ha in main field
- ❖ Mustard inter crop to attract *Plutella*
- ❖ Use of yellow sticky traps against aphids
- ❖ *Plutella* adult monitoring with pheromone traps
- ❖ Application of neem products (azadirachtin based formulations/ NSKE)
- ❖ Need based application of eco-friendly insecticides/fungicide/acaricide

Expected outputs: Validation of cost-effective IPM package, awareness for adoption of different components and reduction of pesticide usage is expected.

Task – 1: Conducting IPM trials at different locations/seasons
Task – 2: Organizing field days

Budget: $9,600 (4,600 TNAU, $5,000 TERI).

Activity 3: Onion IPM package Development
Country: India
Status: Continuing

Scientists involved:

6. G. Gajendran,
7. S. Ramakrishnan,
8. D. Dinakaran,

9. G. Karthikeyan, and
10. S. Mohankumar

Description: Management of major pests (Thrips, Tobacco caterpillar, Flea beetles, Aphids, onion cutworm (*Spodoptera exigua*), Red ants, White grubs and Mole crickets) and major diseases (Damping off, Alternaria leaf spot, Sclerotinia rot, Black rot, Downy mildew, Turnip mosaic and club root).

Progress to date: The following IPM Components as a package are being evaluated in farmers' fields:

- Bulb treatment with *Trichoderma viride* or PGPR consortia
- Soil application of PGPR consortia and *Trichoderma viride*, VAM
- Install yellow / blue sticky traps
- Monitoring of cutworms with pheromone traps
- Spraying PGPR
- Application of neem products (azadirachtin based formulations/ NSKE)
- Need based application of eco-friendly insecticides/fungicide/acaricide

Expected outputs: Validation of cost-effective IPM package, awareness for adoption of different components and reduction of pesticide usage is expected.

Task – 1: Conducting IPM trials at different locations/seasons
Task – 2: Organizing field days districts

Budget: $3,250 (TNAU).

Activity 4: IPM Package Development in chillies and gourds
Country: India
Status: Continuing

Scientists involved:

6. S. Mohankumar,
7. C. Durairaj,
8. G. Karthikeyan,
9. S. Ramakrishnan,
10. G. Gajendran,
11. D. Dinakaran, and
12. N. Kaushik

Description: Management of major pests (Red pumpkin beetle, *Epilachna* beetles, Thrips, White flies, Aphids, Cutworm) and major diseases (Damping off, root knot nematode, Bacterial Wilt, Anthracnose and Sclerotinia). TERI: Minimum of 5 IPM trials of cucurbits in Meerut, Kolar, Chittoor.

Progress to date: The following IPM Components as a package will be evaluated in farmers' fields:
Chillies:

- Seed treatment with *Trichoderma viride* @ 4g/kg of seeds or
- Seed treatment with *Pseudomonas fluorescens* @ 10g/kg of seeds
- Nursery application with *Trichoderma viride* or *Pseudomonas fluorescens* after multiplication with FYM
- Growing castor as border trap crop
- Application of Neemcake @ 250kg/ha
- Soil application of *Pseudomonas fluorescens* @ 2.5kg/ha
- Selection of good and virus disease free seedlings for planting
- Roguing out of virus infected plants up to 45 days of transplanting
- Grow marigold as a trap crop in irrigation channels
- Set up *Helicoverpa* / *Spodoptera* pheromone traps @ 12 numbers / ha
- Release *Trichogramma chilonis* @ 50000/ha
- Install yellow sticky traps
- Spraying neem formulations / neem seed kernel extract
- Need based application of eco-friendly nematicide / insecticides/fungicide

Gourds:

- Seed treatment with *Trichoderma viride* @ 4g/kg of seeds or
- Seed treatment with *Pseudomonas fluorescens* @ 10g/kg of seeds
- Application of Neem cake @ 250kg/ha
- Soil application of *Pseudomonas fluorescens* @ 2.5kg/ha
- Roguing out of virus infected plants
- Set up fruit fly pheromone traps @ 12 numbers / ha
- Install yellow sticky traps
- Spraying Neem formulations / neem seed kernel extract
- Need-based application of eco-friendly nematicide / insecticides/fungicide

A baseline survey has been completed.

Expected outputs: Validation of cost-effective IPM package, awareness for adoption of different components and reduction of pesticide usage is expected.

Task – 1: Conducting IPM trials at different locations/seasons
Task – 2: Organizing field days

Budget: $6,000 ($3,000 TNAU, $3,000 TERI).

Activity 5: Activity 5: Breeding for pest resistance
Country: India
Status: New

Scientists involved:

3. L. Pugalendhi,
4. C. Durairaj,
5. G. Karthikeyan,
6. S. Ramakrishnan, and
7. S. Mohankumar

Description: TNAU is a national leader in genetic modification of crop plants. Under various projects hosted by TNAU, pest resistant germplasm candidates have been produced. The assembled germplasm will be evaluated for pest resistance in IPMCRSP crops.

Progress to date: Germplasm has been assembled from various national and international agencies in four different crops (brinjal/okra/tomato/chillies).

Expected outputs: Pest resistant donors will be identified and exploited in breeding programs.

Task – 1: Evaluating the performance of germplasm (brinjal/okra/tomato/chillies) for pest resistance. Resistance testing will begin by leaf disc assays in the lab. Promising candidates will be moved to secured greenhouse testing on intact plants.

Task – 2: Crossing and hybridization trials with desirable parents will be undertaken to move resistant genes into varieties that acceptable to local consumers.

Budget: $6,000 ($3,000 TNAU, $3,000 TERI).

<u>Activity 6: IPM for protected vegetable cultivation (validating IPM module for tomato)</u>
Country: India
Status: New

Scientists involved:

1. L. Pugalendhi,
2. C. Durairaj,
3. G. Karthikeyan,
4. S. Ramakrishnan,
5. S. Mohankumar, and
6. S. Kaushik

Description: Plastic greenhouses are used to extend the tomato season into the rainy and summer seasons. Plastic greenhouses change the microenvironment of the crop along with susceptibility to pests. Studies on IPM module suited to polyhouse (plastic house) vegetable cultivation will be initiated. IPM package development will proceed from a survey of pests and natural enemies through various IPM

tactics including manipulation of the plastic house itself by screening, ventilation timing, irrigation and shading.

Progress to date: Survey on the occurrence of major pests in vegetables cultivated in polyhouses/shade nets is in progress.

Expected outputs: IPM module suited to polyhouse will be available.

Budget: $5,500 ($2,500 TNAU, $3,000 TERI).

Activity 7: IPM for organic vegetable cultivation (Validating IPM module for organic okra)
Country: India
Status: New

Scientists involved:

1. L. Pugalendhi,
2. C. Durairaj,
3. G. Karthikeyan,
4. S. Ramakrishnan, and
5. S. Mohankumar

Description: Organic vegetable production requires IPM, but some tools available to the conventional grower are not allowed such as synthetic pesticides. The IPM package developed and tested for organic okra must accommodate these restrictions. Studies on IPM module suited to organic vegetable cultivation will be initiated.

Progress to date: Survey on the occurrence of major pests in vegetables cultivated in farms with organic inputs is in progress. The standards of organic certification followed in the state were assessed.

Expected outputs: IPM module suited to organic okra specifically, and where appropriate, other organic vegetables, will be available.

Budget: $2,500 TNAU.

Activity 8: IPM for vegetable nursery
Country: India
Status: New

Scientists involved:

1. L. Pugalendhi,
2. S. Mohankumar,
3. G. Karthikeyan,

4. C. Durairaj, and
5. S. Ramakrishnan

Description: Many pest problems start in the seedling nursery. Infected and infested plants are often transplanted into the production field where insect and disease populations get an early start and increase rapidly. Addressing pest issues in the nursery can give the crop a good start and delay pest infestations. IPM tactics such as soil amendments, solarization, variety selection, root grafting, etc. coupled with thorough inspection of seedlings can ameliorate field problems.

Progress to date: New activity.

Expected outputs: Large scale production of healthy seedlings from vegetable nurseries is possible.

Budget: $2,000 TNAU.

Objective 2: Technology Transfer
Description: To achieve transfer of vegetable IPM packages on a large scale to limited resource farmers in India

Activity - 1: Popularization of different components of IPM
Country: India
Status: New

Scientists involved:
1. G. Karthikeyan,
2. G. Gajendran,
11. D. Dinakaran,
12. S. Ramakrishnan,
13. S. Mohankumar,
14. C. Durairaj, and
15. N. Kaushik

Description: Popularization of biocontrol agents in IPM - *Pseudomonas, Trichoderma, Trichogramma, Anagyrus*; soil organic amendments in IPM; Monitoring of insect pests through pheromone trap and yellow sticky traps will be done through large scale demonstrations.

Progress to date: New activity.

Expected outputs: Large scale adoption of non-chemical eco-friendly IPM components will be popularized

Budget: $6,000 ($3,000 TNAU, $3,000 TERI).

Activity - 10: Collaboration with IAMWARM (World Bank funded scheme) for popularization of IPM in vegetables
Country: India
Status: New

Scientists involved:

1 S. Mohankumar,
2 G. Karthikeyan,
3 C. Durairaj, and
4 S. Ramakrishnan

Description: Irrigated Agriculture Modernization and Water-Bodies Restoration and Management (IAMWARM), a World Bank funded project has been formulated to converge the roles of all the line departments at TNAU. The project aims to improve the service delivery and productivity of irrigated agriculture with effective integrated water resources management in a sub-basin framework in Tamilnadu with the following broad objectives: Improving irrigation service delivery; increase agricultural productivity and stakeholder income; and increase in marketable surplus. Pest management is an integral part of this project. Collaboration between IAMWARM and IPMCRSP will take place where possible.

Progress to date: New activity.

Expected outputs: Large scale adoption of non-chemical eco-friendly IPM components will be popularized.

Budget: $3,000 TNAU.

Activity - 11: Organizing training to extension functionaries and farmers
Country: India
Status: New

Scientists involved:

1. G. Chandrasekar,
2. P. Karuppuchami,
3. G. Karthikeyan,
4. G. Gajendran,
5. D. Dinakaran, and
6. S. Mohankumar

Description: Training for pest diagnostics and training on IPM technologies will be done for extension functionaries.

Progress to date: New activity.

Expected outputs: Extension functionaries from different regions will be trained on pest diagnosis and IPM technologies.

Budget: $3,000 TNAU.

Objective 3: Capacity Building
Description: To strengthen the institutional capacity for vegetable IPM in India

Activity - 12: Capacity building on mass production of biocontrol agents - *Pseudomonas, Trichoderma, Trichogramma*
Country: India
Status: New

Scientists involved:

1. G. Chandrasekar,
2. P. Karuppuchami,
3. G. Karthikeyan,
4. G. Gajendran,
5. D. Dinakaran,
6. S. Mohankumar, and
7. N. Kaushik

Description: Scientists from different South Asian countries will be trained at TNAU on mass production of biocontrol agents - *Pseudomonas, Trichoderma, Trichogramma*. Participation in conferences and workshops.

Progress to date: New activity.

Expected outputs: Scientists from different Asian countries will be trained on mass production of biocontrol agents - *Pseudomonas, Trichoderma, Trichogramma.*

Budget: $11,000 ($8,000 TNAU, $3,000 TERI).

Activity - 13: Analysis of pesticide residues in vegetables
Country: India
Status: Continuing

Scientists involved:

1. P. Karuppuchami and
2. C. Durairaj

Description: Pesticide residues in vegetables will be analyzed and awareness campaigns for consumers will be conducted.

Progress to date: Around 50 vegetable samples were analyzed for pesticide residues.

Expected outputs: Based on pesticide residues in vegetables, awareness campaigns for consumers is more useful.

Budget: $3,000 TNAU.

Activity - 14: Publications
Country: India
Status: New

Scientists involved:

1. G. Chandrasekar,
2. P. Karuppuchami,
3. G. Karthikeyan,
4. G. Gajendran,
5. D. Dinakaran,
6. S. Mohankumar,
7. C. Durairaj, and
8. S. Ramakrishnan

Description: Three research articles on earlier research findings will be published; Onion IPM book is planned for this year; Three book chapters are planned; Twenty extension articles through dailies/ magazines (English/ vernacular language) on IPM is planned; Around 25 posters in different conferences/ seminars/ symposium are planned; Five plant protection Bulletins will be prepared for the benefit of farmers.

Progress to date: New activity.

Expected outputs: Large scale adoption of non-chemical eco-friendly IPM components will be popularized. International visibility of Indian vegetable IPM research and extension will be enhanced.

Budget: $2,000 TNAU.

Activity - 15: Graduate Students and Post Doctoral Research Associates

Country: India
Status: New

Scientists involved:

will be decided based on discussion with Dr. Ed Rajotte/ Dr. Doug Pfeiffer/ Dr. Sally Miller/Dr. R. A. Naidu

Description: Qualified candidates for graduate degrees will be identified for both training in the U.S. and as part of sandwich programs.

Progress to date: New activity.

Expected outputs: India students awarded advanced degrees.

Budget: $2,000 TNAU.

Collaboration with Global Theme Projects:

1. Impact Assessment

Objective: To assess the economic impacts of the IPM packages in relation to global themes

Description: Scientists will perform a baseline survey of the crops involved with the regional project, and will collect data on costs and benefits of our IPM packages as they are developed.
Country: India
Status: Continuing

Scientists involved:

3. Dr. S. Mohankumar,
4. G. Karthikeyan, and
5. N. Kaushik
6. Dr. Selvaraj

Progress to date: Field trials are currently in place, and cost:benefit data will be collected. The baseline survey is a new activity.

Expected outputs: We will be able to document the economic advantages of our IPM packages, further enhancing their adoption.

Budget: $4,010 ($2,010 TNAU, $2,000 TERI).

2. Gender

Objective: To identify unique constraints facing women with respect to pest management in order to advance gender equity through research and extension.

Description: The baseline survey developed in cooperation with the Impact Assessment Global Theme will further document women farmers' constraints in adoption of IPM packages. Gender Global Theme activities will foster an understanding of womens' roles as farmers, as research, and in technology transfer. $4,010 is allocated in the Indian component of the South Asian regional project, and will be used toward Gender Global Themes activities.

Country: India
Status: Continuing

Scientists involved:

4. Dr. K. Uma

Progress to date: A Gender questionnaire on baseline survey is ongoing in IPM CRSP project districts. Based on the survey report, the women farmers' need in India will be further elaborated. The GT management is currently circulating a list of Gender-related activities. Funds allocated to this GT will be associated with these GT objectives.

Expected outputs: Increasing awareness of the gender issues with respect pest management helps to identify gender research team for further intensification in vegetable production and marketing.

Budget: $4,010 TNAU.

3. IPDN:

Objective: To establish the network of researchers / diagnosticians in India.

Description: Expert list of diagnosticians will be prepared and documented in data management spread sheet. The following activities are included in the IPDN Global Theme plan of work, that relate to India:

Objective -2	**Expand networks and implement digital diagnostics**
Activity 2B	Develop the IPDN network in South Asia
Objective -3	**Prioritize crops, pathogens and pests**
Activity 3A	Identify priority crops, pests and pathogens to provide focus for IPDN efforts
Objective 4	**Develop diagnostic assays and protocols**
Activity 4A	Prioritize needed diagnostic protocols, assays, etc.
Objective 5	**Report new diseases and pests and develop incidence maps.**

Activity 5A	Prioritize pathogens or pests to be surveyed/mapped.
Activity-5B	Support identification/reports of new diseases and pests
Objective 6	**Develop Standard Operating Procedures (SOPs).**
Activity 6A	Prioritize at least five pathogen or pest targets for SOP development
Objective 7	**Write IPM recommendations**
Activity 7A	Access pest management solutions developed for key crops by the four RPs and write recommendations in digital and hard copy formats that will accompany diagnoses.
Objective 8	**Train pathologists and entomologists in targeted methodologies or pathogen or pest identification.**
Activity 8A	Conduct hands-on professional diagnostic training program.
Objective 9	**Train key host country scientists from RPs in classical and modern diagnostics**.
Activity 9A	Select individuals for host countries in each region to attend OSU short course.
Objective 10	**Develop and hold web-based training programs (e.g. Webinars)**
Activity 10A	Activities will begin in Year 2.
Objective 11	**Develop and hold Train-the-Trainer programs.**
Activity 11A	Activities will begin in Year 2.

Activity: The Indian component of the South Asian regional project has committed $8,020 (TNAU) to this Global Theme and will work in concert with the above GT activities.

Country: India
Status: Continuing

Scientists involved:

4. G. Karthikeyan,
5. S. K. Manoranjiham, and
6. N. Balakrishnan

Description: Activities will include research, technology transfer and short-term training. We anticipate that the Phase II IPDN GTP will continue to improve capacity for disease and insect pest diagnostics in the target regions and promote accurate IPM implementation and international trade. The research objectives are as follows: 1) Assess diagnostic capacity; 2) Expand networks and implement digital diagnostics; 3) Prioritize crops, pathogens and pests; 4) Develop diagnostic assays and protocols; 5) Report new diseases and pests and develop incidence maps; and 6) Develop and evaluate standard operating procedures for disease diagnosis and insect pest and pathogen identification. Technology transfer and training priorities are to 1) Write management recommendations based on RP technology to accompany diagnoses; 2) Conduct regional professional training programs; 3) provide intensive short-term, hands-on diagnostics experiences; and 4) conduct Train-the Trainer programs for field diagnostics.

Progress to date: India is a site of a spoke lab (in the terminology of this GT). Work is underway in determining how best to foster interaction between the regional project and the GT.

Expected outputs: Awareness of the diagnostic service among the farmers in the project district is increasing.

Budget: $8,020 TNAU

4. Plant Virus Diseases Network

Objective: To monitor virus diseases in vegetables

Activity: The following activities are included in the Plant Virus Disease Network Global Theme plan of work, that relate to India:

Objective - 1	**Status of Virus Knowledge for each host country/region**
Activity - 1	Cataloging known crop – specific virus diseases
Activity - 2	Epidemiological studies
Activity - 3	Finding ecological sources for perpetuation of plant viruses
Objective -2	**Develop long term institutional capacity building and conduct scientist training in host countries**
Activity - 1	Capacity building and Training
Activity - 2	Identifying knowledge gaps
Objective -3	**In cooperation with regional projects, design and implement applied research on specific virus diseases in selected crops in order to develop or improve IPM packages that result from information obtained in objective 1 and 2**
Activity 1	'Rouging' as a management tactic against the PBNV in tomato
Activity 2	Screening of tomato cultivars for PBNV resistance
Activity 3	Design and validation of IPM packages
Activity 4	Seed transmission of Tobacco streak virus in okra
Activity 5	Technology Transfer

Activity: The Indian component of the South Asian regional project has committed $4,010 ($2,010 TNAU, $2,000 TERI) to this Global Theme and will work in concert with the above GT activities.
Country: India
Status: Continuing

Scientists involved:

1. G. Karthikeyan,
2. S. K. Manoranjiham, and
3. N. Balakrishnan

Description: Early detection of plant virus disease and timely control of vector needs improvement in awareness creation not only to our technical field staffs but also to disseminate management technique among the participating farmers.

Progress to date: The South Asian site hosted a workshop organized by the Plant Virus Global Theme, presented to specialists of the three Asian regional projects (South, Central, and Southeast Asia).

Expected outputs: Improved plant health by increasing awareness of the plant virus disease management among the participating farmers from the project districts.

Budget: $4,010 ($2,010 TNAU, $2,000 TERI).

Graduate Students and Post Doctoral Research Associates:

Name: Mr. Sanjay Basnet (provisional upon acceptance at VT)
Sex: Male
Nationality: Nepalese
Discipline: Plant Pathology
Site/Country: South Asia / India
Degree; Ph D
Start date: F. Y. 2010-11
Completion date: 2013-14
IPM CRSP funds: 100%
Advisor/PI: Dr. Doug Pfeiffer
Thesis topic: To be determined
University: Virginia Tech, US

Short-Term Training planned

Workshops:	One workshop cum annual meeting at ADAC&RI, Trichy with all IPM-CRSP scientists and research scholars of TNAU and TERI
Seminars:	Two farmers seminar on vegetable IPM during two different seasons
Field days:	Six field days for demonstrating IPM technologies in major vegetable crops
Mass media events	10 different talks through ALL INDIA RADIO about pest management; Two events through national telecasting channel, Doordarshan
Annual meetings	One workshop cum annual meeting at ADAC&RI, Trichy with all IPM-CRSP scientists and research scholars of TNAU and TERI
Others	Field visits for pest diagnosis and providing solutions to farmers: 100 visits

Publications planned:

Research articles	Three articles on earlier research findings will be published
Books and book chapters	Onion IPM book is planned for this year Three book chapters are planned.
Extension articles	Twenty extension articles through dailies/magazines (English/vernacular language) on IPM is planned
Posters	Around 25 posters in different conferences/seminars/symposium are planned
Bulletins	Five plant protection Bulletins will be prepared for the benefit of farmers
Others	Ten Guest lectures in different organizations on diagnostics and IPM will be delivered

Travel Matrix:

Trip No.	**Number of Individuals**	**Destination Country(ies)**	**Duration**	**Function (Site planning, workshop, symposium etc)**
1	R. Samiyappan	Hawaii, USA	August 1-14,2011	Presenting papers/posters in International Plant Protection Congress- Annual meeting of American Phytopathological Society (August -6 to 10, 2011) Visit to Departments of Entomology, Plant pathology ,Physiology and Weed science and Horticulture, University of Florida and Virginia Tech Meeting management entity and discussion with university team and signing MOU
2	E. I. Jonathan			
3	R. Subbian			
4	N. Kumar			
5	S. Mohankumar			
6	G. Karthikeyan			
7	L. Pugalendhi			
8	G. Gajendran			

Ecologically-based Participatory IPM for Southeast Asia

PI: *Michael Hammig*

Clemson University

Objective 1: to develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

Activity 1. Establish a collaborative network in Cambodia to participate in the SE Asia regional program.

Task. Incorporate IPM CRSP regional project into USAID/Phnom Penh's food security initiative.

Task. Complete a 4-year plan for IPM research and outreach in Cambodia in line with the objectives of the SE Asia regional project.

Objective 2: to improve IPM communication and education leading to widespread adaptation, adoption, and impact of IPM approaches in Southeast Asia.

Activity 1. Conduct economic impact surveys to inform future planning of sources of highest impact and to educate IPM scientists and farmers of the economic benefits to be obtained from IPM adoption.

Task. Continue data collection in the Philippines with samples from trained and untrained farmers.

Task. Adapt the Philippines survey instrument to Indonesia with collaboration of IPB and UNSRAT social scientists.

Activity 2. Conduct gender impact surveys to assess the role of gender in technology adoption and to determine the effects of IPM tactics on gender roles in agricultural systems.

Task. Establish working structure of gender collaborators within the region.

Task. Implement coordinated survey activities in each country.

Objective 3: to enhance the capacity of host country institutions to support research and extension of IPM systems.

Activity 1. Provide training for a host country scientist on plant virus diseases.

Task. A host country scientist, from Cambodia, will travel to Dr. Naidu Rayapati's laboratory in Washington State for training.

Activity 2. Provide training for host country scientists on plant pest diagnostics.

Task. At least one scientist from each host country will be selected to attend the diagnostics workshop in South Asia provided by the IPDN global theme project in 2011.

Activity 3. Conduct a regional workshop in SE Asia for collaborators.

Task: Conduct the regional workshop in the Philippines where collaborators will share experiences to learn from one another and invited international scientists.

Objective 4: to enhance the capability of smallholder farmers to produce and market high quality products for local, national, and international markets.

Activity 1. Work with collaborators in each host country to develop effective IPM systems for production of vegetables and high-value crops.

Task: Clemson scientists will travel to each host country to provide input into research and training efforts of each collaborating institution. Clemson scientists will travel to research sites in each country to observe research activities, assess progress, and make recommendations. These activities are documented in detailed trip reports and subsequently compiled in the annual report.

University of the Philippines, Los Baños

Objective 1: To develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

Activity UPLB-1/1. Evaluation of new IPM technologies for IPM in tomato and eggplant:

Task 1. Design and carry out field experiment for testing tactics against Bacterial wilt in tomato and eggplant – to be set up in split plot design with Grafted vs Non Grafted plants as the major plot and the following treatments as subplot:

a. Drenching of EM (Lactic Acid Bacteria from fermented fruit juices)
b. Drenching of EM (Lactic Acid Bacteria from fermented rice washings)
c. Use of *Pseudomonas flourescens*
d. Use of taumeric extract as bactericide

Activity UPLB-1/2: Grafting in tomato for management of tomato leaf curl and bacterial wilt.

Task 1. Graft wild eggplant as rootstock to manage tomato leaf curl and bacterial wilt and monitor incidence of tomato leaf curl and bacterial wilt.

Task 2. Graft wild cherry tomato as rootstock and monitor incidence of tomato leaf curl.

Description: In recent years, in both northern and central Luzon, tomato leaf curl has been a major disease limiting tomato production. During year 1, a wild eggplant was discovered and shows vigorous growth under extreme waterlogged conditions. Thus, the rootstock of the wild species will be evaluated in small plots to determine if it can increase resistance of commercial tomato cultivars against leaf curl and bacterial wilt compared to the rootstock (EG203) obtained from AVRDC in Taiwan. Another new strategy which will be evaluated is wild cherry tomato as the rootstock to be grafted with existing commercial tomato cultivars, to increase resistance to tomato to the leaf curl virus and possibly other diseases.

Activity UPLB-1/3: Evaluation of new potential biological control agents:

Task 1. Identify *Trichogramma* spp.(*chelonis* or *evanescens*) that is most suitable for control of eggplant fruit and shoot borer

Task 2. Monitor levels of parasitism by *Telenomous* sp. and *Snellenius manilae*, for their role in suppressing populations of cutworms infesting most vegetable crops

Activity 1/4: Determine the potential for use of *Trathala flavoorbitalis*, a larval parasitoid of eggplant shoot and fruit borer.

Task 1. Monitor levels of parasitism in the eggplant shoot and fruit borer.

Task 2. Determine the potential for mass rearing of the *T. flavoorbitalis* parasitoid.

Description: *Trathala flavoorbitalis* exhibited a high degree of parasitism of this pest infesting eggplant (Solleza and Javier, 2009) and shows promise as a potential biocontrol agent against the fruit and shoot borer, a major pest of eggplant limiting eggplant production in Asia. However, its biology, feeding characteristics and mass-rearing techniques are not yet fully understood. These studies need to be conducted before efficacy evaluations in the field.

Activity UPLB-1/5: Mechanical removal of infested eggplant tips to control the eggplant fruit and shoot borer.

Description: When the eggplant fruit and shoot borer (EFSB) attacks the growing tips of eggplants, these wither and die. The borer then moves to fruit, where most of the serious damage occurs. Preliminary evidence has shown that if the farmer removes these dying tips, subsequent damage to the fruits can be avoided. Small plot studies will be conducted at Gawad Kalinga sites and in experimental plots (and with farmers) to determine if mechanical removal of infested eggplant tips provides control of EFSB.

Activity UPLB-1/6: Use of new soil additives to manage insect pests and soil-borne diseases

Task 1: In addition to VAM and mulching, vermicompost and *Trichoderma* will be evaluated for its efficacy in enhancing crop growth, in the process, increase crop resistance to soil-borne diseases. The *Trichoderma* to be used will be the commercially available strain developed by Dr. Virginia Cuevas at UPLB. These new naturally-based products soil additives are cheap and within the reach of resource-poor farmers.

Activity UPLB-1/7: Use of directed post-plant herbicide application to control weeds

Description: Most herbicides which are effective against weeds in vegetables are not selective to vegetables and therefore cannot be used when the vegetable crop has been planted and has emerged. Most farmers thus resort to tedious and expensive weekly hand weeding or apply herbicides before planting or before crop emergence. Pre-plant or pre-emergence herbicide treatments however are too early in the season and cannot usually provide adequate season-long control. Directed post-plant herbicide application with the use of a sprayer with a shielded nozzle has been evaluated for weed

control efficacy in onion in the previous years. Although onion crops with this treatment yielded lower than those treated with farmers' practice and the stale seedbed technique, it reduced the cost of weed control inputs. Ways to improve yields in onion using the directed post-plant application technique will be determined. Also, the feasibility of this treatment in other vegetable crops like tomato and eggplant will be evaluated.

> **Task 1**: Develop shielded nozzle for precise placement of herbicides and test the system in eggplant, tomato, and other crops.

Objective 2: To improve IPM communication and education leading to widespread adaptation, adoption, and impact of IPM approaches in Southeast Asia.

And

Objective 3: To enhance the capability of smallholder farmers to produce and market high quality products for local, national, and international markets.

Activity UPLB-2/1. Dissemination of promising IPM technologies in partnership with the Department of Agriculture and NGOs

Description: In the past four years, activities to disseminate the various IPM technologies were conducted in the form of on-farm demo plots, training, lecture-seminars and workshops with government extension workers and farmers, interviews and focus group discussions with farmers, and field days. All of these activities were conducted in close collaboration, and with highly active and enthusiastic participation of the provincial and municipal agriculturists and local government extension workers.

> **Task 1:** Implement IPM technology transfer to farmers and extension workers in Laguna and Batangas Provinces and to participants in the Gawad Kalinga program supported by the Philippine Department of Agriculture.
>
> **Task 2:** In addition to the active participation of local government extension workers, part of our dissemination efforts is to provide expertise to the participants of the Department of Agriculture-Gawad Kalinga project, to teach IPM technologies like grafting eggplant seedlings and use of earwigs to control pests in their vegetable garden program. This is a nationwide project involving about 2,500 vegetable farms. This task was initiated during year 1 of the project and will be expanded during year 2 of the project.

Training Goals over the next 5 years

1. Short-term training – one or two-week training courses
2. Long-term training – degree studies (MS, PhD)

If funds are available, we hope to avail of a short-term or long-term training for the junior staff of the project, particularly a graduate degree program for M.S. or Ph.D in weed science.

Publications planned

Research papers for submission for publication in refereed journals and extension articles such as leaflets or posters on use of mature IPM CRSP technologies ready for large-scale dissemination will be published.

Travel

Trip No.	**No of Individuals**	**DestinationCountry(ies)**	**Duration**	**Function (Site planning, workshop, symposium etc)**
1) 2011	**5-6**	Philippines	4-5 days	Annual meeting/planning workshop

Philippine Rice Research Institute (PhilRice)

Objective 1: to develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia

Description: Soil borne diseases are major constraints in eggplant and other vegetable crops. Soil micro-organisms have been shown to significantly reduce losses by these diseases.

Activity PR-1/1. Management of soil borne diseases of eggplant using soil micro-organisms: Field studies during the first year, and previous years of the project have shown that soil micro-organisms such as VAM, *Trichoderma, Pseudomonas flourescens* and *Bacillus subtilus* are important tactics in reducing losses by soil born diseases. Methods for the use of VAM and *Trichoderma* have been developed and these are being transferred to farmers through farmer field schools, workshops farmer group meetings, etc. *Pseudomonas flourescens* and *B. subtilus* are just now being considered thus methods for their production is just being initiated.

Status: These activities will continue, although VAM and *Trichoderma* production and use is more highly developed than for *Pseudomonas flourescens* and *Bacillus subtilus*. These latter two micro-organisms will be the subject of investigations during the second year.

Scientists involved: Hermie Rapusas, SE Santiago, JM Ramos

Expected outputs: Increased numbers of farmers and extension workers trained in the use of soil micro-organisms thereby leading to an increase in eggplant production.

> **Task:** Set up farmer participatory research/demonstration plots to show the benefits of the microbial agents in reducing losses by soil borne diseases.

Description: Grafting commercial eggplant onto disease/water-logging resistant EG203 eggplant rootstock has been shown to greatly benefit production.

Activity PR-1/2. Use of rice straw and stale seedbed techniques to reduce weeds, and provide refuge for predators.

> **Task 1**. Organize farmer participatory research to allow farmers to observe the benefits of stale seedbed and rice straw in weed control and increases in natural enemies. Pitfall traps in rice straw plots compared to those in plots without rice straw should provide information on the importance of rice straw in attracting natural enemies (particularly ground-dwelling predators).

Activity PR-1/3. Development and utilization of IPM tactics for management of pests of onion.

> **Task 1**. Use of *Trichoderma,*VAM, *Pseudomonas flourescens* and *Bacillus subtillis* will be explored with onion farmers to determine the extent to which these can be produced and used.
>
> **Task 2**. Obtain cultures of myco-fungicides and develop techniques for their production.
>
> **Task 3. U**se of yellow board sticky traps for leafminers and blue board sticky traps for thrips will be promoted
>
> **Task 4**. Use of SiNPV and SeNPV will be be promoted against cutworm and armyworm, respectively.

Activity PR-1/4. Develop with farmers, major IPM tactics for use in tomato. These will include VAM, *Trichoderma*, SeNPV, SlNPV and botanical insecticides. Stale seedbed will be used for weed control and resistant varieties will be explored.

> **Task 1**: Obtain cultures of the most virulent strains of myco-fungicides and botanical insecticides. Likewise, obtain cultures of SeNPV and SlNPV and test these in field plots that are monitored with pheromones to time the interventions.
>
> **Task 2**: Utilize other cultural practices such as pruning lower leaves, field sanitation, and staking to reduce foliar diseases.

Objective 2: to improve IPM communication and education leading to widespread adaptation, adoption, and impact of IPM approaches in Southeast Asia.

and

Objective 3: to enhance the capability of smallholder farmers to produce and market high quality products for local, national, and international markets.

Activity PR-2/1. Technology Transfer and Promotion of Pest Management Technologies in Rice - Vegetable Cropping Systems.

Description. The technology promotion activity will be carried out in a participatory manner with farmers for greater impact. This includes informational materials produced, delivery method used and IPM tactics promoted. The impact of the technology will be measured by increased production, decreased inputs and increased net income. Farmers and extension personnel training on vegetable IPM will be continuously conducted to scale up well-informed and well-equipped farmers and technicians on vegetable IPM.

Expected outputs. These activities will improve awareness and understanding of management tactics by farmers and will provide the necessary knowledge to apply IPM tactics.

Task 1: IPM CRSP technologies promoted, disseminated and adopted by cooperators and other farmers in the site.

Task 2: Training and extension materials developed and utilized

Task 3: Information and campaign materials developed

Task 4: Media publicity carried out

Task 5: Simplified decision rules for the technologies developed and adopted

Task 6: Stakeholders' workshops carried out

Task 7: Improve the decision making of farmers to reduce production costs, increase income and minimize health and environmental hazards.

Activity PR-2/2. Village-level demonstration, integration and utilization and adoption of tactics involving microbial agents such as VAM, SeNPV, SlNPV, *Trichoderma* sp. and fungal pathogens for whiteflies and thrips in rice - vegetable cropping systems.

Description. Vesicular arbuscular mycorrhizal (VAM) fungi have the ability to assist the plant roots in absorbing water and nutrients especially immobile elements such as phosphorus and zinc. They impart a degree of resistance or tolerance against soil-borne pathogens like nematodes, bacteria and fungi, by secreting growth-promoting substances and by altering the morphology, physiology and biochemical components of the host plants. Their interactions, however, vary depending on host cultivar, species of VAM fungi and pathogens and soil fertility. On-farm/field demonstration trials that are either researcher-managed or farmer-managed are important activities to undertake before the technology could ultimately be integrated with the farming systems. Thus, a major component objective of this project is to integrate VAM technology for onion and vegetable production in rice-based cropping systems to reduce fertilizer and pesticide inputs. In addition, farmer participatory production, utilization and testing of the insect microbial agents are critical for showing their efficacy. Production and testing of fungal pathogens of whiteflies and thrips will be carried out after isolates have been identified, cultured and tested.

***Expected outputs**: Village-level production and utilization of the microbial biological control agents.*

Task 1: Survey, isolation and culture of fungal pathogens of whiteflies and thrips.

Task 2: Village level farmers training on mass production of microbial materials.

Task 3: Village-level campaign for utilization and implementation.

Task 4: Production and distribution of campaign/extension materials for the biological control agents.

Task 5: Evaluation of the implementation/impact assessment.

Activity PR-2/3: Development of a Vegetable Diseases Diagnostic Kit for Farmers.

Description: About 57 common diseases are mainly caused by bacteria, fungi, viruses, and nematodes which make their identification challenging for farmers. Availability of a reliable and simple disease diagnostic kit is the key to helping farmers plan an efficient disease management strategy. Quick and accurate plant disease diagnosis as well as professional services, and up-to-date control recommendation are necessary. Knowing the pests prior to taking action is the most efficient tool in diseases management because prevention is better than cure. This activity will be carried out to develop and make available an easy, farmer-friendly diagnostic tool/kit about vegetable diseases.

Successful plant disease management starts with the correct identification of the causal agent. Hence, disease symptoms, signs, pathogens, and host and different parts of the vegetables will be described in the kit.

Expected outputs: Development of a simple diagnostic kit for farmers will be begun and tested with farmers in their own fields.

Task: Collection and identification of diseases of different vegetable crops.

Task: Description of the signs and symptoms of each disease.

Task: Development of the diagnostic kit.

Task: Pre-testing of the kit – evaluation by farmers.

Task: Modification of the kit based on the farmers' evaluation and finalization of the kit.

Task: Mass production and dissemination of the disease diagnosis kit.

<u>Bogor Agricultural University (IPB)</u>

Objective 1: to develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

and

Objective 2: to improve IPM communication and education leading to widespread adaptation, adoption, and impact of IPM approaches in Southeast Asia.

Activity IPB-1/1. Development and Testing IPM Strategies for Crucifers

Description. *Trichoderma* mixed with bokashi and dipping of seedlings in *Bacillus subtilis* and *Pseudomonas fluorescens* will be tested against club root on crucifers, while hand-picking and botanical insecticide will be tested with farmers for control of catterpillar pests. Plastic mulch will be evaluated for control of weeds.

Expected outputs. These activities will provide information for development of a treatment program for key disease problems in crucifers in the region, as well as for demonstrating the impact of an IPM strategy for control of insect pests.

> **Task:** Information developed on the practical use of bokashi and various biocontrol agents for management of club-root in crucifer.
> **Task:** Assessment of spot-spraying with botanical pesticide and hand-picking egg masses and larval clusters of lepidopteran pests, such as *Crocidolomia*, in crucifers.
> **Task:** Test plastic mulch to suppress weed infestation.
> **Task:** Information obtained from above activities will be incorporated into farmer field school training materials and used in FFS.

Activity IPB-1/2. Development and Testing IPM Strategies for Green Onion

Description. Field trials on green onion will test IPM tactics consisting of: (1) use of SeNPV virus to control *Spodoptera exigua*, (2) application of botanical insecticide to control black aphid *Neotoxoptera formosana*, (3) use of sticky yellow traps to control leafminer infestations, and (4) use of bokashi, *Trichoderma*, *Bacillus subtilis*, and *Pseudomonas flourescens* against plant diseases, (5) use of stale seedbed and hand picking to control weeds.

Expected outputs. The above studies will provide the basis for a comprehensive IPM program for the control of insect pests and diseases on green onion in the key vegetable growing area of West Java.

> **Task:** Compile information on the practical use of bokashi and various biocontrol agents for management of diseases in green onion.
> **Task:** Test SeNPV in the field to evaluate the efficacy in controlling *Spodoptera exigua.*
> **Task:** Assess the practical use of spot-spraying with botanical pesticide against *Neotoxoptera formosana*.
> **Task:** Test yellow sticky traps in the field to assess their efficacy in reducing populations of leaf miners.
> **Task**: Test “open rearing system” for increasing population of predatory fly *Coenosia humilis.*
> **Task:** Test plastic mulch to suppress weed infestation.
> **Task:** Incorporate information from above studies into training materials for use in farmer field schools.

Activity IPB-1/3. Development and Testing IPM Strategies for Tomato

Description. Field trials on tomato will test an IPM package consisting of: (1) use of HaNPV virus to control *Helicoverpa armigera*, (2) need-based application of fungicides to control leafblight, (3) use of sticky yellow traps to control leafminer infestations, and (4) use of bokashi, *Trichoderma*, *Bacillus*

subtilis, and *Pseudomonas flourescens* to induce plant resistance to diseases, (5) use of plastic mulch to control weeds.

Expected outputs. The above studies will provide the basis for a comprehensive IPM program for the control of insect pests and diseases on tomato in the key vegetable growing area of West Java.

Task: Analyze information on the practical use of bokashi and various biocontrol agents for management of diseases in tomato.
Task: Test HaNPV in the field to evaluate its efficacy in controlling *Helicoverpa armigera.*
Task: Assess need-based applications of fungicide against leafblight.
Task: Test yellow sticky traps in the field to assess their efficacy in reducing populations of leaf miners.
Task: Test plastic mulch to suppress weed infestation.
Task: Evaluation of resistance of tomato cultivars to major diseases.
Task: Incorporate information from above studies into training materials for use in farmer and extension agent training.

Activity IPB-1/4. Development and Testing IPM Strategies for Chili Pepper

Description. Field trials on chili peppers will assess the use of bokashi, *Trichoderma*, *Bacillus subtilis*, and *Pseudomonas flourescens* to induce plant resistance to diseases. Several chili lines will also be tested, and need-based applications of fungicides to control anthracnose will be evaluated. Plastic mulch will be evaluated for control of the weeds.

Expected outputs. The above studies will provide the basis for a comprehensive IPM program for the control of diseases on chili pepper in the key vegetable growing areas of West Java.

Task: Information on the practical use of bokashi and various biocontrol agents for management of diseases in chili pepper will be evaluated.
Task: Need-based application of fungicide against anthracnose will be assessed in chili peppers.
Task: Test plastic mulch to suppress weed infestation.
Task: Several chili cultivars will be evaluated for resistance to major diseases.
Task: Incorporate information from activities above into training materials for farmers and extensionists.

Objective 4: to enhance the capability of smallholder farmers to produce and market high quality products for local, national, and international markets.

Activity IPB-4/1. Farmer Level Production of Biotic Agents

Description. Four "Pos Pelayanan Agens Hayati (Posyanti)" / Biotic Agents Service Posts have been established during the project. We will improve the capability and quality control of the posts in mass-production of bokashi, SeNPV, *Trichoderma harzianum*, *Bacillus subtilis*, and *Pseudomonas flourescence*.

Expected outputs. Bokashi, SeNPV, *Trichoderma harzianum*, *Bacillus subtilis*, and *Pseudomonas fluorescence* will be available for use in IPM field trials with participating farmers and extensionists.

Task: Maintain pure culture of biotic agents for distribution to farmer collaborators.
Task: Provide biological agent posts with facilities and equipments for propagating biotic agents.
Task: Train farmer collaborators in mass-propagation of various biocontrol agents.
Task: Assist Posyantis in marketing their products**.**

Sam Ratulangi University (UNSRAT)

Objective 1: to develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

Activity: Strategy For Control of Insect pests and diseases of vegetables in North Sulawesi, Indonesia.

Local PI: Dantje T. Sembel

Co PIs: Ir. Merlyn Meray

Ir Max Ratulangi

Description:

Vegetables such as tomato, chili, cabbage, potatoes and spring onions are important cash crop in North Sulawesi. Most vegetable farmers still use mixture of pesticide (insecticides and fungicides) to spray on crops to control the vegetable pests and diseases. Two recently "introduced" pests of tomato are *Liriomyza sativae* and *Nesidiocoris tenuis*. These two pests act together to cause serious damage to tomato crops particularly in the sub-district Tompaso. Other pests of tomato are *Bactocera papayae* and *Bemisia tabaci.* The fruit fly, *B. papayae* often cause damage to tomato fruits and *B. tabaci* damages the plant by sucking the crop and also acts as a vector of viral diseases.

The main pests of Cabage are *Plutella xylostella* and *Crocidolomia binotalis*. Parasitoid, *D. semiclausum* has established in N. Sulawesi and has been able to control P. xylostella with percentage of parasitism of up to 90 % or more but this parasitoid do not parasitize *C. binotalis* and hence still causing a serious problem on cabbage crops. Pathogenic fungi, *Metarhizium anisopliae* and *Nomurae* riley have also been isolated from lepidopteran larvae and their pathogenicity are now being studied under laboratory and field conditions.

Tomato and chili are very prone to wilt and viral diseases. Local strain of *Trichoderma koningii* are now being tested in the field to reduce the wilt diseases on tomato and chili. Various strains of chili and tomatoes from AVRDC prove to be prone to viral and fungal diseases in North Sulawesi.

Activity: Use of Botanical insecticides and limited use of pesticides to control Nesidiocoris tenuis and Liriomyza sativae on tomato crops in N. Sulawesi Indonesia

Description:

Tomato mirid bug, *Nesidiocoris tenuis* (Miridae: Hemiptera) which is known to be a zoophagous insect was first reported by tomato farmers in North Sulawesi Indonesia in early 2000. During the last 3 years this pest became one of the very important pest of tomato particularly in the sub-district of Tompaso. The bug damages the tomato by sucking the petiole of the flower forming a brown yellow ring which eventually causing the tomato flowers to fall. Another important pest of tomato which also just came up during early 2000 is the leafminer, *Liriomyza sativae*. This pest damages the crop by burrowing on the leaves causing the leaves to die. Farmers have to spray the crop at least 2 to 3 times or more a week to control these two pests.

Survey carried out during 2003-2004 and 2009/2010 showed that there were at least four parasitoids namely, *Hemiptarsenus varicornis, Gronothoma* sp., *Neochrysocharis* sp. and *Opius* sp. that can parasitize the larvae and pupae of *L. sativae*. The most dominant parasitoid was *H. varicornis*. Report elsewhere showed that by reducing or eliminating pesticide can reduce the populations of *Liriomyza* spp. Field experiments carried out from March to June 2010 on tomato crops at Toure, sub-district Tompaso, N. Sulawesi using plastic mulch and rice mulch as well as reducing the use of pesticides to control the populations of these pests have not been very successful.

Objectives:

1. To test several locally available botanical insecticides to control *N. tenuis* and *L. sativae*

2. To study the difference on tomato crop damage and production between unspray and insecticide spray plots.

Status : New

Scientists involved: Ir. Carolus Rante and Ir. Roy Dien

Expected Outputs:

Task 1: Botanical insecticide effective to control *N. tenuis* and or *L. sativae*

Task 2: Assess the impact on tomato production of different treatments: unspray, insecticide spray, and botanical insecticide sprays

Activity: Pathogenicity of local strains of Metarhizium anisopliae and Nomurae sp. on larvae of lepidopteran pests under laboratory and field conditions

Status : Continuing – part of doctorate Dissert*olomia binotalis*. This pest attacks cabbage particularly during the formation of crop' head. The larvae will eat the crop causing the crop to be totally damaged and cannot be marketed. Until now most farmers have to spray the crop to with insecticides to control this pest. Local strains of *Nomurae* sp and *Metarhizium anisopliae* isolated from lepidopteran larvae on

vegetable crops in Sulawesi will be purified, mass produced and tested their pathogenicity on fresh larvae of *C. binotalis* and *Spodoptera* spp. Using different concentration of fungi spores under laboratory condition and an effective pathogenic fungi will be tested under field condition.

Objective: To test under laboratory and field condition the pathogenicity of localstrains of *Nomurae* sp. and *Metarhizium anisopliae* on larvae of *Crocidolomia binotalis* and *Spodoptera* sp.

Progress to date:

Isolation, identification and mass rearing the pathogenic fungi. Local strain of *M. anisopliae* showed to be very pathogenic to larvae of *C. binotalis, P. xylostella* and *Spodoptera* sp. Pathogenic fungi, *Nomurae* sp. has already been able to grow and sporulate on a special prepared media mixed with extract of larvae of *C. binotalis*.

Expected outputs:

Task 1. Local strain of pathogenic fungi *M. anisopliae* and *Nomurae* sp.

Task 2 : Effective biocontrol agent of *C. binotalis* using *M. anisopliae* and *Nomurae* sp.

Activity: Isolation, Identification, Characterization and Antagonistic characters of local strains of *Pseudomonas fluorescens*.

Status : New

Scientists involed : Ir Jouke Paat and Ir. Max Ratulangi

Description: Some strains of *Pseudomonas* sp. are acting as an antagonist and has been used as biological agent against parasitic fungi such as *Fusarium* or *Phytium* as well as phytophagous nematodes. This bacterium known to be able to compete with pathogenic soil microorganisms or can induce systemic resistance in the host plant or most commonly known to produce compounds antagonistic to soil microorganisms. This antagonistic bacterium has never been used as biological agent to control diseases on vegetable crops in North Sulawesi.

Objectives:

(1). To isolate, identify and characterize *P. fluorescens* isolated from different soils in North Sulawesi

(2) To test its antagonistic capability under laboratory condition on pathogenic fungi known to cause diseases of vegetable in N. Sulawesi

Progress to date : Local strains of *Pseudomonas* sp. isolated from different soils. These strains are now being purified and characterized under laboratory conditions

Expected outputs:

Task 1 : Various identified local strains of *P. fluorescens* isolated from different soils in North Sulawesi.

Task 2 : Local strains of *P. fluorescens* which have antagonistic capability to reduce or kill the growth of pathogenic fungi

Activity: Monitoring and Evaluation of Natural Enemies of *Plutella xylostella, Liriomyza sativae* and *Bactocera papayae* in N. Sulawesi.

Status : Continuing

Scientist involved : D.T.Sembel, M. Meray and M. Ratulangi

Description:

Natural enemies are important agents to control pests of crops in the field. Parasitoid *D. semiclausum* was first released on cabbage crops in Tomohon (1991), Rurukan (1993/94) and in Modoinding (1994). Monitoring of the parasitism of this parasitoid on *P. xylostella* has been done since the first released. This parasitoid has established in all cabbage centers in N. Sulawesi. The parasitism is between 30-100 % depending on location and period of samplings. Survey on parasitoids of *Liriomyza* spp. have been carried out since 2003/4 and survey on the parasitoids of *B. papayae* was started in 2009.

Objective:

To monitor and evaluate the role of natural enemies (parasitoids) in reducing the pests of cabbage, (*P. xylostella*), tomato (*Liriomyza* sp. and *B. papayae*) at all centers of cabbage and tomato plantations in N. Sulawesi.

Progress to date:

Parasitoid *D. semiclausum* remain the most important agent that can control the population of *P. xylostella* on cabbage crop. The percentage of parasitism on cabbage crop at Rurukan observed during the month of May to July 2010 was between 90-100 %. Survey carried out during 2003-2004 and 2009 showed that there are at least four parasitoids of *Liriomyza* spp. namely, *Hemiptarsenus varicornis, Gronothoma* sp., *Neochrysocharis* sp. and *Opius* sp. The most dominant parasitoid is *H. varicornis*. The total percentage of parasitism by these parasitoids has been up to 48 %. Survey in 2009 showed that about 10-15 % of the *B. papayae* on tomato was parasitized by *Opius* sp. but studied carried out between Mayi and July 2010 showed no parasitism by *Opius* sp. on *B. papayae* at the same location at Toure, sub-district Tompaso.

Expected outputs:

Task 1. Percent parasitism of parasitoids on *P. xylostella*, *Liriomyza* sp. and *B. papayae* at different centers of vegetable plantations in N. Sulawesi

Activity: Survey on the papaya mealy bug and their natural enemies in N. Sulawesi.

Status : Continuing

Scientists involved : D. T. Sembel, M. Meray and M. Ratulangi

Description:The papaya mealy bug, *Paracoccus marginatus* was first observed on papaya in Manado in August 2009 following of its first report in Bogor in Mei 2008 by IPMCRSP team in Bogor. This pest spread very quickly throughout Manado and within 2-3 months nearly all papaya in Manado have been infested by this pest and after one month of infestation most papaya trees were died due to infestation by this pest. Until mid of this year, 2010, this pest has only been found in Manado and the sub-districts nearby Manado but it has not been found at other places in N. Sulawesi.

Objectives:

(1). To study the spread and extent of damage by papaya mealybug in N. Sulawesi

(2). To identify the natural enemies of the papaya mealy bug

Expected outputs:

Task 1 : The spread and extent of damage of papaya mealy bug in North Sulawesi

Task 2: Natural enemies of the papaya meallybug

Objective 4: to enhance the capability of smallholder farmers to produce and market high quality products for local, national, and international markets.

Activity: The formulation of program for the development of sustainable agriculture and agribusiness in Rurukan and Kumelembuay sub-district East Tomohon.

Objective:

To develop a new model for the development sustainable agriculture in Rurukan and Kumelembuay

Description

Rurukan and Kumelembuay is an ecologically sensitive area in the sub-district of East Tomohon is one of the centers of vegetable crops in North Sulawesi. Most farmers own small agricultural land with an average of about 0.2 ha per family and they are still clearing forest to expand agricultural land in the sloping area. Traditional farming in the sloping area is still being practiced by farmers hence the top soil is very prone to soil erosion. Improved erosion control in the sloping areas will be introduced to the farmers. Most farmers use pesticides to control pests of crops hence these crops cannot be marketed internationally (Singapore and Malaysia). Organic farming is now being introduced to the farmers to get healthy agricultural production. Socialization of a safe agriculture environment by reducing the use of pesticide and developing organic farming is an important aspect to pass on to the farmers. This can be done by having demonstration plots that farmers in the area can see and provide education programs to

explain alternative production systems on a village level scale. Vegetable crops are considered to be a good cash crops but the price of their crops are very much determined by the local collectors, so education to explain the benefits of healthier crops will result in price premiums.

Expected Outputs:

Task 1. A new model to develop an organic farming at the Rurukan Kumelembuay area.

Task 2. Farmers realized the important of developing a better way to reduce erosion in the sloping areas.

Graduate Students :

1. Name : Eva Baideng
Sex: Female
Nationality ; Indonesia
Site/Country: N. Sulawesi Indonesia
Degree : Ph.D
Start Date/Research Activity with IPMCRSP: January 2010
Completion Date : October 2011
IPMCRSP Funds: Partial approx. USD 1500
Advisor: Dr. Dantje T. Sembel
Dissertation Topic: *Strategy for Management of Liriomyza sativae on Tomato Crop in N. Sulawesi.*
University: Sam Ratulangi, Manado, Indonesia

2. Name : Betsy Pinaria
Sex: Female
Nationality: Indonesia
Site/Country: N. Sulawesi Indonesia
Degree : Ph.D
Start Date/Research Activity with IPMCRSP: January 2008
Completion Date : August 2011
IPMCRSP Funds: Partial support USD 500. (See activity 2)
Advisor: Prof. Saartje Rondonuwu-Lumanau
Dissertation Topic: *Effectiveness of local strains of pathogenic fungi isolated from varuous lepidopteran larvae on pests of vegetable crops*
University: Sam Ratulangi, Manado, Indonesia

Short Term Training:

Extension Service/Field School/Field Days :

Topic: 1. Use and mass production of biological agents (Trichoderma sp. SeNPV)

2. Spot spraying of B.t (Thurex) to control C. binotata and other lepidopteran pests

3. Use of plastic mulch on tomato, chili and cabbage crops

Locations: Toure, Rurukan, Modoinding

Collaborative Agents : 1. Bureau of Food Crop and Horticutural Protection N. Sulawesi

2. Farmer's Groups

Seminar:

Topic: IPM CRSP Activities in N. Sulawesi – Pest management of Vegetable Crops

Location: Sam Ratulangi University

Participants : 50 people (Staff/researchers from Sam Ratulangi University and related

Bureau of Agriculture in N. Sulawesi)

Annual Meeting : To be held in the Philippines

Publications:

Research articles : 2-3 articles

Book: Principles of Crop Protection (Indonesian) ?

Travel Matrix:

Trip No.	Number of individulas	Destination/country	Duration	Function
1.	3	Honolulu*	5 days	International Symposium on Crop Protection*

*Note: Costs of travel to Honolulu to attend the International Symposium on Crop Protection in August 2011 will be covered by individuals not from IPMCRSP budget

FIELD/Indonesia

Objective 1: To develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

Activity. Continuation of field studies to develop tactics for management of the sweet potato weevil, *Cylas formicarius*, in Sungai Sariak Village of Baso sub-district, Agam

Task 1. Conduct 2nd year of population monitoring with pheromone traps to determine timing of management practices.

Task 2. Conduct field efficacy tests for control of *Cylas* with a strain of Beauveria developed by the bioagent laboratory in Bukittinggi.

Task 3. Conduct field efficacy tests for control of *Cylas* using entomopathogenic nematodes.

Task 4. Conduct field tests to evaluate the use of sanitation practices for lowering populations of *Cylas*.

Activity. Conduct field studies on management of pests and diseases of chili using microbial agents in Canduang sub-district of Agam.

Task 1. Conduct field efficacy tests using *Beauveria* to control insect pests of chili.

Task 2. Conduct field efficacy tests using *Trichoderma* to control fungal diseases of chili.

Objective 2: To improve IPM communication and education leading to widespread adaptation, adoption, and impact of IPM approaches in Southeast Asia.

Activity. Dissemination of results of *Cylas* field studies in Baso sub-district of Agam

Task 1. Conduct a Farmer Field School on sweet potato IPM with emphasis on management of *Cylas* populations.

Activity. Dissemination of information on IPM tactics for chili, sweet potato, tomato and other vegetables.

Task 1. Conduct a Training of Trainers School for farmer trainers in collaboration with the Agriculture Service Office and Crop Protection Center of West Sumatera's Program 2011.

Task 2. Assist in the revitalization program for Farmer Bioagent Posts in collaboration with West Sumatera's Program 2011.

FIELD Indonesia, North Sumatra

Objective 1: To disseminate IPM knowledge to smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

Activity. Continuation of field studies in Sibayak Valley to develop tactics for management of insect pests and diseases of tomato, chili, and green beans.

Task 1. Conduct field efficacy tests with microbial agents (*Beauveria, Trichoderma*, and VAM) for control of pests and diseases on tomatoes, chili, and green beans.

Task 2. Evaluate the use of plastic mulch for tomatoes, chili, and green beans in farmer field tests.

Activity. Continuation of farmer field studies in cacao at Sibulangit in Deli Serdang District using cultural practices to control insect pests and diseases.

Task 1. Conduct field tests to determine the effectiveness of pod sheathing in reducing damage from cocoa pod borer and pod rot disease.

Objective 2: To improve IPM communication and education leading to widespread adaptation, adoption, and impact of IPM approaches in Southeast Asia.

Activity. Dissemination of results of field studies on cacao and vegetables.

Task 1. Conduct farmer to farmer teaching programs in the three sub-districts where field studies were conducted the previous year.

Objective 3: To enhance the capacity of host country institutions to support research and extension of IPM systems.

Activity. Provide training for host country scientists on IPM tactics.

Task 1. Representatives from FIELD Indonesia will travel to the Philippines to participate in the Southeast Asia IPM CRSP Workshop.

General Directorate of Agriculture Cambodia

Objective 1: to develop IPM knowledge with smallholder farmers producing vegetables and selected other high-value crops in Southeast Asia.

Activity. Conduct surveys on tomato, chilies and crucifers in Kandal, Kampong Cham and Siem Reap Provinces.

Task 1. Conduct surveys of insect pests and natural enemies on vegetable crops.

Task 2. Conduct surveys of virus diseases on tomatoes and chilies.

Activity. Set up experiments at to investigate the use of *Trichoderma harzianum* to control soil borne diseases for selected vegetable crops.

Task 1. Set up field tests of *Trichoderma harzianun* at Kbal Koh Vegetable Research Station.

Task 2. Conduct field trials on *Trichodermna harzianum* with farmer groups in Kandal, Kampong Cham and Siem Reap Provinces.

Activity. Determine feasibility of grafting of tomato on eggplant to control diseases.

Task 1. Test grafting techniques and implement field tests of grafted plants at Kbal Koh Vegetable Research Station.

Objective 3: to enhance the capacity of host country institutions to support research and extension of IPM systems.

Activity. Train agricultural technicians on disease management and researcher methodology.

Task 1. Improve capacity of extension personnel on basic approaches to crop management and implementation of comparison testing.

SE Asia – Travel matrix – FY2011

U.S. to Indonesia/Philippines/Cambodia – 12

Indonesia/Philippines/Cambodia to U.S. – 10

Malaysia to Cambodia/Philippines/Indonesia – 6

Indonesia/Philippines/Cambodia to India – 5

Indonesia/Cambodia to Philippines – 12

Development and Delivery of Ecologically-based IPM Packages for field and Vegetable Cropping Systems in Central Asia

PI: *Dr. Karim Maredia, Michigan State University*

Central Asia Regional IPM Program FY 2011 Workplan
(October 1, 2010 – September 30, 2011)

Project Management:
Dr. Karim Maredia (PI), Michigan State University
Dr. Zakir Khalikulov, CGIAR/ICARDA-Project Facilitation Unit, Tashkent, Uzbekistan

Wheat IPM Package:
Dr. Nurali Saidov, IPM CRSP Coordinator, Tajikistan
Dr. Doug Landis, Michigan State University
Dr. Bohssini Mustapha, ICARDA
Dr. Megan Kennelly, Kansas State University

Tomato IPM Package:
Dr. Barno Tashpulatova, IPM CRSP Coordinator, Uzbekistan
Dr. Frank Zalom, University of California-Davis
Dr. Ravza Mavlyanova, AVRDC/World Vegetable Center

Potato IPM Package:
Dr. Murat Aitmatov, IPM CRSP Coordinator, Kyrgyzstan
Dr. George Bird, Michigan State University
Dr. Walter Pett, Michigan State University

IPM Communication:
Ms. Joy Landis, Michigan State University

Links with IPM CRSP Global Theme Projects:
Pest Diagnostics**:** Dr. Sally Miller, Ohio State University
Viruses**:** Dr. Naidu Rayapati, Washington State University and Dr. Sue Tolin, Virginia Tech University
Gender Issues**:** Dr. Linda Racioppi and Dr. Zahra Jamal, Michigan State University and Dr. Maria Elisa Christie, Virginia Tech University
Socio-Economic Impact Assessment**:** Dr. Mywish Maredia and Richard Bernsten, Michigan State University, and Dr. George Norton, Virginia Tech University

Michigan State University (MSU) in partnership with University of California-Davis, Kansas State University, ICARDA, AVRDC, and several local research and academic institutions and NGOs is

implementing a regional IPM program in Central Asia. The three host countries include - Tajikistan, Uzbekistan and Kyrgyzstan.

The technical objectives of the Central Asia Regional IPM Program are as follow:

1. Develop ecologically based IPM packages for wheat, tomato and potato through collaborative research and access to new technologies.

2. Disseminate IPM packages to farmers and end-users through technology transfer and outreach programs in collaboration with local NGOs and government institutions.

3. Build institutional capacity through education, training and human resource development.

4. Enhance communication, networking and linkages among local institutions in the region and with U.S. institutions, international agricultural research centers, and IPM CRSP regional and global theme programs.

5. Create a "Central Asia IPM Knowledge Network" encompassing a cadre of trained IPM specialists, trainers, IPM packages, information base, and institutional linkages.

The proposed activities for the period covering October 1, 2010 to September 30, 2011 are linked to the above five technical objectives. The current political situation in Kyrgyzstan and its impact in the region and travel restrictions imposed by the U.S. State Department have slowed/delayed the planning and implementation of the project activities in the region.

Objective 1. Develop ecologically-based IPM packages for wheat, tomato and potato cropping systems through collaborative research and evaluation of new technologies and approaches.

Activity 1: Establish IPM Applied Research and Demonstration Sites for testing and evaluating the existing and new approaches and technologies for IPM packages for Wheat, Potato and Tomato in three host countries (Tajikistan, Kyrgyzstan, and Uzbekistan). This will include cultural practices, botanicals and biopesticides, biological control agents/products, resistant varieties, pheromone traps, sticky traps, chemical pesticides, etc. The locations for the research and demonstration sites have been selected and detailed plans have been developed (see more details in the following sections). For Wheat IPM, the project will focus initially focus in Tajikistan, for Potato IPM, the project will initially focus in Kyrgyzstan, and for Tomato IPM, the project will initially focus in Uzbekistan.

Participating scientists/institutions: N. Saidov, B. Tashpulatova and M. Aitmatov, IPM CRSP project coordinators in Central Asia, Collaborators from ICARDA, AVRDC, U.S. Collaborators, local scientists from research institutions and universities in host countries.

Expected output: IPM Applied Research and Demonstration sites established in host countries for wheat, tomato, and potato crops.

Time line: October 2010 – September 2011

Activity 1.A: Wheat IPM Research Demonstration Sites in Tajikistan

Site #1: Wheat IPM Package for Northern part of Tajikistan

a. Name and Location of this site: Farm of Mr. Ilhom Boimatov located in the Spitamen district of Sogd region.

b. Key Pest Problems: At this site focus will be on the Sunn pest (*Eurygaster integriceps)* and diseases include the wheat rusts: yellow rust (*Puccinia striiformis*) and brown rust (*Puccinia recondite*). The key weeds in wheat field include; oat grass (*Avena fatua*), shepherd's purse (*Capsella bursa-pastoris),* pigweed or lambsquarters (*Chenopodium album)* and bermuda grass (*Cynodon dactylon*).

c. IPM Package Components: In this demonstration sites will test the following IPM package components:

1. Resistant Varieites: Plots of 10 X10 m planted to a resistant variety to yellow and brown rusts, 4 reps with two strips of flowering plants including coriander *(Coriandrum sativum L.)*, dill *(Anethum graveolens L.),* sweet basil *(Ocimum basilicum L.),* ziziphora *(Ziziphora interrupta* Juz.), marigold *(Calendula officinalis L.)* and winter cress (*Barbarea vulgaris)* along side the wheat plots to enhance Sunn pest egg parasitoids.
2. Cultural practices (planting date, seed rate, fertilizer application, and weed control) will be as recommended in the country.
3. Hand collection of Sunn pest adults during 2-3 weeks beginning at the time of migration to wheat fields.

This package will be compared to farmers' practices in the same area.

d. Planting and harvesting time for wheat at this site: Wheat will be planted in October 2010 and harvested in June 2011.

e. Names of the local scientists and collaborators: Dr. Anvar Jalilov and Mr. Tavakal Mirzoev from Institute of Plant Production "Ziroatparvar" of Tajik Academy of Agricultural Sciences and Mr. Vokhid Nazirov a scientist from Institute of Zoology and Parasitology the Academy of Science of Tajikistan and students from IPM wheat class from the National University of Tajikistan (biology faculty) and Tajik Agrarian University.

Site #2: Wheat IPM Package for Southern part of Tajikistan

a. Name and Location of this site: Andreevka village in the Durbat Jamoat of the Hissor district.

b. Key Pest Problems: At this site focus will be on the cereal leaf beetle *(Lema melanopus)* and diseases include the wheat rusts: yellow rust (*Puccinia striiformis*) and brown rust (*Puccinia recondite*). The key weeds in wheat field include; oat grass (*Avena fatua*), *s*hepherd's purse (*Capsella bursa-pastoris),* pigweed or lambsquarters (*Chenopodium album)* and bermuda grass (*Cynodon dactylon*).

c. IPM Package Components:

1. Biological Control: Plots of 10 X10 m planted to a resistant variety to yellow and brown rusts, 4 reps with two strips of flowering plants including coriander *(Coriandrum sativum L.)*, dill *(Anethum graveolens L.),* sweet basil *(Ocimum basilicum L.),* ziziphora *(Ziziphora interrupta* Juz.), marigold *(Calendula officinalis L.)* and winter cress (*Barbarea vulgaris)* along side the wheat plots to enhance cereal leaf beetle parasitoids.
2. Cultural practices (planting date, seed rate, fertilizer application, and weed control) will be as recommended in the country.
3. Weed management with cultural practices and application of low toxic herbicides.

This package at these pilot sites will be compared to farmers' practices in the same area.

d. Planting and harvesting time for wheat at this site: Wheat will be planted in October 2010 and harvested in June 2011.

e. Names of the local scientists and collaborators: Dr. Anvar Jalilov and Mr. Tavakal Mirzoev the scientists from Institute of Plant Production "Ziroatparvar" of Tajik Academy of Agricultural Sciences and Mr. Vokhid Nazirov a scientist from Institute of Zoology and Parasitology the Academy of Science of Tajikistan and Students involved in IPM wheat class from the National University of Tajikistan (biology faculty) and Tajik Agrarian University.

Wheat IPM Research in Kyrgyzstan and Uzbekistan

For Wheat IPM research in **Kyrgyzstan**, the project will screen Cereal leaf beetle resistant varieties, and conduct survey of cereal leaf beetle parasitoids at two sites in Kyrgyzstan Sokuluksk district of Jui region, and Isikul region.

For Wheat IPM research in Uzbekistan, the project will evaluate the effects of flowering plants such as coriander, dill*,* sweet basil*,* ziziphora, marigold and winter cress in enhancing Sunn Pest egg parasitoids, and conduct survey of wheat nematodes in Tashkent region and Karakalpak region.

Activity 1.B Potato IPM Research Demonstration Sites in Kyrgyzstan

Site #1: Potato IPM Package for Issyku-Kul Region of Kyrgyzstan

a. Name and Location of this site in Kyrgyzstan: Frunze village, Tupski district of Issyk-Kul region.

b. Key Pest Problems that will be addressed at this site: The IPM package for this site will focus on the Colorado Potato Beetle (*Leptinotarsa decemilineata*) and diseases a late blight of potato *(Phytophthora infestans) and* Potato leafroll viruses M, S, X, and Y. Potato cyst nematodes (*Globodera rostochienses* and *G. pallida*) and root-knot nematodes (*Meloidogyne chitwoodi* and *M. fallax*). The key weeds in potato at this site include: weeds such as swine's-bane *(Chenopodium rubrum L.)* and houndsberry (*Solanum nigrum L.).*

c. IPM Package Components for this site: In this research and demonstration sites we will test the following IPM package components:
   1. To test three potato varieties for resistance to diseases and particularly resistance to late blight of potato (*Phytophthora infestans*); evaluate different potato varieties for resistance to insect pest and nematodes; Evaluate new potato varieties for adaptation to Issyk-Kul region condition.
   2. Biological control of potato spring inoculation of potato seeds and of field soil with Biopesticides such as Thrihodermin, Strepmaitis and Bacilus thurengiensis; Application of immune-response modulating agent as “Baikal” type; Application of “Bacillus subtilis”; Application of “Biolegnin”
   3. Potato Post-Harvest Storage: Identified local traditional knowledge’s on potato post-harvest storage; Application of biological control; Application of botanical pesticides.

d. Planting and harvesting time for potato at this site: The trials consist two parts: The first experiments is storage of potato seeds in October 2010 within testing of Biopesticides such as Thrihodermin, Strepmaitis and Bacilus against of potato disease *Bacterial ring rot and Black scurf of potat;* And second experiment prior to potato seed sowing in the end of April 2011and till of potato harvest in the end of September 2011.

e. Names of the local scientists and collaborators: Dr. Tinatin Doolotkeldieva, local Ph. D students, Saikal Bobysheva and Mahabat Konurbaeva from a Laboratory of Phytopathology and Entomology of Faculty of Agriculture at Kyrgyz-Turkey University name after “Manas”. Mr. Janibai Tumanov, Director of the Kyrgyzstan Central Biolaboratory, Bishakek, Kyrgyzstan.

Site #2: Potato IPM Package for Osh Region of Kyrgyzstan

a. Name and Location of this site in Kyrgyzstan: Uson Kyshnak village, the Osh area of Alaisky region.

b. Key Pest Problems: At this site, the IPM CRSP project will focus on the Colorado Potato Beetle (*Leptinotarsa decemilineata*) and diseases, late blight of potato *(Phytophthora infestans) and* Potato leafroll viruses M, S, X, and Y. Potato cyst nematodes (*Globodera rostochienses* and *G. pallida*) and root-knot nematodes (*Meloidogyne chitwoodi* and *M. fallax*) are also limiting factors. The key weeds in potato at this site include: weeds such as swine's-bane *(Chenopodium rubrum L.)* and houndsberry (*Solanum nigrum L.).*

c. List IPM Package Components for this site (example - Resistant Variety, Cultural Control, Biological Control, etc). In this demonstration sites will test the following IPM package components:

Varieties

1. To test different potato varieties on resistance to diseases and particularly on late blight of potato (*Phytophthora infestans*); To test different potato varieties on resistance to insect pest and nematodes; To test new potato varieties in the Issyk-Kul region condition.
2. Biological control of potato spring inoculation of potato seeds and of field soil with Biopesticides such as Thrihodermin, Strepmaitis and Bacilus thurengiensis; Application of immune-response modulating agent as “Baikal” type; Application of “Bacillus subtilis”; Application of “Biolegnin.”
3. Potato Post-Harvest Storage: Identification of local traditional knowledge’s on potato post-harvest storage for pest control; Application of biological control; Application of botanical pesticides.

d. Planting and harvesting time for potato at this site: The trials consist two parts: The first experiments is storage of potato seeds in October 2010 within testing of Biopesticides such as Thrihodermin, Strepmaitis and Bacilus against of potato disease *Bacterial ring rot and Black scurf of potato;* And second experiment prior to potato seed sowing in the end of April 2011and till of potato harvest in the end of September 2011.

e. Names of the local scientists and institution that will collaborate at this site: Dr. Tinatin Doolotkeldieva, local PhD Students Saikal Bobysheva and Mahabat Konurbaeva from a Laboratory of Phytopathology and Entomology of Faculty of Agriculture at Kyrgyz-Turkey University name after “Manas”. Mr. Talant Joldoshev - specialist from the MSDSP Kyrgyzstan Program of the Aga Khan Foundation.

Activity 1.C Tomato IPM Research Demonstration Sites in Uzbekistan

Site #1: Tomato IPM Package for Greenhouse Farm in Tashkent

a. Name and Location of this site - Farmer, Mr. Tojibaev Jasur, Tashgress area, Kibray District, Tashkent Region 100140, Uzbekistan.

b. Key Pest Problems: Insects: aphids *(Aphis gossypii*, *Myzus persicae* and *Aphis craccivora)*, leaf miner *(Lyriomyza sativa)*, whitefly *(Trialeurodes vaporarium)*; Diseases: *Fusarium oxysporum, Phytophthora infestans;* Weeds: Perennial plants: *Rumex crispus; Taraxacum officinale*.

c. IPM Package Components: Yellow sticky trap, use of microbiological preparations and fertilizers, ecological safety pesticides (fungicides, insecticides and herbicides).

d. Planting and harvesting time of the crop at this site: Planting from September - October and harvesting in May –June.

e. Names of the local scientists and collaborators: Dr. Djumaniyazova Gulnara; Mr. Zaripov Rustam - Institute of Microbiology Academy of science; Mr. Baijanov Bahodir - Research Center "Baykal":

Site # 2: Tomato IPM Package for Greenhouse Farm at the Tashkent Agrarian University in Tashkent

a. Name and Location of this site: Tashkent State Agrarian University, 2 Universitetskaya Str., Kibray district, Tashkent region, 100140, Uzbekistan.

b. Key Pest Problems at this site:
Insects: Leaf miner *(Lyriomyza sativa)*, whitefly*(Trialeurodes vaporarium)*;
Diseases: *Cladosporium fulvum Cooke;*
Weeds: Perennial: Rumex crispus L., Cyperus rotundus L., Convolvulus arvensis

c. List IPM Package Components for each site:Yellow sticky trap, use of microbiological preparations and fertilizers, ecological safety pesticides (fungicides, insecticides and herbicides) and Grafting.

d. Planting and harvesting time for the crop at this site: Planting from September - October 2010 and harvesting in May – June 2011.

e. Names of the local scientists and collaborators:
Dr. Rashidov Murod; Dr. Suleimanov Botir – Biolaboratory Center "Biomarkaz" at Tashkent Agrarian University;
Mr. Pulatov Zarif – Uzbek Research Institute of Plant Protection
Dr. Shukhrat Asatov, Tashkent Agrarian University
Mr. Bakhtiyor Karimov, Tashkent Agrarian University.

Site # 3: Tomato IPM Package for <u>Open Field Culture</u> in Tashkent Region

a. Name and Location of this site: Uzbek Research Institute of Vegetable-Melon Crops and Potato Production, Tashkent region 111172, Uzbekistan

b. Key Pest Problems (insect, diseases, viruses, nematodes, weeds) that will be addressed at this site Insects: White fly *(Trialeurodes vaporarium)*, Fruitworm *(Heliothis armigera)*, Leaf miner (*Lyriomyza sativa),* Russet mite *(Aculops lycopersici);*
Weeds: Annual: *Amaranthus retroflexus L., Amaranthus I., Xanthium strumarium, Setaria veridis, Enchinochloa crus-galli (L.) Et.Sch;* Perennial: *Circium ochrolepidium Juz*. *Plantago major* L;

c. IPM Package Components for each site: Pheromone trap, yellow sticky trap, use of microbiological preparations and fertilizers, ecological safety pesticides (fungicides, insecticides and herbicides).

d. Planting and harvesting time for the crop at this site: Planting from May-June harvesting in July-August-September;

e. Names of the local scientists and collaborators: Dr. Ganiev Farhod - Uzbek Research Institute of Vegetable-Melon Crops and Potato Production; Dr. Djumaniyazova Gulnara and Dr. Zaripov Rustam - Institute of Microbiology Academy of science;

<u>Activity 2: Conduct research on biological control practices/products, cultural control/practices and resistant varieties</u> for wheat, tomato and potato in collaboration with Ministries of Agriculture and local universities.

Participating scientists/institutions: N. Saidov, B. Tashpulatova and M. Aitmatov in collaboration with team members from MSU, UC-Davis, KSU, ICARDA, AVRDC and CIP, local research institutions and local universities. Many of the local scientists involved in the IPM research and demonstration sites will be contribute to the specific research projects.

Expected output: Biological control, host plant resistance and cultural control/practices evaluated for integration in IPM packages.
Time line: October 2010 – September 2011.

Objective 2: Disseminate IPM packages to farmers and end-users through technology transfer and outreach in collaboration with local NGOs and government institutions.

<u>Activity 1: Establish Farmers Field Schools (FFS) at IPM Demonstration sites</u> in each country to transfer knowledge and demonstrate existing and new IPM technologies to local farmers

Participating scientists/institutions: N. Saidov, B. Tashpulatova and M. Aitmatov in collaboration with local agriculture ministries, local NGOs, universities, ICARDA regional program, AVRDC regional program, and U.S. Collaborators. As outlines in the Objective 1, the sites have been selected in each country and plans are being developed for the next planting season. One FFS of 25-30 farmers each will be established at each site/country. These farmers will meet regularly to learn about how to produce a good wheat, potato or tomato crop. They will also learn about the biology of pests, diseases and weeds, and the damage they cause, the economic threshold, natural enemies, and cultural practices, and safe use of pesticides.

Expected output: Farmers Field Schools established at IPM Demonstration sites for wheat, tomato and potato in each of the three countries, and information shared with local farmers and NGOs (20 -30 farmers per FFS).

Timeline: October 2010 – September 2011.

Objective 3: Build institutional capacity through training and human resource development.

Activity 1: Graduate student training in IPM in wheat, tomato and potato: From a pool of 18 potential candidates from Central Asia region, three students (Ms. Shahlo Safarzoda from Tajikistan for Wheat IPM, Mr. Bahodir Eshchanov from Uzbekistan for Tomato IPM, and Mr. Azamat Mamytov from Kyrgyzstan for Potato IPM have been selected for pursuing Ph.D degree programs at MSU with specialization in Wheat IPM, Tomato IPM, and Potato IPM. The program will begin from Fall 2010/Spring 2011. The paper work is in process for obtaining J-1 Visa and the Ph.D students are expected to arrive in the U.S. in October/November 2010.

Participating scientists/institutions: D. Landis, F. Zalom, D. Douches, G. Bird, W. Pett, M. Kennelly, K. Maredia, M. Bohssini, R. Mavlyanova, B. Tashpulatova, N. Saidov, M. Aitmatov, and faculty members of local universities in Central Asia.

Expected output: Ph.D Degree program/training for three students started at MSU. Additional students identified for master degrees training at local universities in each host country.

Timeline: October 2010 – September 2011.

Activity 2: **Pest Diagnostics and Viruses:** In collaboration with two global theme programs, organize a regional training program in Kyrgyzstan in pest diagnostics and viruses for the Central Asia region. The workshop will be hosted at the Plant Protection Department of Kyrgyz-Turkish Manas International University which has excellent laboratory facilities. Given the current political situation in Kyrgyzstan, there is an alternative plan to host the training workshop in Tajikistan. The project will also facilitate participation of scientists from host countries in IPDN's training programs at Ohio State University. In addition, conduct survey of tomatoes and potatoes in Central Asia region (Uzbekistan, Tajikistan and Kyrgyzstan) to identify viruses and virus-like agents, and explore the feasibility of testing potato seed for common viruses, such as PVX, PVS, PVY (and others) in Uzbekistan.

Participating scientists/institutions: T. Doolotkeldieva, N. Saidov, B. Tashpulatova, Zarifa Kodirova, and M. Aitmatov in collaboration with global theme programs in pest diagnostics and viruses (Sally Miller-OSU, N. Rayapati-WSU, Sue Tolin-Virginia Tech).

Expected output: Enhance pest diagnosis skills of local scientists and NGOs, and efficient diagnosis of insect pests, diseases, weeds, nematodes, and viruses in wheat, potato and tomato.

Timeline: January 2011 – September 2011.

Activity 3: Gender Issues in IPM: Addressing gender issues is an important component of the IPM CRSP project. We have identified Ms. Shoira Pahlavonova from Tajikistan to serve as the coordinator of the gender related activities in the region. The gender team will address:

1. The Gender Team will initially focus in Tajikistan:
    a. Create an inventory/directory of gender specialists/outreach workers in IPM CRSP host countries (Tajikistan, Kyrgyzstan and Uzbekistan);
    b. Facilitate research inquiries and information gathering; and
    c. Develop and execute at least 1 gender-related training or workshop
2. Outline opportunities for research on gender in agriculture in consultation with our Gender Coordinator and partners.
3. Visit the wheat IPM demonstration sites in Tajikistan, potato IPM demonstration sites in Kyrgyzstan, and tomato IPM demonstration sites in Uzbekistan. On each visit, meet with women farmers and conduct a Rapid Gender Assessment.
4. Identify and engage student researchers to help evaluate gray literature and to write research reports on gender and agriculture in Central Asia.

Participating Scientists and Collaborators: L. Racioppi, Z. Jamal, M. Elisa Christie and S. Pahlavonova.

Expected Output: Increased awareness on gender issues and gender equity in IPM programs

Time Line: October 2010 to September 2011.

Activity 4: Impact assessment of IPM CRSP project activities in Central Asia: Given the early stages at which the project is on the "research to development" continuum, the impact assessment component of this project will focus on the following activities in FY 2011:

1. Construct impact pathways for research activities on wheat, tomato and potato in the three target countries: The project will organize a focused discussion with each commodity research team to complete a spreadsheet to document the team's actions to generate major outputs, outcomes and realization of the vision of success. The analysis will also capture the projected scale and time dimension for achieving these major milestones along the impact pathway. The construction of these impact

pathways will help identify outputs of this project that have the greatest potential for achieving 'developmental impacts' as defined by adoption and scalability. This information will help guide the scope of the baseline surveys also planned in FY 2011.

2. Conduct baseline assessment: In coordination with the Impact Assessment Global theme, the component PIs will follow a standard set of steps to help assess the economic impacts of major outputs (as identified from the impact pathway analysis) to be generated by this regional project. The first step towards this analysis includes conducting baseline surveys to assess the status of wheat, potato and tomato sectors in three target countries Tajikistan, Kyrgyzstan and Uzbekistan. The size, scale and scope of the survey will be a function of the potential adoption sites and resources available. The baseline data to be collected will include: a) data on input, output, and price; b) crop management practices (including the use of biological, cultural, chemical, etc.) and their associated costs; c) farm household characteristics and demographic data; d) farmer perspective on potential constraints to adoption of IPM technologies; e) gender role in the cropping systems of focused commodities.

If additional resources are made available, baseline data (primary and secondary) will be also collected to help assess broader impacts on poverty, nutrition, health, risk, and the environment. Qualitative assessments using participatory appraisals and focus groups will also be used in collaboration with the Gender global theme to identify potential gender impacts.

Collaborating Scientists and Institutions: R. Bernsten and M. Maredia, Michigan State University; Host Country PIs (B. Tashpulatova, M. Aitmatov, and N. Saidov) and other U.S. and host country collaborators.

Expected Outputs: 1)A report on the impact pathway analysis; 2) Data and preliminary analysis of the baseline assessment.

Start and end-date: October 1, 2010 to September 30, 2011.

Activity 5: Participation of two local scientists from host countries in International IPM short courses organized by MSU and ICARDA.

Participating scientists and institutions: Scientists and NGO representatives from Central Asia, MSU and ICARDA.

Expected output: Increased knowledge in ecologically-based IPM.

Timeline: January 2011 – September 2011.

Activity 6: Organize local workshops and training programs for trainers and farmers on scouting and monitoring for key pests and diseases in wheat, tomato and potatoes during the growing season.

Participating scientists/institutions: local NGOs, Government institutions, IPM CRSP team

Expected output: At least 50 farmers and 5 trainers trained in pest scouting and monitoring.

Timeline: October 2010 – September 2011.

Objective 4: Enhance communication, networking and linkages with U.S. institutions, international agricultural research centers, and IPM CRSP regional and global theme programs to access IPM technologies, information and expertise.

Activity 1: Participation in International Meetings and workshops: Facilitate participation of IPM CRSP coordinators and local scientists from host countries to interact with IPM CRSP Regional Programs and other international meetings and workshops.

Participating scientists and institutions: N. Saidov, B. Tashpulatova and M. Aitmatov

Expected output: Enhanced linkages and collaborations with IPM CRSP regional programs, and other international programs.

Timeline: October 2010 – September 2011.

Objective 5: Create a "Central Asia IPM Knowledge Network" encompassing a cadre of trained IPM specialists, students, IPM packages, information base, and institutional linkages.

Activity 1: Update, expand and enhance the website of the Central Asia regional IPM program in collaboration with project team members. Use social networking and other means to publicize on-going activities of the project.

Participating scientists/institutions: J. Landis, MSU.

Expected output: Enhanced communication with stakeholders, expanded access to resources and knowledge developed in other activities, greater publicity for IPM CRSP project impacts.

Timeline: October 2010 – September 2011.

Activity 2: Development of field guides/manuals, booklets and/or modules on IPM in wheat, tomato and potato.

Participating scientists and institutions: N. Saidov, B. Tashpulatova and M. Aitmatov in collaboration with local Agriculture Ministries, local NGOs, ICARDA regional program, and other regional programs of the IPM CRSP.

Expected output: Field guides/ booklets published and disseminated.

Timeline: October 2010 – September 2011.

Activity 3: Booklet and poster on tomato grafting

Participating scientists and institutions: Uzbek Research Institute of Plant Industry (UzRIPI), Tashkent State Agrarian University (TSAU), AVRDC/World Vegetable Center

Expected output: A booklet and poster on tomato grafting will be published in English and Russian (or appropriate local language).

Timeline: October 2010 – March 2011.

Activity 4: Flyers on IPM Packages for Wheat, Tomato and Potato

Participating scientists and institutions: J. Landis and Project Team (U.S. and Central Asia Collaborators).

Expected output: Three flyers will be published and posted on the IPM CRSP website, and distributed to stakeholders.

Timeline: October 2010 – September 2011.

Activity 5: Publications from phase I Accomplishments

Participating scientists and institutions: K. Maredia, U.S. and Central Asia collaborators.

Expected output: A Review Paper covering accomplishment of Phase I (2005- 2009) to increase the awareness of the work done in Central Asia.

Timeline: October 2010 – March 2011.

Activity 6: Prepare and Display Project Poster

Participating scientists and institutions: J. Landis and U.S. and Central Asia collaborators.

Expected output: A poster highlighting the Central Asia Regional IPM Program activities for display at workshops and conferences in Central Asia region and internationally.

Timeline: October 2010 – September 2011.

Abating the Weed Parthenium (*Parthenium hysterophorus* L.) Damage in Eastern Africa Using Integrated Cultural and Biological Control Measures

PI: *Wondi Mersie, Virginia State University*
Co PIs: *Jenipher Bisikwa (Makerere University - Uganda), Krissie Clarke (PAMS Foundation - Tanzania), Emily Wabuyele (East African Herbarium - Kenya), Kassahun Zewdie (Ethiopian Institute of Agricultural Research (EIAR)), Yeshi Chiche (EIAR), Sintu Alemayehu (EIAR), Lisanework Nigatu (Haramaya University (HU) - Ethiopia), Ibrahim Fitawe (Mekelle University (MU) – Ethiopia), Steve Adkins (University of Queensland - Australia), Lorraine Strathie (Agricultural Research Council – Plant Protection Research Institute (ARC-PPRI) South Africa), Andrew McConnachie (ARC-PPRI - South Africa).*

Description of the project:
Parthenium **(***Parthenium hysterophorus*), a native plant of tropical and sub-tropical South and North America adversely affects food security, biodiversity and human, as well as livestock health, in Eastern Africa. In Eastern Africa, parthenium reduces the yield of many major crops such as sorghum, corn, competes with preferred pasture species and, when consumed by domestic animals, taints their milk and meat, reducing their value. It also causes human health problems such as severe contact dermatitis and respiratory problems. In addition, because of its ability to release toxic chemicals, parthenium replaces natural vegetation and is thus a threat to one of the world's richest region of biodiversity, Eastern Africa. Despite its aggressiveness, parthenium is successfully managed in Australia and India using biological agents such as insects, pathogens and competitive smother plant species. The goal of this project is to develop an integrated weed management system that reduces the adverse impact of parthenium on humans, crops, livestock and plant biodiversity in the East African region.

Objective – I: To collect accurate information on the distribution and spread of parthenium in Kenya, Tanzania and Uganda with follow-up surveys in Ethiopia.

Description: Surveys of parthenium will be conducted in Kenya, Tanzania and Uganda, annually at least for two consecutive years.

Activity - 1: Survey the distribution of parthenium in Kenya, Tanzania and Uganda.

Task- 1 – Conduct survey, compile, analyze, and present data at the annual meeting in Kenya on November 2010.

Countries: Kenya, Tanzania and Uganda.

Status: continuing

Scientists involved: Jenipher Bisikwa (Makerere University - Uganda), Krissie Clarke (PAMS Foundation - Tanzania), Emily Wabuyele (East African Herbarium - Kenya).

Description: The distribution of parthenium in Eastern Africa is not clearly determined. This activity will attempt to answer the following question. How extensive is the spread of parthenium in Kenya, Tanzania and Uganda? Initially, participating countries will enter all known parthenium localities into a spreadsheet. The spreadsheet will be sent to Kenya. Locality data from the spreadsheets will be plotted using the program Mapviewer 7. A baseline map of known distribution will be generated for each of the

participating countries. The climatic modeling program CLIMEX will be used to generate predictive maps of areas in each of the participating countries that are most climatically suitable for parthenium to occur. CLIMEX is a multiparameter, dynamic simulation model, which, in addition to using temperature parameters, also includes humidity and precipitation to estimate potential distributions of animals and plants. The known distribution of parthenium will be overlaid on the CLIMEX predictive outputs in order to generate a list of localities for researchers in each country to survey for parthenium. Surveys will be conducted along road networks in quarter degree squares (QDS) (25 km x 25 km) immediately surrounding baseline localities and areas which were predicted by the CLIMEX model to be suitable for the growth of parthenium. The surveys will be conducted during a 2-3 week period at the end of the summer growth season. In QDS where parthenium was observed and had not been previously recorded, the following data will be recorded: date, geographical coordinates, altitude, locality name, description of infestation with regard to land use. The abundance of parthenium at each site will be recorded as either low (1 plant/m^2), medium (2-3 plants/m^2) or high (>3 plants/m^2). Locality data will be plotted using the mapping programme MAPViewer 7.

Progress to date: Parthenium survey is underway in Kenya, Tanzania and Uganda.

Expected outputs: Preliminary information on the distribution of parthenium in participating countries becomes available.

Budget : $40,151.

Objective- II: To evaluate and demonstrate best management practices for the control of parthenium.

Description: Parthenium is a major problem in pasture lands in Ethiopia and Uganda. Cultural practices that can suppress the growth of parthenium are needed to improve the productivity of desirable pasture species for livestock.

Activity 1: Evaluate native forage species for their ability to suppress parthenium.

Task – 1: Set up greenhouse and field trials to evaluate the performance of various grass and legume species against parthenium.

Country(ies) – Ethiopia and Uganda.

Status: Continuing.

Scientists involved: Lisanework Nigatu and Jenipher Bisikwa.

Description: Experiments on the effectiveness of various native plants and cultural methods against parthenium will be conducted in Ethiopia and Uganda. First fodder species (grasses and legumes) will be evaluated for their competitive ability against parthenium in greenhouse trials. The most promising plant species from the above experiments will be further studied in field plots for their ability to suppress parthenium.

Progress to date: Forage species have been planted. Data will be collected in the coming months.

Expected outputs: Forage species that can suppress parthenium identified.

Budget: $27,263.

Objective- III: To evaluate parthenium biocontrol agents for their safety to non-target plant species.

Description: Evaluation of the biocontrol agents will be conducted under quarantine condition to determine their impact on major crops of the region, as well as on selected indigenous plants closely related to parthenium. The centrifugal phylogenetic method will be followed in selecting test plants for testing candidate control agents. Due attention will be given to indigenous genera and species of the tribe Helianthieae, with utmost attention being given to the endemic and cultivated taxa based on their affinity to *Parthenium hysterophorus* and having similar distribution and ecological preferences with the weed.

Activity – 1: Objective III: Improve/update quarantine facility.

Country(ies): Ethiopia.

Status: Continuing.

Scientists involved: Sintu Alemayehu, Kassahun Zewdie and Million Abebe

Description: Further improvements to the existing facility are needed to enable scientists to quarantine multiple biocontrol agents and evaluate their safety on major crops and selected native plants before applying for permission to release. The facility can be used to evaluate biological agents of other weeds or pests in the future.

Progress to date: Improvements have been made by installing new benches, cages and increasing the area. But these improvements will continue to optimize conditions for bioagents and ensure facility maintains established quarantine standards.

Expected outputs: Increased and improved capacity to assess and introduce biological control agents in Ethiopia.

Task – 1: Develop specific tasks and hire a contractor to make the improvements.

Budget: $22,404.

Activity 2, Objective III: Conduct host range test of the stem-boring weevil *Listronotus setosipennis* under quarantine. Hosts include major crops, and native plants taxonomically related to parthenium.

Country: Ethiopia.

Status: Continuing.

Scientists involved: Sintu Alemayehu, Kassahun Zewide and Million Abebe

Description: Evaluation of the host range of listronotus will start with no-choice tests (test plant species only), followed by choice tests (with parthenium) for those plant species where there is feeding, oviposition or development on non-target species. All non-target plant species tested will have approximately similar above-ground biomass (leaves, stems) as control plants. Each group of test plants evaluated at one time will include control plants (parthenium). Each plant species tested will be replicated at least three times. Variables measured will include oviposition, feeding, development and survival of listronotus.

Progress to date: The host range test for listronotus is underway in the quarantine facility.

Expected outputs: Information on the safety, establishment and effectiveness of biocontrol agents for parthenium management becomes available.

Task – 2: Culture listronotus and assess damage to the test plants and look for any oviposition by the bioagent.

Budget: $42, 4204.

Objective - IV: To release and evaluate the impact of approved bicontrol agents for the control of parthenium.

Description: Once the agents have been proven suitable for release in Ethiopia, based on the quarantine evaluation (objective 3), application permits for their release will be compiled. Data generated in objective 3 and relevant information from Australia, South Africa and other countries on the host range evaluation of parthenium biocontrol agents will be included in the applications. Permit applications to release biocontrol agents will be made first to the Ethiopian government and then to USAID. Once the appropriate permits have been received, the biocontrol agents will be taken out of the quarantine facilities to mass rearing sites. They will then be released to parthenium infested areas.

Activity – 1: Apply to USAID for a permit to mass rear and release the leaf-feeding beetle, *Zygogramma bicolorata,* for the control of parthenium.

Country: Ethiopia.

Status: New.

Scientists involved: Wondi Mersie and Million Abebe.

Description: Permit from USAID is needed before Zygogramma is reared and released in fields to control parthenium.

Progress to date: Application for permit has been submitted to USAID.

Expected outputs: Permission to release Zygogramma in Ethiopia is granted by USAID.

Task – 1: Prepare Initial Environmental Examination; advertise to obtain public comment in Ethiopia.

Budget: $4,282.

Activity- 2: Establish rearing sites and train personnel on culturing biocontrol agents, collection of baseline and impact data.

Country: Ethiopia.

Status: New.

Scientists involved: Sintu Alemayehu, Kassahun Zewide, Million Abebe, Lisanework Nigatu and Wondi Mersie.

Description: Establishment and training of personnel in rearing and evaluating the performance of bioagents will begin immediately after the receipt of release permit from USAID.

Progress to date: Three potential sites for the rearing of bioagents have been identified.

Expected outputs: Biocontrol agents are reared in mass and released in parthenium infested areas of Ethiopia.

Task – 1: Survey sites for rearing.

Budget: $12,282.

Graduate Students and Post Doctoral Research Associates:

Under recruitment - 3

Short-Term Training planned

Annual meeting - 1

Publications planned:

Research articles - 2
Posters - 4
Proceedings of parthenium workshop - 1
Others – reprint and distribute parthenium ID and posters on the impact of parthenium on human health.
Abstracts- 6

Travel Matrix:

Trip No.	Number of Individuals	Destination Country(ies)	Duration	Function (Site planning, workshop, symposium etc)
1	14	Kenya	7 days each	Workshop and annual meeting
2	3	Ethiopia	15 days each	Site planning
3	2	South Africa	15 days	Training

Performance Indicators for Monitoring and Evaluation:

ID	Description	Completion Date	Responsible Individual
Activity – 1 Obej. I	Survey the distribution of parthenium in Kenya, Tanzania and Uganda	09-30-12	Jenipher Bisikwa, Krissie Clarke, Emily Wabuyele
Task - 1	Conduct survey, compile, analyze, and interpret first year parthenium survey data	09-30-11	Jenipher Bisikwa, Krissie Clarke, Emily Wabuyele
Activity – 1 Obej. II	Evaluate native forage species for their ability to suppress parthenium	09-30-12	Lisanework Nigatu Jenipher Bisikwa,
Task – 1	Set up greenhouse and field trials to evaluate the performance of various grass and legume species against parthenium	09-30-12	Lisanework Nigatu Jenipher Bisikwa,

Activity – 1 Obej. III	Improve/update quarantine facility	09-30-11	Sintu Alemayehu Kassahun Zewdie
Task 1	Develop specific tasks and hire a contractor start making the improvements	09-30-11	Sintu Alemayehu Kassahun Zewdie
Activity – 2 Obej. III	Conduct host range test of the stem-boring weevil *Listronotus setosipennis* under quarantine	09-30-11	Sintu Alemayehu Kassahun Zewdie Million Abebe
Task 2	Culture listronotus and assess damage to the test plants and look for any oviposition by the bioagent.	09-30-11	Sintue Alemayehu Kassahun Zewdie Million Abebe
Activity -1 Obej. IV	Apply to USAID for a permit to release the leaf-feeding beetle, *Zygogramma bicolorata* against parthenium	11-30-10	Wondi Mersie
Task 1	Prepare Initial Environmental Examination; advertize to obtain public comment in Ethiopia	08-31-10	Wondi Mersie Million Abebe
Activity -2 Objec. IV	Establish rearing sites and train personnel	09-30-14	Sintu Alemayehu Kassahun Zewdie Million Abebe Wondi Mersie
Task 1	Survey sites for rearing bioagents and select specific sites	09-30-14	Sintu Alemayehu Kassahun Zewdie Million Abebe Wondi Mersie Lisanework Nigatu

The International Plant Diagnostic Network: Gateway to IPM Implementation and Enhanced Trade

PI: *Sally Miller, Ohio State University*

Objective 1. Assess diagnostic capacity.

Activity 1A. Survey professionals involved in plant disease and pest diagnostics for infrastructural and human capacity to perform critical functions.

Tasks

1. Complete collection of survey data for professionals newly recruited into the IPDN.
    a. Develop list of diagnosticians in Nepal and conduct survey of diagnostic capacity (joint with South Asia RP)
2. Analyze survey data (new and with previously collected) and prepare publication.
3. Administer a follow-up survey for professionals working in labs already part of the network to both assess capacity and gauge adoption of the DDIS-CIMS and other IPDN Phase I products.

Objective 2. Expand networks and implement digital diagnostics

Activity 2A. Expand the network in the IPDN regions (East and West Africa, Central America and Asia) to include additional laboratories in participating countries and new laboratories in new countries.

Tasks

1. Recruit additional laboratories that should be included in the IPDN, including key university labs, NPPO labs and private operations.
    a. Latin America-Caribbean: work to integrate Ecuador into IPDN (joint with LAC RP)
    b. Establish a disease and pest diagnostic network in Bangladesh, India and Nepal (joint with South Asia RP)
2. Expand list of subject matter experts and add to DDIS-CIMS system.
    a. Develop plant pathology and entomology expert list for Nepal
3. Train new participants in DDIS-CIMS at workshops (see below).
4. Meet goal of 25 digital samples per region through DDIS in Year 2; 100 digital samples for South Asia.
5. Assess use of DDIS-CIMS in each region, including number of samples entered (CIMS), number of digital samples, number of physical samples, and number of labs using DDIS.

Activity 2B. Expand lists of subject matter experts.

Tasks

1. Expand list of experts at the Year 2 training programs (see below).

2. Contact key individuals (pathogen and pest experts) in each cooperating country and elsewhere. Complete a spreadsheet indicating areas (s) of expertise for those willing to serve and post on the DDIS-CIMS web portal (access limited to IPDN members). This task will be continued in Year 2.

Objective 3. Prioritize crops, pathogens and pests.

Activity 3A. Identify priority crops, pests and pathogens to provide focus for IPDN efforts

Tasks

1. Complete prioritization of crops in Bangladesh and Nepal.
2. Build consensus within the networks in each region as to identified priorities, and post priorities on DDIS-CIMS web portal.

Activity 3B. Workshop to integrate virus diagnostics into the IPDN framework in East Africa (Joint with IPM CRSP E. A. RP and IPVD Global Theme Program)

Task

1. Refine workplans for IPDN and Virus Global Themes for remainder of project, with emphasis on: going from diagnostics to management protocols; developing disease ID, diagnostic, and management training programs for extension agents and growers; integrating low-cost disease diagnostics by cell phone. **Secondary objectives**: 1) Create roadmap for developing: (i) virus and other disease diagnostic tools and priorities for tomato and passion fruit; (ii) SOPs on viruses and major plant diseases; (iii) PRAs on vectors, viruses, and other plant diseases; (iv) for passion fruit specifically, SOPs and PRAs on major diseases and insects; develop management protocols; 2) Set date/plan for regional training program in virus diagnostics Year 3.

Objective 4. Develop diagnostic assays and protocols.

Activity 4A. Prioritize needed diagnostic protocols, assays, etc.

Task

1. Work with IPVD to identify and test virus diagnostic protocols.
2. Develop pictorial guides to diagnosis of target pathogens in priority crops.
3. Work with Regional Programs to identify needed diagnostic assays and begin implementation of protocols if available.
    a. LAC – establish cultural, serological and/or molecular protocols as appropriate for detection of *Clavibacter* (tomato bacterial canker/potato ring rot) and *Phytophthora* spp. Collaborate with IPVD in evaluation of tests for detection of Liberibacter in psyllids (vectors) and plants.

Objective 5. Report new diseases and pests and develop incidence maps.

Activity 5A. Prioritize pathogens or pests to be surveyed/mapped.

Tasks

1. Continue prioritization in cooperation with host country NPPOs, APHIS and IPM CRSP RPs (and IPVD for viruses).
2. South Asia: Perform joint surveys and document the pest species (insects, disease pathogens and nematodes) attacking selected vegetable crops with diagnostic characteristics in India, Nepal and Bangladesh.
    a. Document the pest species (insects, disease pathogens and nematodes) attacking selected vegetable crops with diagnostic characteristics.
3. West Africa: Document disease and insect pest problems as part of production surveys being conducted by the WA RP for potatoes and cabbage (Mali and Senegal), and tomatoes (Mali, Senegal and Ghana).
4. Search for additional funds to support surveys.

Activity 5B. Support identification/reports of new diseases and pests.

Task

1. Provide supplies and technical advice to support host country researchers in identifying and reporting invasive species. Provide funds for page charges.

Objective 6. Develop Standard Operating Procedures (SOPs).

Activity 6A. Complete SOPs for at least five pathogen or pest targets

Tasks

1. Confirm pest/pathogen/priority crop lists in each region.
2. Recruit small working groups to write SOPs
3. Complete one SOP per region; post on DDIS-CIMS web portal.
4. (Kenya, Joint with E.A. RP) Use information collated on the diagnostic techniques/tools available for major diseases of **tomato and passion fruit**, along with the identified knowledge gaps to develop SOPs). Potentially useful tools/techniques will be incorporated into draft SOPs, which will then be discussed and refined in a workshop.

Technology Transfer and Training Objectives

Objective 7. Write IPM recommendations

Activity 7A. Access pest management solutions developed for key crops by the six RPs and write recommendations in digital and hard copy formats that will accompany diagnoses.

Tasks

1. Write one recommendation in the appropriate format per target crop (up to three crops) in each region, with cooperation of RPs.

2. (East Africa) Explore opportunities for use of SMS technology in diagnostics and preparation of disease or pest incidence maps (IITA project).
3. (South Asia) Prepare incidence map for *Paracoccus* and tospoviruses in Tamil Nadu.

Objective 8. Train pathologists and entomologists in targeted methodologies or pathogen or pest identification.

Activity 8. Conduct hands-on professional diagnostic training programs in West Africa, Central America, and Central Asia.

Task

1. (Regional coordinators) Organize the training programs, recruit local resource persons, provide supplies, equipment and reference materials, and identify participants. Coordinate with IPVD for training in all regions.
    a. LAC – current priorities for training are bacterial pathogens, e.g. *Ralstonia* and *Clavibacter*; seedborne diseases, *Fusarium* race identification.
    b. West Africa – collaborate with IPVD to conduct training program in Ghana (target March or April 2011). Focus on diseases and pests of West Africa RP target crops. Prioritize pests/pathogens and develop focused workshop.
    c. Central Asia – collaborate with the IPDV and the Central Asia RP to conduct a training program in Kyrgystan (Turkish-Kyrgysh University in Bishkek or other suitable venue) or other Central Asian country on one or more plant pathogens or pests as prioritized by the Central Asia RP. Focus will be on selected pests and pathogens of tomato (bacterial pathogens and viruses), potato (clean seed and Colorado Potato Beetle), and wheat (rust).

2. (OSU and participating US Institutions): Seek outside source(s) of funding to support the training programs.

Objective 9. Train key host country scientists from RPs in classical and modern diagnostics.

Activity 9. Select individuals for host countries in each region to attend OSU short course.

Task (optional)

1. Identify individual for training; arrange additional (up to one month) in OSU or other diagnostic laboratory.

Objective 10. Develop and hold web-based training programs (e.g. Webinars)

Activity 10. Conduct one hr webinars on prioritized subjects.

Task

1. Identify subjects for 1-3 diagnostics webinars.

   Suggested subject matter: Seed borne diseases, seed pathology, *Clavibacter* identification, *Fusarium* races, Phytoplasma diseases, *Liberobacter* epidemiology, vectors, mealybug identification, and identification of sucking pests in vegetables, tomato viruses, and eggplant fruit and shot borer.

2. (OSU) Complete training in GoToMeeeting or similar program for conducting webinars.

3. Recruit experts to present webinars.

4. Advertise webinars throughout regions through IPDN and IPM CRSP.

Objective 11. Develop and hold Train-the-Trainer programs.

Activity 11A. Training farmers and extension staff on diagnosis and management of common diseases of tomato and passion fruit (East Africa and South Asia).

Tasks

1. Identify farmers and agricultural extension staff during field visits and trial establishment by the regional project team.

2. (Kenya, joint with E.A. Regional Project)- Train individuals identified in Task 1 on the diagnosis of the main diseases affecting tomato and passion fruit in their localities. This will take the form of on-farm sessions and a joint workshop to systematically train them on the steps in diagnosis and management of the diseases. The tasks will be coupled with analysis of diseased samples obtained from farm sites hosting the regional project trials.

3. (South Asia) - Train individuals identified in Task 1 on the diagnosis of the main diseases affecting eggplant, okra and tomato and cucurbits.

Activity 11B. Train extension workers from different regions in pest and disease diagnosis and IPM (India, joint with South Asia RP)

Tasks

1. Identify extension functionaries for target regions.
2. Prepare materials on diagnostics for priority crops.
3. Conduct training.

Short-Term Training planned

	US co-PIs	**SA**	**SEA**	**CA**	**LAC**	**EA**	**WA**
Workshops	2				1		1
Seminars/webinars	1	1				1	
Field days							
Mass media events							
Annual meetings	2	1			1	1	1
Train-the-trainers programs		1				1	
OSU Diagnostics Short Course	1						

Publications planned:

Research articles/notes	4
Books and book chapters	
Extension articles	12
Posters	3
Bulletins	
Website contributions	4

Travel Matrix:

Trip No.	Number of Individuals	Destination Country(ies)	Duration	Function (Site planning, workshop, symposium etc)
1	10	Guatemala		Planning, Research
2	25	Guatemala		Workshop
3	25	Honduras		Workshop
4	5	India		Planning, research
5	5	Bangladesh		Planning, research
6	5	Nepal		Planning, research
10	25	Uzbekistan		Workshop
11	25	Tajikistan		Workshop
12	25	Kyrgyzstan		Workshop
13	5	Mali		Planning, research
14	5	Senegal		Planning, research
15	5	Ghana		Planning, research
16	25	Ghana		Workshop
17	5	Uganda		Planning, research
18	5	Nigeria		Planning, research
19	5	Tanzania		Planning, research
20	5	Kenya		Planning, research
21	5	U.S.A.		Attend OSU Diagnostics Short Course
22	10	U.S.A.		Symposium in Hawaii, site planning

Performance Indicators for Monitoring and Evaluation:

Tasks	ID	Description	Completion Date	Responsible Individual (s)
	Objective 1	Document virus and vector prevalence through surveys, and investigate associated biology and ecology in cropping systems		
	Activity 1	Document and compile viruses in priority crops		
1	Task 1	Survey for viruses in West Africa	Ongoing	Gilbertson
2	Task 2	Survey peppers and tomatoes in several countries and regions	Ongoing	All co-PIs

3	Task 3	Initiate collaborations with scientists in East Africa, mainly Uganda, and plan for surveys and research on virus diseases of pepper, tomato and passion fruit.	2011	Deom, Gilbertson
	Activity 2	Develop diagnostic methods and capacity for detecting sweetpotato and potato viruses and virus-like agents.		
4	Task 1	In Honduras, begin to establish a center for production of virus-free sweetpotato germplasm	2011	Brown
5	Task 2	Develop diagnostic tests for Liberibacter using PCR for detection in plants and psyllid vectors	2011	Brown
6	Task 3	Develop a membrane-based hybridization test for detection of Liberibacter in psyllids.	2011	Brown
7	Task 4	Explore the feasibility of testing potato seed for common viruses, as PVX, PVS, PVY in Uzbekistan	2011	Rayapati and Kodirova
	Activity 3	Conduct research on biology and ecology of clusters of viruses relative to their means of survival and dissemination in cropping systems.		
8	Task 1	Etiology of tomato and pepper begomovirus diseases in various countries	Ongoing	All co-PIs
9	Task 2	Ecology of the chocolate spot disease of tomato, virus-vector interactions, vector confirmation.	Ongoing	Brown
10	Task 3	Etiology and ecology of RNA viruses	Ongoing	Tolin, Deom, others
11	Task 4	Virus (es) associated with necrosis diseases of tomato	2011	Rayapati, others
12	Task 5	Complete studies on TSV seed transmission in okra in India	2011	Rayapati and Karthikeyan
13	Task 6	Document virus(es) associated with mosaic disease in yard-long bean in Indonesia	2011	Rayapati, Damayanti, and Hadayat

14	Task 7	Begin documentation of viruses in tomato and potato in Central Asian countries, beginning in Uzbekistan	2011	Rayapati and Kodirova
15	Task 8	Conduct epidemiological research on a vector-borne, virus-like pathogen, the causal agent of zebra chip of potato and vein-greening of tomato and pepper.	2011	Brown
	Objective 2	Develop long-term institutional capacity building and conduct scientist training in host countries for detection and diagnosis of plant virus (and virus-like) diseases, in screening and monitoring for resistance, and in ecological research of virus-vector-host interactions in selected vegetable cropping systems.		
	Activity 1	Assess virus detection and diagnosis capacity, and vector expertise, in regions and host countries.		
16	Task 1	Complete identification of scientists and institutions in host countries as collaborators.	2011	Tolin, all co-PIs
17	Task 2	Assess needs and appraise capability and constraints for virus research, particularly in countries of the Asian regions, in cooperation with the IPDN-GT.	Ongoing	Tolin, all co-PIs
18	Task 3	Summarize virus diagnostic capability surveys from in previous phase and expand to new host country participants, in collaboration with IPDN-GT.	Complete partially in 2011	Tolin, all co-PIs
19	Task 4	Work with IPDN GT to integrate virus diagnostics into the EA-RP program, and plan for a workshop in March or April 2011. Plan for workshops in WA and SEA in later years.	Complete partially in 2011	Tolin, Gilbertson, Deom, Rayapati
20	Task 5	Identify level of expertise in host countries for conducting lab and field research (ecological, vector, resistance, impact) on virus diseases.	Ongoing	All co-PIs
	Activity 2	Conduct training of host country scientists to enhance ability to recognize virus disease by visual symptoms, apply appropriate diagnostic assays, associate disease incidence with vector biology and virus-vector interactions, and predict intervention approaches from virus ecology.		

21	Task 1	Conduct workshops within host countries and regions. In year 2 (November 2010), hold a Virus-Vector Workshop in Honduras	2011	Rivera, Brown, Tolin, Gilbertson
22	Task 2	Prioritize short-term and long-term training needs and activities.	2011	All co-PIs
23	Task 3	Conduct short-term training	Ongoing	All co-PIs
24	Task 4	Conduct long-term graduate student training	Ongoing	All co-PIs
	Objective 3	In cooperation with regional projects, design and implement applied research on specific virus diseases in selected crops in order to develop or improve IPM packages that employ results obtained in Objectives 1 and 2.		
	Activity 1	Conduct applied research for IPM packages that include devising best management practices to manage virus diseases, and assessment of impact, as indicated in region and country work plans.		
	Activity 1a	Monitoring the host-free period for tomato virus management		
25	Task 1	Maintain and if necessary modify the successful TYLCV IPM program in the Dominican Republic.	Ongoing	Gilbertson, Martinez
26	Task 2	Continue to work to establish IPM programs for insect-transmitted viruses in tomato in Guatemala.	Continuing	Palmeiri, Brown, Gilbertson
27	Task 3	Expand the tomato IPM program for whitefly-transmitted viruses to other parts of West Africa.	Continuing	Gilbertson
	Activity 1b	Management of necrotic viral diseases in tomato through clean seedling production, roguing, and variety selection.		
28	Task 1	Conduct roguing trials in three locations in Tamil Nadu during the main cropping season and gather yield data	2012	Rayapati and Karthikeyan
29	Task 2	Conduct field trials in three locations in Tamil Nadu to evaluate 25 tomato varieties and hybrids and gather yield data.	2011	Rayapati and Karthikeyan

30	Task 3	Develop a list of nurseries in major tomato-growing areas of Tamil Nadu and document methods of raising tomato seedlings (open field vs. shade house), and assess relative risk level for early infection of plants with PBNV in selected nurseries.	2011	Rayapati and Karthikeyan
31	Task 4	Compare marketable quality of tomato fruits produced by healthy and PBNV-infected tomato.	2011	Rayapati and Karthikeyan
	Activity 1c	Epidemiology of psyllid vector/Liberobacter and whitefly vector/virus in potato and other crops to design management practices.		
32	Task 1	Determine psyllid and whitefly dispersal and transmission times by yellow sticky trap catches	Beginning	Brown, Palmeiri, Melgar, Rivera
33	Task 2	Recommend targeted insecticide use to avoid continuous sprays by farmers.	Continuing	Brown, Melgar, Rivera
	Activity 2	Conduct trials to evaluate germplasm for resistance to viruses.		
33	Task 1	Conduct germplasm field testing within the solanaceous crop cluster (pepper, potato, tomato) in Honduras	Begin in 2011	Rivera, Brown
35	Task 2	Evaluate commercial and noncommercial seed having resistance to potyviruses to begin determining the efficacy of the resistant germplasm.	Begin in 2011	Deom, Tolin, Rayapati, several regions
36	Task 3	Evaluate TYLCV resistant tomato in WA	Ongoing	Gilbertson
	Activity 3	Participation of host country scientists in workshops and field days to transfer virus management technologies to farmers as part of an IPM package		
37	Task 1	Conduct one field day and two seminars on vegetable IPM in Tamil Nadu for farmers and nurseries	2011	Rayapati and Karthikeyan
38	Task 2	Develop a plan for inclusion of virus disease management as part of IPM field days	2011	All co-PIs, host country scientists

International Plant Virus Disease Network

PI: *Sue Tolin, Virginia Tech*

Description of the project:
Plant virus diseases transmitted by insect vectors and through seed or germplasm continue to be one of the major constraints on vegetable production in the tropics. These diseases present numerous challenges for detection and diagnosis, understanding pathogen biology, and management. This relates to the difficulty of identifying specific viruses based on symptomatology, the complexity of virus biology in the field and natural ecosystems, their effective dissemination by vectors (e.g. aphids, thrips and whiteflies) and the lack of chemical controls for viral diseases.

Activities are new or continuing from year 1. The total budget is $150,000, 68% of which is distributed to five US institutions (7.6% indirect to VT; 26% to collaborating institution), and 24.4% to host countries. All Regional projects are to designate $10,000 to PVD-related activities, most of which is assigned to host countries.

Objective 1: Document the prevalence of the most economically important plant virus diseases and their vectors in the region of interest through surveys, and investigate the associated biology and ecology with a cropping systems perspective.

Description: In all sub-program regions of the PVD global theme, we will use available diagnostic assays and develop new assays, to determine the identity of the virus-vector-crop complexes in high priority cropping systems being studied in regional programs. Host country scientists will be integral to the surveys and where possible, laboratory capacity and expertise will be developed in country. Results will be essential to understand ecological, biological, and economic factors that could be used to abate losses in vegetable agroecosystems to viruses.

Expected Outputs:

1. Organized information packages for viruses of tomato, of pepper (including chillies and hot peppers), and other priority crops according to interests of regions and host countries.
2. Organized information packages for aphid, thrips, and whitefly-transmitted viruses.
3. Organized information packages for seed and propagule-borne viruses, providing host country scientists and organizations the scientific basis to produce and certify virus-free potato, sweetpotato and traditional seed for disease management.

Activity 1: For priority crops selected by host countries and regions, compile information on virus diseases known to be prevalent or of potential importance, or documented in surveys conducted by this project or by regional projects.

Task 1: Survey for viruses in West Africa. Status: Continuing. Scientists involved: R. L. Gilbertson, T. Kon (UC-D), I. Kollo (Ghana), M. Noussourou, K. Gamby (Mali), M. Osei, S. Diao (Senegal).

Description and progress to date: This work involves conducting surveys of vegetable production areas in West Africa, collecting samples of plants with virus-like symptoms. The samples are tested for various viruses using PCR and other methods. Two surveys of peppers and other crops (okra) have been conducted in Mali and viruses infecting pepper, okra and other crops identified.

Task 2: Survey of peppers and tomatoes in several countries and regions to identify viruses and virus-like agents.

Status: Continuing.

Scientists involved: M. Palmieri (Guatemala), Mauricio Rivera (FHIA, Honduras), J. K. Brown (UAZ); R. L. Gilbertson, T. Kon, T. Melgarejo (UC-D), N.A. Rayapati (WSU), G. Karthikeyan (India), A. Muquit (Bangladesh), T.A. Damayanti and S. H. Hidayat (Indonesia), C. Cheythyrith (Cambodia), Z. Kodirova (Uzbekistan).

Regions/Country(ies): South Asia (Bangladesh, India), Southeast Asia (Indonesia and Cambodia), Central Asia (Uzbekistan), LAC (Dominican Republic, Guatemala, Honduras, Peru)

Description and progress: This work involves continuing to survey and identify viruses and virus-like agents infecting peppers and tomatoes in countries in Asia, Central America and the Caribbean, with an emphasis on begomoviruses. In Honduras potyvirus and closterovirus positive samples of sweet potato have been documented, but the source of these viruses -- introduced in planting material or by in-field transmission – is not yet known. Potato has been confirmed positive for *Ca*. Liberibacter solanacearum infection. A survey of tomato and pepper was conducted in Guatemala and a survey of tomato conducted in Peru. A begomovirus infecting Jatropha in the Dominican Republic is being characterized to see if this crop is a reservoir for viruses of tomato. A begomovirus causing tomato leaf curl in Bangladesh is being characterized. In Guatemala (Del Valle-Palmieri; UA Brown) surveys are underway to identify begomoviruses in wild hosts that are important in virus spread and management in tomato and pepper crops. PCR primers and a positive control have been provided to Guatemala for Liberibacter detection in plants. TYLCV-specific primers and positive control (cloned fragment) have been supplied and is in use in Honduras (M.M. Roca, ZAMORANO) and Guatemala (Palmieri, Del Valle). Surveys are underway in Asian countries in collaboration with host country scientists for aphid-, whitefly- and thrips-transmitted viruses (Rayapati).

Task 3. Initiate collaborations with scientists in East Africa and plan for surveys and research on virus diseases of pepper, tomato and passion fruit. (Deom, Gilbertson, host country scientists associated with EA-RP, IPDN)
Status: New

Activity 2. Develop diagnostic methods and capacity for detecting sweetpotato and potato viruses and virus-like agents.

Description: This work is to develop diagnostic assays for viruses frequently carried in vegetative seed of sweetpotato and potato, and to propagate and distribute virus-tested seed to farmers. Diagnostics tests will consist of PCR, RT-PCR, and dot blot assay with non-radioactive probes will be developed and employed. In addition serological assays already available commercially will be employed and tested in relation to nucleic acid methods.

Expected outputs: Management of virus diseases of sweetpotato and potato through reduction of viruses in seed pieces, enabling production of a local supply of clean seed.

Tasks:

1. In Honduras, begin to establish a center for production of virus-free sweetpotato germplasm , involving tissue culture, acquisition of positive controls, and design and testing of primers for PCR and RT-PCR. (Brown, Rivera , LAC RP)
2. Develop diagnostic tests for virus-like agents such as Liberibacter using PCR for detection in plants and psyllid vectors (Honduras – Rivera, Brown, others; Guatemala – Palmieri, Brown, LAC-RP).
3. Develop a membrane-based hybridization test for detection of Liberibacter in psyllids.(Brown. LAC-RP)
4. Explore the feasibility of testing potato seed for common viruses, as PVX, PVS, PVY in Uzbekistan (Kodirova, Rayapati, CA-RP) and Mali (various scientists, Gilbertson, WA-RP)

Activity 3: Conduct research on biology and ecology of clusters of viruses relative to their means of survival and dissemination in cropping systems.

Expected outputs: Improved understanding of the etiology and biology of these diseases, improved diagnostics and understanding of disease epidemiology.

Task 1. Etiology of tomato and pepper begomovirus diseases in various countries.
Status: Continuing. Scientists involved: Many.
Sub-Tasks:

1a. Pepper yellow vein disease in Mali. (Gilbertson/Kon, UCD; WA-RP)
1b. Tomato begomovirus diseases in Guatemala. (Gilbertson/Kon, UCD; Palmieri, Brown, LAC)
1c. Tomato and pepper viruses in Dominican Republic (Tolin, Deom, Brown, Gilbertson, Martinez)
1d. Tomato and pepper viruses in Honduras (Brown, Tolin, Rivera, Roca)
1e. Sweetpotato viruses in Honduras (Brown, Rivera)

Task 2: Ecology of the chocolate spot disease of tomato, virus-vector interactions, and vector confirmation. (Guatemala – Palmieri, Brown, student trainee)
Task 3. Etiology and ecology of RNA viruses, primarily Potyviruses, Tobamoviruses and Cucumoviruses (CMV) in pepper – incidence, ecology, etc. (LAC-RP Dominican Republic, WA-RP Mali, SEA-RP Indonesia, Cambodia; SA-RP India, Bangladesh).
Task 4. Verify and document the identity of virus (es) associated with necrosis diseases of tomato.
Status: Continuing. Scientists Involved: Karthikeyan (India) and Rayapati, WSU.

Task 5. Complete studies on TSV seed transmission in okra in India. (Karthikeyan and Rayapati)
Task 6. Document and molecularly characterize virus(es) associated with mosaic disease in yard-long bean in Indonesia. Rayapati, WSU; Sri Hendrastuti Hidayat and Tri Asmira Damayanti ,BAU, Indonesia.
Task 7. Begin documentation of viruses in tomato and potato in Central Asian countries, beginning in Uzbekistan. (Kodirova; Rayapati)

Task 8. Conduct epidemiological research on a vector-borne, virus-like pathogen, the causal agent of zebra chip of potato and vein-greening of tomato and pepper. (Brown, U AZ; FHIA, UVG)

Objective 2: Develop long-term institutional capacity building and conduct scientist training in host countries for detection and diagnosis of plant virus (and virus-like) diseases, in screening and monitoring for resistance, and in ecological research of virus-vector-host interactions in selected vegetable cropping systems.

Activity 1: Assess virus detection and diagnosis capacity, and vector expertise, in regions and host countries.

Description: This activity was begun in the last phase under the two previous global theme projects on viruses, and collaborated with the IPDN Global Theme. Countries in the Asia regions were not included in the last IPDN.

Progress to date: Tolin and Gilbertson participated in the IPDN-GT planning meeting in March 2010 in Guatemala. Rayapati and Tolin designed and delivered a workshop on virus diagnostics and management in India in July 2010 for the three Asian regions. Brown participated in a regional training workshop on Liberibacter solanacearum in potato and tomato in Honduras in August 2010 (85 attendees; local and USDA co-sponsors with IPM CRSP).

Expected outputs: The result of this objective will be enhanced institutional capacity to enable timely diagnosis of viral disease problems, and monitoring tools for conducting research on viruses in specific cropping systems.

Tasks

1. Complete identification of scientists and institutions in host countries as collaborators.
2. Assess needs and appraise capability and constraints for virus research, particularly in countries of the Asian regions, in cooperation with the IPDN-GT.
3. Summarize virus diagnostic capability surveys from in previous phase and expand to new host country participants, in collaboration with IPDN-GT.
4. Work with IPDN GT to integrate virus diagnostics into the East Africa-RP program, and plan for a workshop in Year 3. Plan for joint workshops in Year 2 in Central Asia and in West Africa, tentatively March or April 2011. Plan for a SEA workshop in later years.
5. Identify level of expertise in host countries for conducting lab and field research (ecological, vector, resistance, impact) on virus diseases.

Activity 2: Conduct training of host country scientists to enhance ability to recognize virus disease by visual symptoms, apply appropriate diagnostic assays, associate disease incidence with vector biology and virus-vector interactions, and predict intervention approaches from virus ecology.

Progress to date: We organized a workshop and planning meeting for Asian regions (South Asia, Southeast Asia and Central Asia) to develop linkages and assess the current research and need for capacity building activities. Host country scientists were exposed to various aspects of viruses, their spread and management, as well as recognition of field symptoms and diagnosis by lab-based methods like TBIA, ELISA and PCR techniques.

Tasks

1. Conduct workshops within host countries and regions. In year 2 (November 2010), hold a Virus-Vector Workshop in Honduras (Rivera, Melgar, Roca, Brown, Gilbertson, Tolin, LAC- RP).
2. Prioritize short-term and long-term training needs and activities.
3. Conduct short-term training.
4. Conduct long-term graduate student training.

Objective 3: **In cooperation with regional projects, design and implement applied research on specific virus diseases in selected crops in order to develop or improve IPM packages that employ results obtained in Objectives 1 and 2.**

Description: The aim of this objective is to develop IPM strategic packages that minimize yield loss caused by plant viruses and virus-vector complexes, or by seed-borne viruses, to improve farm income and sustainability using knowledge gained in Objective 2 activities. These projects will be designed and performed in cooperation with Regional Projects, using funding they allocate to host countries. Training host country scientists in the conducting field research to observe successes and validate results will be implicit in all activities. Impact of IPM packages measured by yield changes, economic impact of virus infection, and adoption of IPM packages by farmers will be done in association with RP and Impact Assessment Global Theme projects in the respective host countries or regions. Guidance documents will be developed on protocols for screening germplasm for resistance to virus, selecting and maintaining virus-free seeds and seedlings, and will be provided to in-country collaborators and other entities, including private seed companies.

Activity 1. Conduct applied research for IPM packages that include devising best management practices to manage virus diseases, and assessment of impact, as indicated in region and country work plans.

Activity 1a– *Monitoring the host-free period for tomato virus management*

Regions/Country(ies): LAC (Dominican Republic, Guatemala); WA (Mali, Ghana, Senegal)

Status: Continuing Scientists involved: A. Almanzar, T. Martinez, M. Palmieri , I. Kollo, M. Noussourou, K. Gamby, M. Osei, S. Diao and R. Gilbertson.

Tasks

1. Maintain and if necessary modify the successful TYLCV IPM program in the Dominican Republic. *Description and progress*: We continue to monitor whiteflies on a monthly basis using PCR and TYLCV primers to assess the build-up of TYLCV in the Dominican Republic and the effect of the host-free period. We are receiving and processing the whitefly samples from the Dominican Republic as part of the IPM project. We are also characterizing some TYLCV strains from the Dominican Republic that are suspected of infecting TYLCV-resistant varieties.

2. Continue to work to establish IPM programs for insect-transmitted viruses in tomato in Guatemala. In Guatemala, we continue to work toward the implementation of the tomato IPM package for whitefly-transmitted begomoviruses. The general package has been developed, the challenge now is implementation.

3. Expand the tomato IPM program for whitefly-transmitted viruses to other parts of West Africa.
   Description and Progress: Continue to develop and extend the IPM program for whitefly-transmitted viruses to other areas in Mali and to Ghana and Senegal. This will include implementation of the host-free period, use of improved varieties and regional sanitation. The IPM program has been successfully implemented in Baguineda Mali and is being evaluated in Kati. We are in the process of expanding it to other areas in Mali and to Ghana and Senegal.

Activity 1b*. Management of necrotic viral diseases in tomato through clean seedling production, roguing, and variety selection.*

Regions/Country(ies): South Asia (India); Scientists involved: G. Karthikeyan, Naidu Rayapati

Expected outputs:

Information on roguing for reducing Peanut bud necrosis virus (PBNV) spread made available.
Information on field response of tomato varieties and hybrids against PBNV made available.

Tasks

1. Conduct roguing trials in three locations in Tamil Nadu during the main cropping season and gather yield data.
2. Conduct field trials in three locations in Tamil Nadu to evaluate 25 tomato varieties and hybrids and gather yield data.
3. Develop a list of nurseries in major tomato-growing areas of Tamil Nadu and document methods of raising tomato seedlings (open field vs. shade house), and assess relative risk level for early infection of plants with PBNV in selected nurseries.
4. Compare marketable quality of tomato fruits produced by healthy and PBNV-infected tomato.

Activity 1c. Epidemiology of psyllid vector/Liberobacter and whitefly vector/virus in potato and other crops to design management practices. (Honduras, Guatemala – Brown, Rivera?)

Description and expected outputs: Viable detection methods will be used to monitor *Ca.* Liberibacter in psyllids trapped or collected in study fields to determine the percentage of the psyllid population harboring the bacterial pathogen of zebra chip and tomato/pepper veinal greening diseases. . Management will rely on epidemiological information and vector dynamics gained from surveys of study fields and insect vector populations conducted throughout the growing season and intervening timeframe.
Task 1. Determine psyllid dispersal and transmission times by yellow sticky trap catches.

Task 2. Recommend targeted insecticide use to avoid continuous sprays by farmers.

Activity 2. Conduct trials to evaluate germplasm for resistance to viruses.

Tasks

1. Conduct germplasm field testing within the solanaceous crop cluster (pepper, potato, tomato) in Honduras (Rivera. LAC-RP).

2. Evaluate commercial and noncommercial seed having resistance to potyviruses to begin determining the efficacy of the resistant germplasm. (Martinez, Deom, LAC-RP).
3. Evaluate TYLCV resistant tomato in WA (Mali).

Activity 3. Participation of host country scientists in workshops and field days to transfer virus management technologies to farmers as part of an IPM package.

Task 1. Conduct one field day and two seminars on vegetable IPM in Tamil Nadu for farmers and nurseries

Regions/Country(ies): South Asia (India) Status: New

Scientists involved: G. Karthikeyan, S. Manoranjitham, N. Balakrishnan, N. Rayapati

Progress to date:
Field studies were conducted during previous phase on roguing as a practical approach for minimizing the spread of Peanut bud necrosis virus (PBNV) in tomato. This approach has been accepted in the 'Scientific Workers Conference' of the Tamil Nadu Agricultural University for adoption and dissemination. This information need to be shared with farmers to promote rouging as a tactic for the management of PBNV. In addition, field trials were carried out to evaluate response of tomato varieties and cultivars to PBNV. This information needs to be shared with farmers to encourage them grow agronomically acceptable varieties and/or hybrids that are least susceptible to PBNV. Knowledge about PBNV infection in seedlings at nurseries needs to be disseminated to stakeholders for the supply of 'clean' seedling s to farmers.
Task 2. Develop a plan for inclusion of virus disease management as part of IPM field days. (Host country scientists)

Graduate Students and Post Doctoral Research Associates:

Name: Tomas Melgarejo
Sex: Male
Nationality: Peruvian
Discipline: Virology
Site/Country: Guatemala/Dominican Republic
Degree: Ph.D.
Start date: Sept 30, 2009
Completion date: August 31, 2013
IPM CRSP funds: partial + Fulbright Fellowship
Advisor/PI: R. Gilbertson
Thesis topic: Virus characterization, detection and management of a tomato-infecting begomovirus from Peru and a Jatropha-infecting begomovirus from the Dominican Republic.
University: University of California - Davis

Name: Sudarsana Poojari
Sex: Male
Nationality: Indian
Discipline: Virology

Site/Country: USA
Degree; PhD
Start date: Spring 2009
Completion date: Spring 2013
IPM CRSP funds: Partial
Advisor/PI: Naidu Rayapati
Thesis topic: TBD
University: Washington State University

Name: Olufemi J. Alabi
Sex: Male
Nationality: Nigeria
Discipline: Virology
Site/Country: USA
Degree; Post-doc
Start date: Not applicable
Completion date: Not applicable
IPM CRSP funds: Partial
Advisor/PI: Naidu Rayapati
Thesis topic: Not applicable
University: Washington State University

Short-Term Training planned

Training of a scientist from IDIAF in Dominican Republic in Univ del Valle laboratory in Guatemala.

	US co-PIs	**SA**	**SEA**	**CA**	**LAC**	**EA**	**WA**
Workshops:	1				1	1	
Seminars:	5						
Field days:	1	1	1	1	3		2
Mass media events	0						
Annual meetings	5				1		
Others							

Publications planned:

Research articles	3
Books and book chapters	
Extension articles	2
Posters	5
Bulletins	
Others	5

Travel Matrix:

Trip No.	Number of Individuals	Destination Country(ies)	Duration	Function (Site planning, workshop, symposium etc)
1	8	Dominican Republic		Global theme planning
2	1	Ecuador		
3	5	Guatemala		
4	10	Honduras		Workshop
5	5	India		Planning, research
6	2	Bangladesh		
7	2	Nepal		
8	5	Indonesia		Planning, research
9	2	Cambodia		
10	2	Philippines		
11	2	Uzbekistan		Planning, research
12	1	Tajikistan		
13	0	Kyrgyzstan		
14	8	Mali		Planning in West Africa
15	2	Senegal		
16	2	Ghana		
17	8	Uganda		Planning in East Africa
18	2	Tanzania		
19	2	Kenya		
20	15	U. S. A.		Symposium in Hawaii, site planning

Performance Indicators for Monitoring and Evaluation:

Tasks	ID	Description	Completion Date	Responsible Individual (s)
	Objective 1	Document virus and vector prevalence through surveys, and investigate associated biology and ecology in cropping systems		
	Activity 1	Document and compile viruses in priority crops		
1	Task 1	Survey for viruses in West Africa	Ongoing	Gilbertson
2	Task 2	Survey peppers and tomatoes in several countries and regions	Ongoing	All co-PIs
3	Task 3	Initiate collaborations with scientists in East Africa, mainly Uganda, and plan for surveys and research on virus diseases of pepper, tomato and passion fruit.	2011	Deom, Gilbertson
	Activity 2	Develop diagnostic methods and capacity for detecting sweetpotato and potato viruses and virus-like agents.		
4	Task 1	In Honduras, begin to establish a center for production of virus-free sweetpotato germplasm	2011	Brown

5	Task 2	Develop diagnostic tests for Liberibacter using PCR for detection in plants and psyllid vectors	2011	Brown
6	Task 3	Develop a membrane-based hybridization test for detection of Liberibacter in psyllids.	2011	Brown
7	Task 4	Explore the feasibility of testing potato seed for common viruses, as PVX, PVS, PVY in Uzbekistan	2011	Rayapati and Kodirova
	Activity 3	Conduct research on biology and ecology of clusters of viruses relative to their means of survival and dissemination in cropping systems.		
8	Task 1	Etiology of tomato and pepper begomovirus diseases in various countries	Ongoing	All co-PIs
9	Task 2	Ecology of the chocolate spot disease of tomato, virus-vector interactions, vector confirmation.	Ongoing	Brown
10	Task 3	Etiology and ecology of RNA viruses	Ongoing	Tolin, Deom, others
11	Task 4	Virus (es) associated with necrosis diseases of tomato	2011	Rayapati, others
12	Task 5	Complete studies on TSV seed transmission in okra in India	2011	Rayapati and Karthikeyan
13	Task 6	Document virus(es) associated with mosaic disease in yard-long bean in Indonesia	2011	Rayapati, Damayanti, and Hadayat
14	Task 7	Begin documentation of viruses in tomato and potato in Central Asian countries, beginning in Uzbekistan	2011	Rayapati and Kodirova
15	Task 8	Conduct epidemiological research on a vector-borne, virus-like pathogen, the causal agent of zebra chip of potato and vein-greening of tomato and pepper.	2011	Brown
	Objective 2	Develop long-term institutional capacity building and conduct scientist training in host countries for detection and diagnosis of plant virus (and virus-like) diseases, in screening and monitoring for resistance, and in ecological research of virus-vector-host interactions in selected vegetable cropping systems.		
	Activity 1	Assess virus detection and diagnosis capacity, and vector expertise, in regions and host countries.		
16	Task 1	Complete identification of scientists and institutions in host countries as collaborators.	2011	Tolin, all co-PIs
17	Task 2	Assess needs and appraise capability and constraints for virus research, particularly in countries of the Asian regions, in cooperation with the IPDN-GT.	Ongoing	Tolin, all co-PIs

18	Task 3	Summarize virus diagnostic capability surveys from in previous phase and expand to new host country participants, in collaboration with IPDN-GT.	Complete partially in 2011	Tolin, all co-PIs
19	Task 4	Work with IPDN GT to integrate virus diagnostics into the East Africa-RP program, and plan for a workshop in Year 3. Plan for joint workshops in Year 2 in Central Asia and in West Africa, tentatively March or April 2011. Plan for a SEA workshop in later years.	Complete partially in 2011	Tolin, Gilbertson, Deom, Rayapati
20	Task 5	Identify level of expertise in host countries for conducting lab and field research (ecological, vector, resistance, impact) on virus diseases.	Ongoing	All co-PIs
	Activity 2	Conduct training of host country scientists to enhance ability to recognize virus disease by visual symptoms, apply appropriate diagnostic assays, associate disease incidence with vector biology and virus-vector interactions, and predict intervention approaches from virus ecology.		
21	Task 1	Conduct workshops within host countries and regions. In year 2 (November 2010), hold a Virus-Vector Workshop in Honduras	2011	Rivera, Brown, Tolin, Gilbertson
22	Task 2	Prioritize short-term and long-term training needs and activities.	2011	All co-PIs
23	Task 3	Conduct short-term training	Ongoing	All co-PIs
24	Task 4	Conduct long-term graduate student training	Ongoing	All co-PIs
	Objective 3	In cooperation with regional projects, design and implement applied research on specific virus diseases in selected crops in order to develop or improve IPM packages that employ results obtained in Objectives 1 and 2.		
	Activity 1	Conduct applied research for IPM packages that include devising best management practices to manage virus diseases, and assessment of impact, as indicated in region and country work plans.		
	Activity 1a	Monitoring the host-free period for tomato virus management		
25	Task 1	Maintain and if necessary modify the successful TYLCV IPM program in the Dominican Republic.	Ongoing	Gilbertson, Martinez
26	Task 2	Continue to work to establish IPM programs for insect-transmitted viruses in tomato in Guatemala.	Continuing	Palmeiri, Brown, Gilbertson
27	Task 3	Expand the tomato IPM program for whitefly-transmitted viruses to other parts of West Africa.	Continuing	Gilbertson

	Activity 1b	Management of necrotic viral diseases in tomato through clean seedling production, roguing, and variety selection.		
28	Task 1	Conduct roguing trials in three locations in Tamil Nadu during the main cropping season and gather yield data	2012	Rayapati and Karthikeyan
29	Task 2	Conduct field trials in three locations in Tamil Nadu to evaluate 25 tomato varieties and hybrids and gather yield data.	2011	Rayapati and Karthikeyan
30	Task 3	Develop a list of nurseries in major tomato-growing areas of Tamil Nadu and document methods of raising tomato seedlings (open field vs. shade house), and assess relative risk level for early infection of plants with PBNV in selected nurseries.	2011	Rayapati and Karthikeyan
31	Task 4	Compare marketable quality of tomato fruits produced by healthy and PBNV-infected tomato.	2011	Rayapati and Karthikeyan
	Activity 1c	Epidemiology of psyllid vector/Liberobacter and whitefly vector/virus in potato and other crops to design management practices.		
32	Task 1	Determine psyllid and whitefly dispersal and transmission times by yellow sticky trap catches	Beginning	Brown, Palmeiri, Melgar, Rivera
33	Task 2	Recommend targeted insecticide use to avoid continuous sprays by farmers.	Continuing	Brown, Melgar, Rivera
	Activity 2	Conduct trials to evaluate germplasm for resistance to viruses.		
33	Task 1	Conduct germplasm field testing within the solanaceous crop cluster (pepper, potato, tomato) in Honduras	Begin in 2011	Rivera, Brown
35	Task 2	Evaluate commercial and noncommercial seed having resistance to potyviruses to begin determining the efficacy of the resistant germplasm.	Begin in 2011	Deom, Tolin, Rayapati, several regions
36	Task 3	Evaluate TYLCV resistant tomato in WA	Ongoing	Gilbertson
	Activity 3	Participation of host country scientists in workshops and field days to transfer virus management technologies to farmers as part of an IPM package		
37	Task 1	Conduct one field day and two seminars on vegetable IPM in Tamil Nadu for farmers and nurseries	2011	Rayapati and Karthikeyan
38	Task 2	Develop a plan for inclusion of virus disease management as part of IPM field days	2011	All co-PIs, host country scientists

IPM Impact Assessment for the IPM CRSP

PI: *George Norton*
Co PIs: *Jeffrey Alwang and Daniel Taylor*

Brief description of the project: This global theme project provides leadership and coordination on impact assessment for each regional IPM program on the IPM CRSP. It uses a common set of methods for impact assessment of IPM packages in the regional programs to assess economic and environmental impacts of the IPM practices and packages developed and extended on the IPM CRSP. It also conducts specialized in-depth assessments of poverty, environmental, and nutritional impacts of IPM packages. It builds institutional capacity in IPM impact assessment among regional and national partners. It coordinates with IPM programs at IARCs and with other USAID-supported agriculture and natural resource management programs. It also disseminates impact assessment methods beyond the CRSP.

Objective - 1: Apply Common Set of methods for Impact Assessment

Description: A common set of methods will be used that will link data, methods, and impacts at different geographic scales and types of outcomes. For example, costs and yield data at the plot or field level will be combined with data on prices, quantities, IPM adoption rates, and other factors in models that produce indicators of impacts on income for every regional package, and on poverty, nutrition, and environmental improvement for selected IPM packages

Activity - 1: Work with regional programs to complete surveys and summarize the data in reports

Regions/Country(ies): Bangladesh, India, Uganda, Ecuador, Indonesia, Dominican Republic

Status: Continuing

Scientists involved: Norton, Alwang, Taylor

Description: Some surveys were initiated in year 1, others will be started in year 2. One survey completed in a prior year was analyzed. In each case, the data will be summarized in reports.
Progress to date: Surveys in Bangladesh, India, and Ecuador were begun and others such as the Dominican Republic and Uganda are planned. Mali and Senegal have been completed, and the data analyzed.

Expected outputs: Reports with baseline data on adoption of IPM practices disaggregated by gender, perceptions of pest problems, etc

Task – 1: Finish surveys in Bangladesh, India and summarize results in reports
Task – 2: Prepare report out of Ecuador survey
Task – 3: Conduct surveys in Indonesia, Uganda, and the Dominican Republic and summarize results in reports.
Task – 4: Plan surveys in other IPM CRSP countries for Year 3

Budget: $10,000

Activity 2: Short term training on impact assessment

Regions/Countries: Uganda, Tanzania, Kenya, Dominican Republic

Status: Continuing

Scientists involved: Taylor, Norton

Description: Conduct an impact assessment workshop in East Africa that was postponed from year 1 and short term training at Virginia Tech for an economist from the Dominican Republic.
Progress to date: Meetings were held on impact assessment with economists in Bangladesh, Nepal, India, Honduras, Ecuador, Uganda, and the Dominican Republic in collaboration with regional planning meetings.

Expected outputs: Increased understanding by host country scientists of impact assessment methods

Task – 1: Prepare workshop materials, organize and conduct Uganda workshop.
Task – 2: Organize and complete three-week training for economist from the DR at Virginia Tech.
Task – 3: Provide training materials to economists in regional programs so they can conduct their impact assessment workshops in other host countries.

Budget: 12,000

Objective – 2: Specialized in-depth Impact Assessments of Poverty, Environmental, Nutritional, and Other Impacts

Description: These studies are conducted for regional IPM programs as part of theses and dissertations to assess variety of impacts such as poverty impacts, general equilibrium effects, intra-household impacts, the value of impacts on institutional changes, and more detailed health, environmental, gender, and nutritional impacts.

Activity - 1: Manuscript preparation out of West Africa tomato IPM impact assessment
Regions/Countries: Mali, Senegal and complete simple impact analyses for at least 2 other IPM CRSP technologies that have been adopted.

Status: Continuing

Scientists involved: Norton, Alwang

Description: Working with Theo Nouhoheflin from the West African site who completed his masters thesis in Summer 2010, and with Don Mullins form the regional program, we will prepare and submit a manuscript to a journal on the impacts of the host free period in tomato in Mali and other IPM practices in Mali and Senegal. Economic surplus analysis completed for two technologies already adopted and manuscripts prepared.

Progress to date: Masters thesis completed with data from 600 households in Mali and Senegal.

Expected outputs: Journal article submitted and accepted for publication from tomato work in West Africa

Task – 1: Prepare manuscript and submit from West Africa tomato work
Task – 2: Complete analysis and prepare manuscript for at least 2 other technologies already released on the IPM CRSP

Budget: 7,000

Activity 2: Assessment of optimal mix of IPM dissemination approaches

Regions/Countries: Bangladesh and Nepal

Status: Continuing

Scientists involved: Norton, Alwang, Taylor

Description: M.S. Graduate (Leah Harris) completing thesis that assesses the effectiveness and optimal mix of funding for a set of dissemination approaches for specific types of IPM practices.

Progress to date: Ms. Harris has planned her approach to the analysis and collected information for her thesis in Bangladesh and Nepal.

Expected outputs: Masters thesis; modeling approach for assessing optimal dissemination approaches for different types of IPM practices.

Task – 1: Analyze data collected from the countries in an economic model for Bangladesh.
Task – 2: Conduct qualitative analysis for Nepal
Task – 3: Prepare and defend thesis

Budget: 36,000

Graduate Students and Post Doctoral Research Associates:

1. Name: Leah Harris
Sex: Female
Nationality: USA
Discipline: Agricultural Economics
Site/Country: Bangladesh and Nepal
Degree: Masters
Start date: August 16, 2009
Completion date: August 1, 2011
IPM CRSP funds: 33%
Advisor/PI: George Norton
Thesis topic: Developing a cost-effective IPM dissemination strategy: An example from Bangladesh and Nepal
University: Virginia Tech

2. Name: To be selected in August
Sex: Female or male
Nationality: U.S.A.
Discipline: Agricultural Economics
Site/Country:
Degree: Masters
Start date: August, 2010
Completion date: August, 2012
IPM CRSP funds: 100%
Advisor/PI: George Norton
Thesis topic:
University: Virginia Tech

Short-Term Training planned

Workshops: East Africa
Annual meetings: South Asia, Latin America, East Africa
Others: Individual short term training for person from Dominican Republic in US.

Publications planned:

Research articles: 2
Books and book chapters: 1
Extension articles:
Posters: 1
Bulletins
Others: 2 impact assessment briefs

Travel Matrix:

Trip No.	Number of Individuals	Destination Country(ies)	Duration	Function (Site planning, workshop, symposium etc)
1	2	Uganda, Mali, Tanzania	1 week and 4 weeks	Impact workshop and participating in site planning and review
2	1	DR, Guatemala, Honduras, Ecuador	1 week each country	Participating in site planning, reviewing progress on baselines
3	1	India, Bangladesh, Nepal	1 week each	Participating in site planning, reviewing progress on baselines
4	1	U.S (from Dominican Republic)	3 weeks	Short term training on impact assessment methods

*Proposed dates may change depending on changing circumstances

Performance Indicators for Monitoring and Evaluation:

ID	Description	Completion Date	Responsible Individual
Obj1: Activity - 1	Baseline surveys completed in target countries	Sept 2011	Norton
Task - 1	Bangladesh & India survey reports complete	Sept 2011	Norton
Task - 2	Ecuador survey report complete	Sept 2011	Alwang

Task - 3	Surveys in the DR and Uganda Complete	Sept 2011	Norton and Taylor
Activity - 2	Short term training	Sept 2011	
Task – 1	Uganda workshop	June 2011	Norton and Taylor
Task – 2	D.R. economist trained	April 2011	Norton
Task - 3	Training materials sent to regional program economists	Sept 2011	Norton
Obj 2: Activity - 1	West Africa tomato manuscript sent to journal and other papers prepared	Sept 2011	Norton
Task - 1	Tomato manuscript sent to journal	January 2011	Norton
Task - 2	Analyses completed and manuscripts prepared for two additional IPM technologies	Sept 2011	Norton
Activity 2	Optimal mix of dissemination approaches	Sept 2011	Norton and Harris
Task -1	Analyze data from Bangladesh	January 2011	Harris and Norton
Task - 2	Qualitative analysis of Nepal data	Feb 2011	Harris and Norton
Task 3	Prepare and defend thesis	July 2011	Harris and Norton

Gender Equity, Knowledge, and Capacity Building

PI: *Maria Elisa Christie, Virginia Tech*

First the US-managed objectives are listed, followed by regional workplans. Objective 1 is not listed independently for RPs, as all will be completing activities listed under US managed objective, listed immediately below.

Overall Goal: Increase gender equity and broaden impacts of IPM CRSP

Objective 1: Gender equity: Increasing participation of and benefits to women

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location (Country)	Date
1	Include gender experts and persons with responsibility for gender on team to increase capacity to integrate gender.	RP: name and CV of regional gender coordinator and gender team contact information GGT PI: Compile on-line gender directory	RP PI & GGT PI	Compile on-line gender directory	All	ongoing
2	Prepare workplan for year three to mainstream gender activities. Include monitoring and evaluation plan and reporting system.	RP: Program-specific and qualitative indicators; opportunities for impact identified; participation strategies incorporated GGT PI: Provide guidance with reporting format; compile CRSP-wide report	GGT PI; for RP Gender Coordinators: C Asia: Racioppi and Jamal SE Asia: Lestari S. Asia: Uma LAC: Cruz W Africa: TBD E Africa: Mangheni	Provide guidance with GGT workplan for RPs and compile CRSP-wide GGT workplan.	All	July 2011
3	Prepare gender components of the annual report for Regional Program.	Gender components included in annual report	RP Gender Coordinators as above	N/A	RPs	September 2011

4	Prepare GGT annual report to be submitted to GGT PI using GGT format and indicator chart.	GGT specific annual report	RP Gender Coordinators as above	Compile information for GGT annual report	USA	September 2011

Objective 2: Capacity building: Empowering teams to integrate gender

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Women-only trainings, women-led trainings, working with women's organizations and other participation strategies to include more women and address their priorities.	GGT indicator chart included in GGT annual report. List of trainings in annual reports should include gender of facilitator/trainer.	RP Gender Coordinators	Focus group activities linked to research below	Mali, Uganda, Kenya, Dominican Republic, Cambodia, Nepal, India
2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	RP: Gender workshop (in second country if a workshop was carried out in FY 1) GGT PI: Planning and guidance documents	RP with GGT PI support DR: Cuevas Kenya: Mangheni Cambodia: Sitha	Support regional workshops	Dominican Republic, Kenya, Cambodia

3	Provide 1 teaching module with PowerPoint presentation from written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing Identify and post key articles on agriculture and gender.	1 teaching module with PowerPoint presentation per region Create Scholar site with key resources (articles and others)	GGT PI & RP Gender Coordinators	1. Teaching module from Ecuador. 2. Compile 6 and place on-line. 3. Key articles posted on Scholar	USA
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university, progress and research abstract in report.	GGT PI Bangladesh: Karim and Huq Hussein Indonesia: Puspitawati Cambodia: Sitha Uganda: Mangheni	Theses: Megan Byrne (VT), Tahera Sultana & Umme Habiba (University of Dhaka), Cambodia TBD, Indonesia TBD, Uganda TBD	USA, Ecuador, Bangladesh, Cambodia, Indonesia, Uganda

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Student research	Research proposal, field report or thesis	GGT PI Bangladesh: Karim and Shahnaz; Indonesia: Puspitawati; Cambodia: Sitha; Uganda: Mangheni	3 Masters Theses, 3 research abstracts, 2 pesticide articles (English & Spanish)	USA, Bangladesh, Cambodia, Indonesia, Uganda
2	Analysis of sex-disaggregated data from baseline survey.	Article for regional publication	RP Gender Coordinators	Megan for Ecuador	USA, Ecuador

3	Collect and analyze gray literature for specific research topic identified in FY 1 case study.	Literature review of unpublished reports (governmental, NGO, etc.) in country or region from previous research identified	RP Gender Coordinators	N/A	
4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	RP: Revised case study report for publishing as research note on IPM CRSP website and for local publication GGT PI: Case studies online Cross-cutting research article use of 4 Gender Dimensions framework in IPM research	RP & GGT PI	1. Case studies online 2. Cross-cutting research article use of 4 Gender Dimensions framework in IPM research 3. Second article based on case studies for value chain analysis and/or kitchenspace	All & USA
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	RP Gender Coordinators; Puspitawati; GGT PI and student Megan Byrne	2 presentations at Women in International Development discussion series at VT; presentation at the Annual Conference of the Association of American Geographers (AAG); other presentation in region	USA Indonesia Ecuador
6	Survey of impacts of gender workshop	Monitoring and evaluation of workshops carried out in FY 1 and 2; report and draft article	GTT Pi with Regional Program Gender Coordinators	Answer survey questions	Ecuador, Mali, Uganda, Indonesia, Central Asia, India, Dominican Republic, Kenya, Cambodia

Work Plan: Year 2 (October 1, 2010-September 30, 2011)

Latin America & the Caribbean

Objective 2: Capacity building: Empowering teams to integrate gender

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Women-only trainings, women-led trainings, working with women's organizations and other participation strategies to include more women and address their priorities.	GGT indicator chart included in GGT annual report. List of trainings in annual reports should include gender of facilitator/trainer.	Cuevas	Conduct training sessions on symptoms recognition of pests and diseases under protected crops lead by women in San Josè de Ocoa Valley.	Dominican Republic
2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	Gender workshop (in second country if a workshop was carried out in FY 1)	RP (Cuevas) with support from RP Gender Coordinator (Cruz) and GGT PI	Conduct workshop about gender issues and the role of women in the agriculture in different localities of Ocoa.	Dominican Republic

3	Provide 1 teaching module with PowerPoint presentation from written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing Identify and post key articles on agriculture and gender.	1 teaching module with PowerPoint presentation per region Create Scholar site with key resources (articles and others)	Cruz & GGT PI	Women and pesticides (from MS student Megan Byrne)	Ecuador (Megan/MEC)
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university, progress and research abstract in report.	GGT PI	Master's Thesis: Megan Byrne (VT)	USA, Ecuador (Megan/MEC)

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Student research	2 Field report and 1 thesis	Cruz & GGT PI	Master's Thesis, 2 pesticide articles (English & Spanish)	Ecuador
2	Analysis of sex-disaggregated data from baseline survey.	Article for regional publication in Spanish on pesticides and gender A compilation of the DR data and a brief description will be produced.	Cruz	Elena for Ecuador Baseline survey in DR-compilation and description	Ecuador, Dominican Republic

3	Collect and analyze gray literature for specific research topic identified in FY 1 case study.	Research paper	Cruz	USAID is interested in understanding ex-ante the potential impacts of CRSP research on women. assessment of gender-related obstacles to increased capture of value added in the blackberry market chain	Honduras Ecuador
4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	Revised case study report for publishing as research note on IPM CRSP website and for local publication	Cruz, Byrne & GGT PI	Conduct preliminary assessment of women's roles in agricultural activities in San Josè de Ocoa. Case study regarding women and pesticides	Dominican Republic Ecuador (Megan)
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	Cruz, Byrne, GGT PI	Presentation at Women in International Development discussion series at VT (Megan Byrne) and at Annual Meeting of Association of American Geographers	Ecuador

Work Plan: Year 2 (October 1, 2010-September 30, 2011)

West Africa

Objective 2: Capacity building: Empowering teams to integrate gender

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Women-only trainings, women-led trainings, working with women's organizations and other participation strategies to include more women and address their priorities.	GGT indicator chart included in GGT annual report. List of trainings in annual reports should include gender of facilitator/trainer.	RP TBD and Diallo	Work with women's organization: raise awareness of IPM benefits	Mali Senegal
2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	RP: Gender workshop (in second country if a workshop was carried out in FY 1) GGT PI: Planning and guidance documents	RP with GGT PI support TBD	4-day workshop in Ghana for local research team and students	Ghana
3	Provide 1 teaching module with PowerPoint presentation from written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing.	1 teaching module with PowerPoint presentation per region	RP (Doucouré) & GGT PI	Module on IPM and potato based on survey	Mali
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university, progress and research abstract in report.	RP & GGT PI	Identify student; pay tuition in fall 2011	Ghana

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Student research	Research abstract proposal	RP TBD	n/a	Ghana
2	Analysis of sex-disaggregated data from baseline survey.	Article or research note for regional publication	RP Doucouré	Analysis of Mali potato survey	Mali
3	Collect and analyze gray literature for specific research topic identified in case study.	Literature review of unpublished reports (governmental, NGO, etc.) in country or region from previous research identified	RP TBD (hold until next FY)	n/a (do in FY 3 with student in Ghana)	
4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	Case study draft report for publishing as research note on IPM CRSP website and for local publication GGT PI: Case studies online Cross-cutting research article use of 4 Gender Dimensions framework in IPM research	RP TBD & GGT PI	Carry out Rapid Gender Assessment to gauge knowledge base of agrochemicals deriving from gendered activities in productive and reproductive sphere	Ghana
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	RP	Not until FY 3	

Work Plan: Year 2 (October 1, 2010-September 30, 2011)

East Africa

Objective 2: Capacity building: Empowering teams to integrate gender

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Women-only trainings, women-led trainings, working with women's organizations and other participation strategies to include more women and address their priorities.	GGT indicator chart included in GGT annual report. List of trainings in annual reports should include gender of facilitator/trainer.	RP: Mangheni		
2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	RP: Gender workshop (in second country if a workshop was carried out in FY 1) GGT PI: Planning and guidance documents	RP Mangheni with GGT PI support	Researchers and collaborators in Kenya and Tanzania trained in gender and participative methodologies in agricultural research	Kenya Tanzania
3	Provide 1 teaching module with PowerPoint presentation from written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing Identify and post key articles on agriculture and gender.	1 teaching module with PowerPoint presentation per region Create Scholar site with key resources (articles and others)	RP Mangheni & GGT PI		
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university, progress and research abstract in report.	RP Mangheni and GGT PI	MSc student recruited	

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Student research	Research proposal, field report or thesis Literature review and detailed research proposal developed	RP Mangheni & GGT PI	Student's research work on the gender concept developed in year 1	
2	Analysis of sex-disaggregated data from baseline survey.	Article for regional publication	RP Mangheni	Gender integrated in surveys developed by Impact Global theme (e.g. labor, income, decision-making) Gender responsive baseline and impact assessments	
3	Collect and analyze gray literature for specific research topic identified in FY 1 case study.	Literature review of unpublished reports (governmental, NGO, etc.) in country or region from previous research identified	RP Mangheni	Literature Review on Hot Pepper in Uganda	Uganda

4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	RP: Revised case study report for publishing as research note on IPM CRSP website and for local publication GGT PI: Case studies online Cross-cutting research article use of 4 Gender Dimensions framework in IPM research	RP Mangheni & GGT PI	Data analysis outputs and case study on Hot pepper in Uganda & Article for publication RGA in Kenya -A report on gender based constraints and the disadvantages faced by women and opportunities for increasing gender equity and benefits to women through IPM in one project site in Kenya -Recommendations for increasing gender equity and participation of women. Basis for Year 3 work plan.	Uganda, Kenya
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	RP		

Work Plan: Year 2 (October 1, 2010-September 30, 2011)

Central Asia

Objective 2: Capacity building: Empowering teams to integrate gender

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Women-only trainings, women-led trainings, working with women's organizations and other participation strategies to include more women and address their priorities.	GGT indicator chart included in GGT annual report. List of trainings in annual reports should include gender of facilitator/trainer.	RP: Pahlavonova; Racioppi and Jamal	Visit the wheat IPM demonstration sites in Tajikistan, potato IPM demonstration sites in Kyrgyzstan, and tomato IPM demonstration sites in Uzbekistan. On each visit, meet with women farmers and conduct a Rapid Gender Assessment.	Tajikistan, Kyrgyzstan, Uzbekistan
2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	RP: Gender workshop (in second country if a workshop was carried out in FY 1) GGT PI: Planning and guidance documents	RP Pahlavonova; Racioppi and Jamal with GGT PI support	1 gender workshop	Tajikistan

3	Provide 1 teaching module with PowerPoint presentation from written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing Identify and post key articles on agriculture and gender.	1 teaching module with PowerPoint presentation per region Create Scholar site with key resources (articles and others)	RP Racioppi and Jamal & GGT PI	Created from gender workshop	Tajikistan
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university, progress and research abstract in report.	Leave until FY 3	Identify and engage student researcher to write research reports on gender and agriculture in Central Asia	Tajikistan

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Student research	Research proposal, field report or thesis	Leave until FY 3	Identify and engage student researcher to write research reports on gender and agriculture in Central Asia	Tajikistan
2	Analysis of sex-disaggregated data from baseline survey.	Article for regional publication	RP—delay until FY 3	From data collected at Gender Workshop site	Tajikistan

3	Collect and analyze gray literature for specific research topic identified in FY 1 case study.	Literature review of unpublished reports (governmental, NGO, etc.) in country or region from previous research identified	RP Racioppi and Jamal	To be done by student researcher	Tajikistan
4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	RP: Revised case study report for publishing as research note on IPM CRSP website and for local publication GGT PI: Case studies online Cross-cutting research article use of 4 Gender Dimensions framework in IPM research	RP & GGT PI Racioppi and Jamal	Case study report from Gender Workshop	Tajikistan
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	RP Racioppi and Jamal	Presentation of research at conference	Tajikistan

Work Plan: Year 2 (October 1, 2010-September 30, 2011)

South Asia

Objective 2: Capacity building: Empowering teams to integrate gender

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Women-only trainings, women-led trainings and other participation strategies to include more women and address their priorities.	Number of women participating in IPM CRSP short-term trainings; List of trainings to include gender of facilitator/trainer (in annual reports)	RP: Uma	Field day and trainings has been planned by IPM scientists	IPM sites in India

2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	RP: Gender workshop (in second country if a workshop was carried out in FY 1) GGT PI: Planning and guidance documents	RP Uma with GGT PI support (may be completed in FY 1)	1. International work shop 2. Gender assessment for specific technology adoption	India
3	Provide 1 teaching module with PowerPoint presentation from your written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing.	1 teaching module with PowerPoint presentation per region	RP Uma & GGT PI	After International workshop	
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university and research proposal abstract included in GGT annual report	RP & GGT PI	2 Geography Masters students at University of Dhaka	Bangladesh

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Student research	Research proposal, field report or thesis	RP Huq Hussein and Karim & GGT PI	Ms. Tahera Sultana is carrying out fieldwork on "Women's role in adoption of IPM inputs in vegetable cultivation", and Ms. Umme Habiba on "Women's role in vegetable cultivation". India student (TBD): “How food and food preferences affects farmers’ disposition to alternatives to pesticides	Bangladesh India

2	Analysis of sex-disaggregated data from baseline survey.	Article for regional publication	RP—Uma	Baseline survey to identify women farmers' constraints in adoption of IPM packages. General IPM component doing survey & use data from impact study	India
3	Collect and analyze gray literature for specific research topic identified in FY 1 case study.	Literature review of unpublished reports (governmental, NGO, etc.) in country or region from previous research identified	RP Uma		India
4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	RP: Revised case study report for publishing as research note on IPM CRSP website and for local publication GGT PI: Case studies online Cross-cutting research article use of 4 Gender Dimensions framework in IPM research	RP Uma & GGT PI		India
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	RP Uma	Around 25 posters in different conferences/seminars/symposium are planned	India

Work Plan: Year 2 (October 1, 2010-September 30, 2011)

South East Asia

Objective 2: Capacity building: Empowering teams to integrate gender

Task	Description and purpose	Output	Responsible Party	Specific Regional Activity	Location
1	Women-only trainings, women-led trainings, working with women's organizations and other participation strategies to include more women and address their priorities.	GGT indicator chart included in GGT annual report. List of trainings in annual reports should include gender of facilitator/trainer.	RP: Lestari, Sitha	1. Implementation of RGA at farmer group level 2. Workshop on the results of RGA by farmers	Indo and Cambodia
2	Gender and participative methodology workshop(s) to increase gender awareness and integration into research and training activities; understand and practice participative methodologies and strategies to better include women; scale up impact of FY1 workshop, if applicable.	RP: Gender workshop (in second country if a workshop was carried out in FY 1) GGT PI: Planning and guidance documents	RP Sitha with Lestari and GGT PI support	Conduct gender workshop/training for IPM CRSP team and other stakeholders on the gender analysis for IPM research	Cambodia

3	Provide 1 teaching module with PowerPoint presentation from written case study for web resources. GGT PI will compile and post 6 information modules online for information resources and sharing.	1 teaching module with PowerPoint presentation per region	RP Puspitawati & GGT PI	Develop module of the RGA training for farmers IPM CRSP partners based on experienses of the training and workshop conducted in each country	Indo
4	Long term training: select, advise and support student working on IPM gender research.	Student name, level, program, university, progress and research abstract in report.	RP Puspitawati, Dayo and Sitha & GGT PI	Series of meetings with student and reserachers on the selected study	Indonesia, Phil and Cam

Objective 3: Research: Producing and disseminating knowledge of gender issues in IPM

Task	**Description and purpose**	**Output**	**Responsible Party**	**Specific Regional Activity**	**Location**
1	Student research	Research proposal, field report or thesis	RP Puspitawati, Dayo and Sitha & GGT PI	Develop research proposal, field report or thesis on the topic of gender and IPM technology	Indo, Phil and Cam
2	Analysis of sex-disaggregated data from baseline survey.	Article for regional publication	RP Lestari, Puspitawati, Dayo and Sitha	Conduct baseline survey on RGA	Phil and Indo
3	Collect and analyze gray literature for specific research topic identified in FY 1 case study.	Literature review of unpublished reports (governmental, NGO, etc.) in country or region Previous research identified	RP Puspitawati, Dayo and Sitha	Identify unpublished reports (governmental, NGO, etc.) in country or region to support topic of gender research	Indo, Phil and Cam

4	Analysis of data from Rapid Gender Assessment in FY 1 to include methodological notes on the use of the 4 Gender Dimensions framework.	RP: Revised case study report for publishing as research note on IPM CRSP website and for local publication GGT PI: Case studies online Cross-cutting research article use of 4 Gender Dimensions framework in IPM research	RP Lestari, Sitha & GGT PI	FGD, farmer group meeting and writing of Gender Case Study on IPM CRSP reserach	Phil & Cam
5	Present research results of FY 1 and 2 at local, regional, or international forum to increase visibility of gender work in IPM CRSP.	Conference presentation PowerPoint of same presentation to post on IPM CRSP website	RP Lestari, Puspitawati, Dayo and Sitha	Prepare and present integrated results of FY 1 and 2 of gender work in IPM CRSP	Indo, Phil and Cam